Exercise for improving balance in older people (Review)

Howe TE, Rochester L, Jackson A, Banks PMH, Blair VA

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[Intervention Review]

Exercise for improving balance in older people

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Editorial group: Cochrane Bone, Joint and Muscle Trauma Group.
Publication status and date: Edited (no change to conclusions), published in Issue 4, 2008.
Review content assessed as up-to-date: 26 July 2007.

Citation: Howe TE, Rochester L, Jackson A, Banks PMH, Blair VA. Exercise for improving balance in older people. *Cochrane Database of Systematic Reviews* 2007, Issue 4. Art. No.: CD004963. DOI: 10.1002/14651858.CD004963.pub2.

ABSTRACT

Background

Diminished ability to maintain balance may be associated with an increased risk of falling. In older adults, falls commonly lead to injury, loss of independence, associated illness and early death. Although some exercise interventions with balance and muscle strengthening components have been shown to reduce falls it is not known which elements, or combination of elements, of exercise interventions are most effective for improving balance in older people.

Objectives

To present the best evidence for effectiveness of exercise interventions designed to improve balance in older people living in the community or in institutional care.

Search strategy

We searched the Cochrane Bone, Joint and Muscle Trauma Group Specialised Register (Feb 2006), the Cochrane Central Register of Controlled Trials (CENTRAL) (*The Cochrane Library* 2006, Issue 1), MEDLINE (1966 to February 2006), EMBASE (1980 to February 2006), other databases and reference lists of articles. No language restrictions were applied.

Selection criteria

Randomised controlled trials and quasi-randomised trials testing exercise interventions designed to improve balance in older people were included. We excluded trials of interventions targeting individuals with specific conditions in order not to broaden the scope of this review too widely. Trials were included where participants were randomised to receive the following: a single exercise intervention or a multiple exercise intervention and a control group (usual activities or attention or recreational activity). Trials comparing two or more exercise interventions and a control group were also included.

Data collection and analysis

Three pairs of members of the review team independently assessed trial quality and extracted data. For each trial, relative risk and 95% confidence intervals were calculated for dichotomous outcomes, and mean differences and 95% confidence intervals calculated for continuous outcomes. Where appropriate, results of comparable groups of trials were pooled and 95% confidence intervals calculated.

Main results

For the 34 included studies there were 2883 participants at entry. Statistically significant improvements in balance ability were observed for exercise interventions compared to usual activity. Interventions involving gait; balance; co-ordination and functional exercises; muscle strengthening; and multiple exercise types appear to have the greatest impact on indirect measures of balance. There was trend towards an improvement in balance with cycling on a static cycle. However, there was limited evidence that effects were long-lasting.

Authors' conclusions

Exercise appears to have statistically significant beneficial effects on balance ability in the short term but the strength of evidence contained within these trials is limited. Many of these mainly small studies demonstrated a range of methodological weaknesses. The failure across the included studies to apply a core set of standardised outcome measures to determine balance ability restricts the capacity to compare or pool different trials from which firm conclusions regarding efficacy can be made. Further standardisation in timing of outcome assessment is also required as is longer term follow-up of outcomes to determine any lasting effects.

PLAIN LANGUAGE SUMMARY

Exercise for improving balance in older people

A decrease in ability to maintain balance may be associated with an increased risk of falling. In older adults, falls often lead to injury, loss of independence, associated illness and early death. The objective of this review is to present the best evidence for the effectiveness of exercise interventions designed to improve balance in older people living in the community or in institutional care.

The review included 34 studies, with a total of 2883 participants, the majority of whom were women and on average over 75 years old. The review found that exercise has statistically significant positive effects on balance as opposed to usual activity for older people. This review investigated a variety of interventions. Those that appeared to have the greatest impact were walking; balance; co-ordination and functional exercises; muscle strengthening; and multiple exercise types. Improvements were seen in the ability to stand on one leg, reach forward without overbalancing and walking. There was trend towards an improvement in balance with cycling on a static cycle. In general, this review agrees with other systematic reviews covering related areas in older people, such as resistance training for physical disability and falls prevention.

Quality of evidence on the effectiveness of interventions was mixed, with many studies demonstrating a range of methodological weaknesses. In particular, there was a lack of a core set of standardised measures to determine balance ability across the 34 studies, which limits the interpretation of results. Thus, it was difficult to compare studies or to group the results of different studies. There was also a lack of follow up of participants that makes it hard to determine any long term effects of interventions.

Future studies should be well designed and provide detailed and accurate reporting. Ideally, trials should follow up participants one year after taking part to record long term effects, rather than just focusing on results immediately after the intervention.

BACKGROUND

NB: For an explanation of some of the terms used in this review,
please see the Glossary of Terms (Table 1).

Table 1. Glossary of terms

Glossary

Table 1. Glossary of terms (*Continued*)

1RM - one repetition maximum score
3D - 3D exercise including tai chi, qi gong, dance, yoga
ADL - Activities of Daily Living
AP - Anterior - Posterior
BBS - Berg Balance Scale
BPM - Balance Performance Monitor
cm - centimetres
CoM: body's centre of mass
COP - centre of pressure
COPD - Chronic Obstructive Pulmonary Disease
EPESE - Established Populations for the Epidemiologic Studies of the Elderly short physical performance battery
Ex - Exercise
FRT - Function Reach Test
GBFT - Gait, balance, functional tasks
GEN ACTIVITY - general physical activity
HR - Heart Rate
Hr - hour
Km- kilometres
LOS - Locus Of Support
min - minute
ML - medio-lateral
mm - millimetres
MMSE - Mini Mental Status Examination
m/s - metres per second
NSD - no significant difference
PNF - proprioceptive neuromuscular facilitation
PRE - Progressive Resistance Exercise
RCT - randomised controlled trial
RMS - root mean squared
s - seconds
SD - Standard Deviation
SLS - Single Legged Stance
SMD - standardised mean difference
STRENGTH - strength training including resistance or power training
TUG - Timed up and go test
WMD - weighted mean difference

Balance is defined as the ability to maintain the projection of the body's centre of mass (CoM) within manageable limits of the base of support, as in standing or sitting, or in transit to a new base of support, as in walking (Winter 1995). The base of support is composed of the area between all points of contact of the body with another surface; points of contact also include extensions of the body through assistive devices e.g. walking sticks and frames. Balance is an integral component of daily (functional) activities, however, balance control is very complex and multifactorial. The task being undertaken and the environment in which it is taking place both affect an individual's ability to control balance, by altering the biomechanical and information processing needs (Huxham 2001). Balance may be measured when the body has a constant, or static, base of support, or during movement from one base of support to another. It can be analysed directly by quantifying the position of the CoM in relation to the base of support. Alternatively, balance can be measured indirectly through observation, self reporting or other reporting methods such as objective tests of functional activities.

However, the ability to undertake functional activities is complex and multifaceted involving not only balance but other factors such as strength, proprioception, integrity of the neuromuscular system, pain, vision and in some instances fear of falling.

Physiological changes related to ageing include, for example, cognitive impairment (Nevitt 1989), reductions in muscle strength (Daubney 1999; Doherty 1993), proprioception (Skinner 1984), joint range of motion (Mills 1994) and reaction time (Stelmach 1994), and changes in sensory systems (Berg 1989). These factors potentially negatively affect balance control and impact on the functional ability of the older person.

Diminished ability to maintain balance may be associated with an increased risk of falling (Berg 1989). In older adults, falls commonly lead to injury, loss of independence, associated illness and early death (Baker 1985; Berg 1989; Tinetti 1988). An extensive review of published trials of interventions to reduce the incidence of falling in elderly people has been published (Gillespie 2004). Although some exercise interventions with balance and muscle strengthening components have been shown to reduce falls (Campbell 1997; Robertson 2001; Wolf 1996), it is not clear which element or combination of elements is necessary to achieve this result.

Biofeedback and visual feedback have been used to improve balance control by addressing internal factors that are thought to contribute towards balance (Geiger 2001; Walker 2000). However, such interventions have tended to focus on single components of balance control; a multifactorial approach may be more appropriate.

Although there have been traditional literature reviews describing studies designed to improve balance in the elderly (Chandler 1996) there is still uncertainty surrounding the efficacy of exercise interventions, the effectiveness of the dosage (frequency, duration or intensity of delivery), setting in which the intervention takes place, level and type of supervision, or indeed who is most likely to benefit.

OBJECTIVES

To present the best evidence for effectiveness of exercise interventions designed to improve balance in older people living in the community or in institutional care.

The following hypothesis was tested:

- Exercise interventions designed to improve balance are as effective as usual care, attention or recreational activities.

METHODS

Criteria for considering studies for this review

Types of studies

We included randomised controlled trials and quasi-randomised trials (e.g. randomised by date of birth or hospital record number) testing exercise interventions designed to improve balance in older people against a control group. Control group activity included either usual activities or attention (receiving the same attention or contact with the investigators such as attending appointments) or recreational activities.

Types of participants

We included trials with participants described as older adults, elderly, geriatric, aged, seniors or all over the age of 60, and studies that separately randomised and analysed the group described above. The participants could have included frail older people, or healthy older people, of either gender, living in the community or in institutional care. Participant characteristics of interest included age, gender, functional status at entry and residential status.
In order not to broaden the scope of this review too widely, we excluded trials of interventions targeting individuals with specific conditions such as; stroke, Parkinson's disease, multiple sclerosis, labyrinthitis, Meniere's disease, amputation of upper or lower limbs, cognitive impairments, dementia, osteoporosis, rheumatoid arthritis, osteoarthritis, hip fracture or Alzheimer's disease.

Types of interventions

Trials were included where participants were randomised to receive the following: a single exercise intervention or a multiple exercise intervention and a control group (usual activities, receiving the same attention as the intervention group or recreational activities). Trials comparing two or more exercise interventions and a control group were also included.
Exercise interventions designed to improve balance were defined as those in which participants exercise their muscles (and neuromuscular responses) against an external force, as a consequence of voluntary movement, or in response to an unexpected perturbation/stimulus in order to maintain the body's centre of mass within manageable limits of the base of support or in transit to a new base of support. Examples of exercise interventions include: walking, cycling, balance training, and tai chi.
The exercise interventions could take place in the home, institutional dwelling, community, gymnasium or clinic setting and could be self-supervised (for example using exercise sheets/video), individually supervised or as part of a supervised group, the supervisor could include for example, self, peer, physical trainer or healthcare professional.

Types of outcome measures

The main outcome of interest was balance, defined as the ability to maintain the body's centre of mass within manageable limits of the base of support, as in maintaining a standing or sitting position,

or in transit to a new base of support, as in walking or moving. Outcome measures were classified according to the dimensions of the ICF (International Classification of Functioning, Disability and Health) (WHO 2001): impairment, activity limitation or participation restriction.

To be included, studies must have reported primary outcome measures that are direct or indirect measures of balance performance.

- Direct measures (ICF dimension impairment) include force platform indicators (centre of pressure behaviour or position) (Winter 1995).
- Indirect measures of balance (ICF dimension activity limitation) based on quantification of functional abilities included, but were not restricted to: Functional Reach Test (Duncan 1990), temporal parameters of gait, one legged standing time, timed up and go test (Podsiadlo 1991).
- Indirect measures of balance based on observation were restricted to the Berg Balance Scale (Berg 1992).

We excluded timed walking tests such as distance walked in 3, 6 or 12 minutes, as these are indicators of aerobic capacity rather than balance ability. Trials that focused on fall rates, numbers of fallers, or other surrogate measures of balance, for example muscle strength or global functional ability, and did not report balance as a primary outcome, were excluded; these have been reviewed elsewhere (Gillespie 2004; Latham 2004).

Information was sought on the level of adherence or compliance with the exercise intervention, the magnitude and duration of effect, and adverse events associated with the exercise intervention.

Search methods for identification of studies

We searched the Cochrane Bone, Joint and Muscle Trauma Group Specialised Register of trials (Feb 2006), the Cochrane Central Register of Controlled Trials (*The Cochrane Library* 2006, Issue 1), MEDLINE (1966 to 28th Feb 2006), EMBASE (from 1980 to 28th Feb 2006), PEDro - The Physiotherapy Evidence Database (http://www.pedro.fhs.usyd.edu.au/accessed 28th Feb 2006), OTseeker - The Occupational Therapy Systematic Evaluation of Evidence Database (http://www.otseeker.com accessed 28th Feb 2006), CINAHL (from 1982 to 28th Feb 2006), AMED (from 1985 to 24th March 2006), and reference lists of articles. No language restrictions were applied. Further trials were identified by contact with institutions and experts in the field.

In MEDLINE (OVID ONLINE) the first two phases of the optimal trial search strategy (Robinson 2002) were combined with one subject specific search (Appendix 1, column 1), and the less precise third phase of the optimal trial search strategy was combined with a more precise subject specific search (Appendix 1, column 2). Search strategies are also shown for *The Cochrane Library* (Appendix 2), CINAHL (Appendix 3), EMBASE (Appendix 4), AMED (Appendix 5), PEDro (Appendix 6), and OTseeker (Appendix 7).

Data collection and analysis

Selecting trials for inclusion

The search strategy identified 1297 titles for potential inclusion. From the title, abstract, and descriptors, pairs of members of the review team independently reviewed the results of the literature searches to identify potentially relevant trials for full review. From the full text of 158 papers that appeared to meet the selection criteria, 34 trials were selected for inclusion. Disagreement was resolved by consensus or third party adjudication.

Data collection

Three pairs of members of the review team used a customised data extraction tool, tested prior to use, to independently extract data. Disagreement was resolved by consensus or third party adjudication. We contacted authors of studies where there was inadequate reporting of data to enable clarification and where appropriate to allow pooling.

Assessment of methodological quality

Methodological quality was independently assessed for each study by three pairs of members of the review team using a modification of the Cochrane Bone Joint & Muscle Trauma Group's quality assessment tool (Madhok 2006). The final scoring scheme for 15 aspects of trial quality included items from the Cochrane Bone Joint & Muscle Trauma Group's quality assessment tool (items denoted by 'M'), items from the Delphi list (Verhagen 1998) (items denoted by 'D') and items from the Maastricht-Amsterdam consensus list for Methodological Quality Assessment (Bellamy 1997) (items denoted by 'MAC') (*see* Table 2). Any disagreement was resolved by consensus or third party adjudication.

Table 2. Methodological quality assessment items and possible scores

Items and scores
M-A (D1b). Was the assigned treatment adequately concealed prior to allocation? 2 = method did not allow disclosure of assignment. 1 = small but possible chance of disclosure of assignment or unclear. 0 = quasi-randomised or open list/tables.

Table 2. Methodological quality assessment items and possible scores (*Continued*)

Cochrane code: Clearly Yes = A; Not sure = B; Clearly No = C
M-B (D8). Were the outcomes of patients/participants who withdrew described and included in the analysis (intention to treat)? 2 = withdrawals well described and accounted for in analysis. 1 = withdrawals described and analysis not possible. 0 = no mention, inadequate mention, or obvious differences and no adjustment.
M-C (D4). Were the outcome assessors blinded to treatment status? 2 = effective action taken to blind assessors. 1 = small or moderate chance of unblinding of assessors. 0 = not mentioned or not possible.
M-D (D2). Were the treatment and control group comparable at entry? 2 = good comparability of groups, or confounding adjusted for in analysis. 1 = confounding small; mentioned but not adjusted for. 0 = large potential for confounding, or not discussed.
M-E (D6). Were the participants blind to assignment status after allocation? 2 = effective action taken to blind participants. 1 = small or moderate chance of unblinding of participants. 0 = not possible, or not mentioned (unless double-blind), or possible but not done.
M-F (D5). Were the treatment providers blind to assignment status? 2 = effective action taken to blind treatment providers. 1 = small or moderate chance of unblinding of treatment providers. 0 = not possible, or not mentioned (unless double-blind), or possible but not done.
M-G. Were care programmes, other than the trial options, identical? 2 = care programmes clearly identical. 1 = clear but trivial differences. 0 = not mentioned or clear and important differences in care programmes.
M-H (D3). Were the inclusion and exclusion criteria clearly defined? 2 = clearly defined. 1 = inadequately defined. 0 = not defined.
M-I. Were the interventions clearly defined? 2 = clearly defined interventions are applied with a standardised protocol. 1 = clearly defined interventions are applied but the application protocol is not standardised. 0 = intervention and/or application protocol are poorly or not defined.
M-J. Were the outcome measures used clearly defined? 2 = clearly defined. 1 = inadequately defined. 0 = not defined.

Table 2. Methodological quality assessment items and possible scores (*Continued*)

M-K. Were tests used in outcome assessment clinically useful? 2 = optimal. 1 = adequate. 0 = not defined, not adequate.
M-L. Was the surveillance active, and of clinically appropriate duration (i.e. at least 3 months)? 2 = active surveillance and appropriate duration (3 months follow up or more). 1 = active surveillance, but inadequate duration (less than 3 months follow up). 0 = surveillance not active or not defined.
D7. Were point estimates and measures of variability presented for the primary outcome measures? 2 = yes 1 = point estimates, but no measures of variability presented 0 = vague descriptions
MAC-1. Was the compliance rate in each group likely to cause bias? 2 = compliance well described and accounted for in analysis 1 = compliance well described but differences between groups not accounted for in analysis 0 = compliance unclear
MAC-2. Was there a description of adverse effects of the intervention(s)? 2 = well described 1 = poorly described 0 = not described

Data analysis

Where available and appropriate, quantitative data for the outcomes listed in the inclusion criteria are presented in the Analyses (01.01 to 07.16). Where studies reported standard errors of the means (SEMs), standard deviations were obtained by multiplying standard errors of means by the square-root of the sample size. For each trial, relative risk and 95% confidence intervals were calculated for dichotomous outcomes, and weighted mean differences (WMD) and 95% confidence intervals calculated for continuous outcomes (reporting mean and standard deviation or standard error of the mean). Standardised mean differences (SMD) and 95% confidence intervals were calculated when combining results from studies using different ways of measuring the same concept. Change scores have been reported separately as these cannot be incorporated into meta analyses of standardised mean differences.

Where appropriate, results of comparable groups of trials were pooled using the fixed effect model and 95% confidence intervals calculated. Heterogeneity between comparable trials was tested using a standard chi-squared test and considered statistically significant at $P < 0.1$ after due consideration of the value of I squared. In the presence of heterogeneity the results of comparable groups of trials were pooled using the random effect model and 95% confidence intervals calculated.

Sensitivity and sub-group analysis

It was anticipated that sensitivity analyses would be undertaken, when indicated, to investigate the effects of methodological quality, for example, allocation concealment and intention-to-treat analysis. Where cluster randomised trials were combined with each other or with other studies in a meta-analysis, sensitivity analyses were performed to investigate the effect clustering had on the results.

Where the data allowed, we also planned separate outcome analyses to test the following hypotheses:

- exercise interventions are equally effective in males and females;

- exercise interventions are equally effective in young old (mean age 60-75 years) and older old (mean age over 75 years);

- exercise interventions are equally effective in frail and less frail;

- effectiveness is not dependent on the duration and (or) intensity of exercise interventions;

- effectiveness is not dependent on the setting in which the exercise intervention is delivered;

- effectiveness is not dependent on the level or type of supervision of the exercise intervention.

RESULTS

Description of studies

See: Characteristics of included studies; Characteristics of excluded studies.

In all 158 full papers were considered for inclusion in this review. Of these 83 were excluded for reasons given in the 'Characteristics of excluded studies' table; 20 in the 'Studies awaiting assessment' section; and 16 in the 'Classification pending' section (NB a number of papers related to the same study). There were 39 papers included in this review which described 34 studies.

For the 34 included trials there were 2883 participants at entry. One study was published only as an abstract (McGarry 2001). There was great variation across the trials in the characteristics of participants, design and content of the exercise interventions, and the outcomes assessed. A brief summary is provided here and more detailed information is provided in the 'Characteristics of included studies' table. Trials took place in North America (n = 18), Europe (n = 7), Asia (n = 6) and Australasia (n = 3).

Participants

The participants in 27 trials were defined as healthy older people (Boshuizen 2005; Brouwer 2003; Buchner 1997a; Buchner 1997b; Cress 1999; Crilly 1989; Islam 2004; Jessup 2003; Johansson 1991; Lichtenstein 1989; Lord 1995; Lord 2003; Lord 2005; MacRae 1994; McGarry 2001; McMurdo 1993; Nelson 2004; Okumiya 1996; Paillard 2004; Ramsbottom 2004; Reinsch 1992; Rooks 1997a; Schoenfelder 2004; Shigematsu 2002; Suzuki 2004; Wolf 1997; Wolfson 1996) and participants in the remaining seven trials had general frailty and/or functional limitations (Krebs 1998; Rubenstein 2000; Sauvage 1992; Shimada 2004; Sihvonen 2004; Wolf 2001; Zhang 2006). Participants were residing in institutions (hospital or residential care facilities) in five trials (Crilly 1989; McMurdo 1993; Sauvage 1992; Schoenfelder 2004; Sihvonen 2004); the community in 27 trials (Boshuizen 2005; Brouwer 2003; Buchner 1997a; Buchner 1997b; Cress 1999; Islam 2004; Jessup 2003; Johansson 1991; Krebs 1998; Lichtenstein 1989; Lord 1995; Lord 2003; Lord 2005; MacRae 1994; McGarry 2001; Nelson 2004; Okumiya 1996; Paillard 2004; Ramsbottom 2004; Reinsch 1992; Rooks 1997a; Rubenstein 2000; Shigematsu 2002; Suzuki 2004; Wolf 1997; Wolfson 1996; Zhang 2006); and types of residence was mixed in two trials (Shigematsu 2002; Wolf 2001).

Nine trials included only women (Crilly 1989; Jessup 2003; Johansson 1991; Lichtenstein 1989; Lord 1995; MacRae 1994; Shigematsu 2002; Sihvonen 2004; Suzuki 2004) and four trials only men (Nelson 2004; Okumiya 1996; Rubenstein 2000; Sauvage 1992). The other 21 trials included both men and women in varying proportions; in the majority of trials, the proportion of women was typically greater.

The average age of participants was 60-75 years in 14 trials (Jessup 2003; Johansson 1991; Krebs 1998; Lord 1995; MacRae 1994; McGarry 2001; Nelson 2004; Paillard 2004; Ramsbottom 2004; Reinsch 1992; Rooks 1997a; Rubenstein 2000; Sauvage 1992; Zhang 2006) and over 75 years in the remaining 20 trials.

Exercise interventions

All the exercise interventions described were land-based. We categorised exercise interventions of included studies based on the taxonomy of exercise interventions developed by ProFaNE (Lamb 2006). (NB numbers of participants indicated are at entry to the trial. For information on numbers in each group, see the 'Characteristics of included studies' table or the Analyses).

Gait, balance, co-ordination and functional tasks

Eleven trials involving 694 participants at entry investigated the effects of exercise programmes involving gait, balance, co-ordination and functional task activities on balance performance. The content of the exercise programmes was varied. Brouwer 2003 (38 participants) included low resistance exercises against gravity, using theraband for legs and trunk, reaching, weight shifting, marching on spot, and a home exercise programme. Crilly 1989 (50 participants) included exercise aimed at improving breathing, single and double limb balance, co-ordination, flexibility, strength and relaxation. Islam 2004 (43 participants) included balance exercises designed to challenge the visual (e.g. opened /closed eyes), vestibular (e.g. move head), somatosensory (e.g. stand on foam) and muscular (e.g. standing on one leg, bending body in different directions) systems. Lichtenstein 1989 (50 participants) included stretching, "static balance" (e.g. standing on one leg), "active balance" (e.g. using tandem heel/toe gait, walking along a line), "response exercises" (e.g. performing manoeuvres in response to changing colour signals), walking and cool-down and relaxation. MacRae 1994 (80 participants) included a stand up, step up routine designed to improve strength and balance with warm up and cool down. McGarry 2001 (22 participants) included the "Get off your Rocker" balance class, including single leg stance, exercises with Swiss balls and tandem walking. Reinsch 1992 (107 participants) included stand-ups and step-ups and functional exercises. Sihvonen 2004 (28 participants) included dynamic exercise on a force platform and training device with visual feedback

on movement of the Centre of Pressure (COP). Wolf 1997 (72 participants) included standing on a force platform using exercise to move a target via a cursor on screen, this involved performing excursions outside the base of support with eyes open and closed. Wolf 2001 (94 participants) included exercise in sitting, standing and walking, in a variety of situations to test balance. Wolfson 1996 (110 participants) included exercise on a PRObalancemaster with COP feedback, standing and sitting, exercises using gym balls with eyes open and eyes closed, with and without perturbations, and gait on foam and narrow beams.

Strengthening (including resistance or power training)

Six trials involving 513 participants at entry investigated the effects of exercise programmes involving strengthening, including resistance or power training, on balance performance. Boshuizen 2005 (110 participants) included strengthening exercises of lower limbs with theraband and increasing resistance in sitting and standing. Buchner 1997a (51 participants) included free weights and gym equipment. Cress 1999 (56 participants) included combined endurance and resistance exercises. Krebs 1998 (132 participants) included the 'strong for life programme' a 35 minute video of 11 exercises, resistance using elastic bands, functional movement patterns similar to proprioceptive neuromuscular facilitation (PNF) for the arms and legs. Rooks 1997a (131 participants) included stair climbing with resistance, seated knee extension, standing, standing knee extension. Wolfson 1996 (110 participants) included stretching and progressive resistive exercise with sand bags for the hip and knee.

3D exercise (including tai chi, qi gong, dance, yoga)

Four trials involving 193 participants at entry investigated the effects of 3D exercise programmes on balance performance. Buchner 1997b (106 participants) included exercise involving dance movement to music. Shigematsu 2002 (38 participants) included aerobic dance exercise to music. Wolf 1997 (72 participants) included ten forms of tai chi quan. Zhang 2006 (49 participants) included a simplified form of 24 forms of tai chi plus 11 easy forms for home exercise.

General physical activity

Only two trials involving 91 participants at entry investigated the effects of general physical activity on balance performance. McMurdo 1993 (49 participants) included exercises that were performed seated and following a warm-up, exercises were designed to put joints in upper and lower limbs through their full range of movements. As the study progressed participants were encouraged to sustain muscle contractions for longer and increase the number of repetitions. In Okumiya 1996, 42 participants completed a warm up, light aerobic exercise aimed at improving neuromotor co-ordination and muscle-strengthening exercises, followed by a cool down.

General physical activity (walking)

Four trials involving 290 participants at entry investigated the effects of walking on balance performance. Buchner 1997b (106 participants) involved participants walking outdoors. Paillard 2004 (21 participants) included individual walking programmes determined by lactate levels during a VO2 max test. Rooks 1997a (131 participants) included participants walking at their own pace on level ground. Shimada 2004 (32 participants) involved gait training on a bilateral separated treadmill.

General physical activity (cycling)

Buchner 1997b (106 participants at entry) investigated the effects of cycling on a static cycle on balance performance.

Multiple intervention types (combinations of the above)

Twelve trials involving 1559 participants at entry investigated the effects of multiple exercise types on balance performance. Jessup 2003 (18 participants) included strength training that began with 8 to 10 repetitions at 50% of the pre-test one repetition maximum (1RM) score and progressed to 75% RM. This programme also included load-bearing walking, stair-climbing and balance-training exercises while wearing weighted vests; and balance-training exercises in walking. Johansson 1991 (34 participants) involved walking in different directions at different speeds, combined with exercises involving movement of the arms, neck and trunk and exercise to music including weight transfer exercises while sitting and standing and rising from and sitting down in a chair. Lord 1995 (197 participants) involved an exercise programme aimed at improving strength, flexibility, co-ordination, and balance; the individualised exercise regimes were based on the participants' falls risk profile. In Lord 2003 (280 participants), the exercise programme included a warm-up period, conditioning period including aerobic exercises, specific strengthening exercises, and activities for balance, hand-eye and foot-eye coordination, and flexibility. In Lord 2005 (620 participants), the programme was based on falls risk profile, individualised exercises aimed at improving strength and balance and/or vision if a problem. It included a peripheral warm up, conditioning, strength, flexibility, coordination and balance. Nelson 2004 (72 participants) included exercise for balance and strength using free weights working at 7/8 on a 10-point Borg Scale, tandem walks, turning, plus 120 minutes of physical activity per week. Ramsbottom 2004 (22 participants) included free weights to strengthen and develop power in shoulder, hip adductors, abductors, flexors and extensors, the knee flexor and extensors. Exercise progressed by increasing the number of repetitions. The programme also included functional mobility, stretching and balance exercises. Rubenstein 2000 (59 participants) involved Progressive Resistance Exercise (PRE) for the muscles of the hip, knee and ankle, endurance training on a bike and treadmill and indoor walking and balance training. Sauvage 1992 (14 participants) included PRE and aerobic conditioning (>70% exercise stress tested maximal heart rate) using gym equipment and ergometers. Schoenfelder 2004 (81 participants) included strength and endurance training plus 10 minutes walking. Suzuki 2004 (52 participants) included an exercise centred falls prevention programme that included home based exercise aimed at enhancing muscle strength, balance and gait and also included resistance exercise and Tai Chi. Wolfson 1996 (110 par-

ticipants) included exercise on a PRObalancemaster with centre of pressure feedback, standing and sitting including exercise with gym balls with eyes open and eyes closed, and with and without perturbations. It also included gait on foam and narrow beams, stretching and PRE with sand bags for the hip and knee.

Exercise delivery: settings

The exercise interventions took place in a variety of settings; in institutions - five trials (Crilly 1989; McMurdo 1993; Schoenfelder 2004; Shimada 2004; Sihvonen 2004); home - three trials (Krebs 1998; Nelson 2004; Wolf 2001); community - 13 trials (Boshuizen 2005; Lichtenstein 1989; Lord 1995; Lord 2003; Lord 2005; Okumiya 1996; Paillard 2004; Ramsbottom 2004; Reinsch 1992; Rooks 1997a; Shigematsu 2002; Suzuki 2004; Zhang 2006); and gymnasium or clinic - 14 trials (Brouwer 2003; Buchner 1997a; Buchner 1997b; Cress 1999; Islam 2004; Jessup 2003; Johansson 1991; MacRae 1994; McGarry 2001; Rubenstein 2000; Sauvage 1992; Wolf 1997; Wolf 2001; Wolfson 1996). Wolf 2001 was a factorial design with 2 arms of the study involving different interventions taking place in different settings.

The interventions were delivered mainly as part of supervised groups (28 trials); or individually supervised - four trials (Shimada 2004; Sihvonen 2004; Wolf 2001; Wolfson 1996); or self-supervised (for example using exercise sheets/video) - three trials (Krebs 1998; Nelson 2004; Okumiya 1996).

The supervisors were healthcare professionals or fitness instructors in 19 trials (Boshuizen 2005; Brouwer 2003; Crilly 1989; Islam 2004; Johansson 1991; Lord 1995; Lord 2003; Lord 2005; MacRae 1994; McGarry 2001; Okumiya 1996; Ramsbottom 2004; Rooks 1997a; Rubenstein 2000; Shigematsu 2002; Shimada 2004; Wolf 1997; Wolf 2001; Zhang 2006). The background of the supervisor was not stated in 12 trials (Buchner 1997a; Buchner 1997b; Cress 1999; Jessup 2003; Johansson 1991; Lichtenstein 1989; McMurdo 1993; Paillard 2004; Sauvage 1992; Sihvonen 2004; Suzuki 2004; Wolfson 1996).

Exercise delivery: duration

The duration of the exercise programmes ranged from 4 weeks (Sihvonen 2004) to 12 months (Lord 1995; Lord 2003; Lord 2005; Reinsch 1992) with the most frequent being 3 months. The frequency of the individual sessions ranged from once every two weeks (Suzuki 2004) to every day (Zhang 2006), the most common being three times per week. The duration of each session ranged from 15 mins (Schoenfelder 2004) to 90 mins (Jessup 2003), the most frequent being one hour.

Exercise delivery: compliance

The definition of adherence or compliance with the exercise intervention and the method of recording and reporting varied considerably across trials and thus these data are difficult to interpret. Typically adherence or compliance was reported as the median or mean percentage of actual sessions completed compared to the total available sessions. This was reported in 15 trials and ranged from 65% (Crilly 1989) to 95% (Sauvage 1992).

Further details are provided in the 'Characteristics of included studies' tables.

Comparison interventions

We compared exercise interventions with a control group. The control group was usual activities in 24 trials (Boshuizen 2005; Buchner 1997a; Buchner 1997b; Cress 1999; Crilly 1989; Islam 2004; Jessup 2003; Johansson 1991; Krebs 1998; Lichtenstein 1989; Lord 1995; Lord 2003; Lord 2005; McGarry 2001; Okumiya 1996; Paillard 2004; Rooks 1997a; Rubenstein 2000; Sauvage 1992; Shigematsu 2002; Shimada 2004; Sihvonen 2004; Suzuki 2004; Zhang 2006) and attention or recreational activities in 10 trials (Crilly 1989; MacRae 1994; McMurdo 1993; Nelson 2004; Ramsbottom 2004; Reinsch 1992; Schoenfelder 2004; Wolf 1997; Wolf 2001; Wolfson 1996).

Exercise was categorised as:

01: Gait, balance, co-ordination and functional tasks;
02: Strengthening;
03: 3D exercise;
04: General physical activity;
05: General physical activity (walking);
06: General physical activity (cycling);
07: Multiple intervention types (combinations of the above).

Outcomes

We only included trials that reported primary outcome measures that were direct or indirect measures of balance performance, however a wide variety of outcomes (11 broad categories described below) were assessed in these trials and often they utilised different methods of data collection and reporting.

Direct measures

Force platform and sway indicators

Force platforms allow the measurement of the movement of the centre of pressure, or limits of stability, under different conditions. Force platforms or sway meters were used in 16 trials (Brouwer 2003; Buchner 1997b; Crilly 1989; Islam 2004; Jessup 2003; Lichtenstein 1989; Lord 1995; Lord 2003; Lord 2005; McMurdo 1993; Paillard 2004; Ramsbottom 2004; Sauvage 1992; Sihvonen 2004; Wolf 1997; Wolfson 1996). Typically when these tests are performed under static conditions (e.g. quiet stance, one leg stance) lower values indicate better balance ability but when performed under dynamic conditions (e.g. leaning forwards, backwards and sideways) higher values indicate better balance ability.

Indirect quantifiable measures

Functional reach

The distance an individual can reach forward beyond arms length while maintaining a fixed base of support in standing (Duncan 1990) was used in six trials (Cress 1999; McGarry 2001; Okumiya 1996; Ramsbottom 2004; Shigematsu 2002; Shimada 2004). Higher values indicate better balance ability.

Timed up-and-go

Timed up-and-go (i.e. time to stand, walk 3 m, turn, and return to sitting), measured in seconds (Podsiadlo 1991), was used in four trials (Boshuizen 2005; McGarry 2001; Okumiya 1996;

Ramsbottom 2004). Lower values indicate better balance ability.

Gait speed

Gait speed, time to walk a known pre-determined distance, was used as an outcome in 17 trials (Boshuizen 2005; Brouwer 2003; Buchner 1997a; Buchner 1997b; Cress 1999; Johansson 1991; Krebs 1998; Lichtenstein 1989; MacRae 1994; Nelson 2004; Rooks 1997a; Sauvage 1992; Schoenfelder 2004; Shimada 2004; Suzuki 2004; Wolfson 1996; Zhang 2006). This was expressed in different units of measurement; velocity (e.g. m/s, cm/min, m/min), or time (s) taken to complete the required distance. A higher value of velocity indicates faster mobility and thus better balance ability, whereas a higher time to complete a required distance indicates slower mobility. The distance walked varied from 2 m (Nelson 2004) to 30 m (Johansson 1991) and was typically measured at the participant's preferred pace of walking usually this was from a standing start and finish but sometimes included acceleration and deceleration distances.

Single legged stance

Single legged stance is the ability to balance on one leg measured as the time before placing the opposite leg on the ground. This outcome measure was used in 13 trials (Buchner 1997a; Johansson 1991; Lichtenstein 1989; MacRae 1994; Nelson 2004; Reinsch 1992; Rooks 1997a; Rubenstein 2000; Shigematsu 2002; Shimada 2004; Suzuki 2004; Wolfson 1996; Zhang 2006). This test was undertaken in a variety of conditions; eyes open and eyes closed and was in some cases measured subject to ceiling effects with a maximum time allowed ranging from 15 s (Rubenstein 2000) to one minute (Suzuki 2004). Higher values indicate better balance ability.

Parallel stance

Parallel stance is the ability to stand with both feet placed beside each other measured as the time before loss of balance and movement of either leg. This outcome measure was used in two trials (Buchner 1997a; Schoenfelder 2004). Higher values indicate better balance ability.

Tandem stance

Tandem stance is the ability to stand with one foot placed in front of the other and touching heel to toe measured as the time before loss of balance and movement of either leg. This outcome measure was used in four trials (Boshuizen 2005; Buchner 1997a; Rooks 1997a; Schoenfelder 2004). Higher values indicate better balance ability.

Tandem walk

Tandem walk is the ability to walk with one foot placed in front of the other and touching heel to toe, measured as the time taken to walk a set distance or the number of steps taken before loss of balance occurs. This outcome measure was used in three trials (Nelson 2004; Rooks 1997a; Suzuki 2004). Higher values indicate better balance ability.

Tilt boards

The ability to maintain balance whilst standing on a tilt board that allows movement only in the antero-posterior direction or multiple directions, measured in time to loss of balance, was used in two trials (Buchner 1997a; Buchner 1997b). Higher values indicate better balance ability.

Balance beams

The ability to walk on wide (17 cm) and narrow (8.5 cm) beams, measured as distance completed before loss of balance (m), or speed of walking (m/s), was used in 4 trials (Buchner 1997a; Buchner 1997b; Cress 1999; Johansson 1991). Higher values indicate better balance ability.

Indirect observational measures

Berg Balance Scale

The Berg Balance Scale is a 56 point scale comprising 14 items of activities of daily living deemed safe for elderly people to perform, each item is scored 0-4 (Berg 1992). This was used in three trials (McGarry 2001; Sihvonen 2004; Wolf 2001). Higher values indicate better balance ability.

Risk of bias in included studies

Methodological quality assessment scores for each item are given in Table 3 and Table 4, a brief summary is provided here.

Table 3. Methodological quality assessment scores M-A (D1b) to M-G

Study ID	M-A (D1b)	M-B (D8)	M-C (D4)	M-D (D2)	M-E (D6)	M-F (D5)	M-G
Boshuizen 2005	1	2	2	2	0	0	0
Brouwer 2003	1	1	0	2	0	0	0
Buchner 1997a	1	2	1	2	0	0	0

Table 3. Methodological quality assessment scores M-A (D1b) to M-G (*Continued*)

Buchner 1997b	1	2	2	2	0	0	0
Cress 1999	1	0	0	2	0	0	0
Crilly 1989	1	2	0	2	0	0	0
Islam 2004	2	2	0	2	0	0	0
Jessup 2003	1	2	2	2	0	0	0
Johansson 1991	1	1	2	2	0	0	0
Krebs 1998	1	1	1	2	0	0	2
Lichtenstein 1989	2	1	0	1	2	0	0
Lord 1995	2	2	2	2	0	0	2
Lord 2003	1	1	0	0	0	0	0
Lord 2005	1	1	2	2	0	0	0
MacRae 1994	2	0	0	0	2	0	2
McGarry 2001	1	0	0	0	0	0	0
McMurdo 1993	2	2	2	2	0	0	0
Nelson 2004	1	1	2	2	0	0	0
Okumiya 1996	1	1	2	2	0	0	0
Paillard 2004	2	0	0	0	0	0	1
Ramsbottom 2004	2	2	0	1	0	0	2
Reinsch 1992	1	1	0	1	1	0	1
Rooks 1997a	1	0	0	2	1	0	0
Rubenstein 2000	1	0	1	2	0	1	2

Table 3. Methodological quality assessment scores M-A (D1b) to M-G (*Continued*)

Sauvage 1992	1	0	2	2	0	0	2
Schoenfelder 2004	1	0	1	1	2	0	0
Shigematsu 2002	1	0	0	2	2	0	2
Shimada 2004	1	1	0	2	0	0	2
Sihvonen 2004	1	1	0	2	0	0	2
Suzuki 2004	1	2	2	2	0	0	2
Wolf 1997	1	0	0	2	0	0	2
Wolf 2001	2	2	1	2	0	0	2
Wolfson 1996	2	1	2	2	0	2	2
Zhang 2006	0	0	0	2	0	0	2

Table 4. Methodological quality assessment scores M-H (D3) to MAC-2

Study ID	M-H (D3)	M-I	M-J	M-K	M-L	D7	MAC-1	MAC-2
Boshuizen 2005	1	2	2	2	1	2	1	0
Brouwer 2003	2	2	2	2	1	2	1	0
Buchner 1997a	2	2	2	2	2	2	2	1
Buchner 1997b	2	2	2	2	2	2	2	0
Cress 1999	2	2	2	2	0	2	0	0
Crilly 1989	2	0	2	1	1	2	0	0
Islam 2004	2	2	2	1	2	2	2	2
Jessup 2003	2	2	2	1	2	2	0	0

Table 4. Methodological quality assessment scores M-H (D3) to MAC-2 (*Continued*)

Johansson 1991	2	2	2	1	1	2	1	0
Krebs 1998	2	2	2	1	0	2	2	0
Lichtenstein 1989	2	2	2	1	2	2	1	2
Lord 1995	2	2	2	1	2	2	2	1
Lord 2003	0	1	2	1	2	2	1	1
Lord 2005	2	2	2	1	2	2	2	0
MacRae 1994	1	2	2	1	2	2	2	0
McGarry 2001	0	0	1	2	0	0	0	0
McMurdo 1993	2	2	2	1	2	0	1	0
Nelson 2004	2	2	2	2	0	2	1	2
Okumiya 1996	1	1	2	1	2	2	1	0
Paillard 2004	2	2	2	1	0	2	0	0
Ramsbottom 2004	2	2	2	2	2	2	1	0
Reinsch 1992	1	2	2	1	0	2	1	0
Rooks 1997a	2	2	2	2	0	2	0	2
Rubenstein 2000	2	2	2	2	0	2	0	0
Sauvage 1992	2	2	2	2	1	2	2	0
Schoenfelder 2004	2	2	2	2	2	2	1	0

Table 4. Methodological quality assessment scores M-H (D3) to MAC-2 *(Continued)*

Shigematsu 2002	2	2	2	2	1	2	2	0
Shimada 2004	1	2	2	2	0	2	2	1
Sihvonen 2004	2	2	2	1	1	2	2	0
Suzuki 2004	1	1	2	1	2	1	2	2
Wolf 1997	2	2	2	2	2	2	0	0
Wolf 2001	2	2	2	1	2	2	0	0
Wolfson 1996	2	2	2	2	2	2	2	2
Zhang 2006	1	2	2	2	0	2	2	0

Randomisation

The reported method of randomisation included random number tables, block randomisation using permuted blocks, and stratification. However, 13 trials did not state the method of randomisation (Boshuizen 2005; Brouwer 2003; Buchner 1997b; Cress 1999; Islam 2004; Krebs 1998; Johansson 1991; McGarry 2001; Okumiya 1996; Paillard 2004; Sauvage 1992; Schoenfelder 2004; Wolf 1997). Of the seven trials that were cluster randomised (Lichtenstein 1989; McMurdo 1993; MacRae 1994; Lord 1995; Lord 2003; Reinsch 1992; Shigematsu 2002), none reported that an adjustment had been made for cluster randomisation. The units of randomisation were place of residence or community centre but the analysis in the primary reporting was by individual.

Allocation

Allocation concealment was adequate in 10 trials (Jessup 2003; Lichtenstein 1989; Lord 2003; Lord 2005; MacRae 1994; Ramsbottom 2004; Rubenstein 2000; Shigematsu 2002; Wolf 2001; Wolfson 1996); unclear in 22 trials (Boshuizen 2005; Brouwer 2003; Buchner 1997a; Buchner 1997b; Cress 1999; Crilly 1989; Islam 2004; Johansson 1991; Krebs 1998; Lord 1995; McMurdo 1993; Nelson 2004; Okumiya 1996; Paillard 2004; Reinsch 1992; Rooks 1997a; Sauvage 1992; Schoenfelder 2004; Sihvonen 2004; Suzuki 2004; Wolf 1997; Zhang 2006); and not used in two trials (McGarry 2001; Shimada 2004).

Blinding

It is difficult to ensure blinding of participants in trials of exercise interventions. In an attempt to minimise bias, 10 trials used attention or recreational control groups (the participants received matching periods of attention or recreational activity) (Crilly 1989; MacRae 1994; McMurdo 1993; Nelson 2004; Ramsbottom 2004; Reinsch 1992; Schoenfelder 2004; Wolf 1997; Wolf 2001; Wolfson 1996). Seventeen trials stated that assessors for all outcomes were blind to the group allocation (Boshuizen 2005; Buchner 1997a; Buchner 1997b; Krebs 1998; Jessup 2003; Johansson 1991; Lord 1995; Lord 2005; McMurdo 1993; Nelson 2004; Okumiya 1996; Rubenstein 2000; Sauvage 1992; Schoenfelder 2004; Suzuki 2004; Wolf 2001; Wolfson 1996); however, 17 trials did not report the status of blinding of assessors (Brouwer 2003; Cress 1999; Crilly 1989; Islam 2004; Lichtenstein 1989; Lord 2003; MacRae 1994; McGarry 2001; Paillard 2004; Ramsbottom 2004; Reinsch 1992; Rooks 1997a; Shigematsu 2002; Shimada 2004; Sihvonen 2004; Wolf 1997; Zhang 2006).

Follow-up and exclusions

Most trials (n = 29) did not have any follow up beyond the end of the programme of exercise intervention. For those five trials re-

porting follow-up (Brouwer 2003; Buchner 1997b; Schoenfelder 2004; Wolf 2001; Wolfson 1996) the duration varied from 6 weeks (Brouwer 2003) to 1 year (Wolf 2001). Twenty-nine trials reported losses that ranged from 3% of participants (Johansson 1991) to 48% of participants (Wolf 2001), however, five trials did not report whether any losses were incurred (McGarry 2001; Paillard 2004; Shigematsu 2002; Wolf 1997; Wolfson 1996). Most trials included only participants that completed the entire trial in their analysis whereas eight trials stated that they used intention-to-treat analysis (Buchner 1997a; Buchner 1997b; Cress 1999; Ramsbottom 2004; Reinsch 1992; Rooks 1997a; Suzuki 2004; Wolf 2001).

Study size

Nine trials had more than 100 participants at entry (Buchner 1997a; Buchner 1997b; Krebs 1998; Lord 1995; Lord 2003; Lord 2005; Reinsch 1992; Rooks 1997a; Wolfson 1996) but most were small. Ten trials had less than 40 participants at entry (Brouwer 2003; Jessup 2003; Johansson 1991; McGarry 2001; Paillard 2004; Ramsbottom 2004; Sauvage 1992; Shigematsu 2002; Shimada 2004; Sihvonen 2004). The smallest sample was Sauvage 1992 with only 14 participants.

Effects of interventions

Gait, balance co-ordination and functional tasks versus control (Analyses 01.01 to 01.16)

Eleven trials involving 694 participants at entry investigated the effects of exercise programmes involving gait, balance, co-ordination and functional task activities versus control. Sixteen different outcome measures representative of direct, indirect quantifiable and observational measures were used to evaluate these interventions. Statistically significant differences were observed in only five of these measures.

01.01 Anterior-Posterior (A-P) stability during stance (quiet and dynamic) with eyes open

Three studies (Brouwer 2003; Crilly 1989; Wolf 1997) provided data on AP stability during stance with eyes open. A meta-analysis of standardised differences in means gave a statistically significant decrease of 0.71 standard deviations immediately after the exercise intervention (95% CI -1.33 to -0.09) indicating better balance ability in the exercise groups (n = 116). Two studies reported follow up. For Brouwer 2003 (n = 30) there was a tendency towards better balance ability of the exercise group (P = 0.09) (95% CI -1.37 to 0.10) at 6 weeks post intervention, while Wolf 1997 (n = 35) reported a statistically significant difference of 0.96 standard deviations at 4 months post intervention (CI -1.67 to -0.26) in favour of the exercise group.

0 ***1.02 Medio-lateral (ML) stability during stance (quiet and dynamic) with eyes open***

Three studies (Brouwer 2003; Crilly 1989; Wolf 1997) (n = 116) provided data on this outcome measure. A meta-analysis of standardised differences in means indicated a tendency towards better balance ability in the exercise groups immediately after the exercise intervention (P = 0.19) (95% CI -0.98 to 0.20). This tendency was maintained at 6 weeks post intervention (Brouwer 2003) (P = 0.07) (95% CI -1.42 to 0.06). However, Wolf 1997 (n = 35) observed a statistically significant increase of 1.09 standard deviations at 4 months post intervention (95% CI 0.37 to 1.81) indicating better balance ability in the control group.

01.05 Functional base of support during a dynamic test

One study (Wolfson 1996), involving analysis of 35 participants, provided data on this outcome measure. A statistically significant difference of 0.12 cm, (95% CI 0.05 to 0.19) was observed immediately post intervention and a difference of 0.08 cm (95% CI 0.01 to 0.15) was maintained at 6 months post intervention (n = 33) indicating better balance ability in the exercise group.

01.06 Loss of balance during sensory organisation test

Only one study (Wolfson 1996) provided data on this outcome measure and tendency towards better balance ability in the exercise group (P = 0.06) (95% CI -2.24 to 0.04) was observed immediately post intervention (n = 53) and there was a statistically significant difference in the number of errors of 1.10 (95% CI -2.16 to -0.04) at 6 months post intervention (n = 47) indicating better balance ability in the exercise group.

01.07 Maximum excursion of limits of stability test

Only one small study (Islam 2004) (n = 29) used this measure. Statistically significant differences in maximum excursion were observed for leaning forward (20.10 mm, 95% CI 8.66 to 31.54), right (19.00 mm, 95% CI 9.02 to 28.98) and left (12.80 mm, 95% CI 4.10 to 21.50) indicating better balance ability in the exercise group. A tendency towards better balance was observed for the exercise group for leaning backwards.

01.10 Single leg stance time eyes open

Four studies (Johansson 1991; MacRae 1994; Reinsch 1992; Wolfson 1996) provided data on 164 participants' single legged stance time with eyes open. A meta-analysis of standardised differences in means gave a statistically significant increase of 0.33 standard deviations immediately after the exercise intervention (95% CI 0.02 to 0.64). However this difference does not appear to be maintained in one study (Wolfson 1996) (n = 37) at 6 months follow up.

01.16 Berg Balance Scale

Three studies (McGarry 2001; Sihvonen 2004; Wolf 2001) provided data using the Berg Balance Scale. A statistically significant difference of 2.72 points (Weighted Mean Difference (WMD)) across the three studies (n = 126) was observed immediately after the exercise intervention (95% CI 0.94 to 4.50), indicating better balance ability in the exercise groups. In one study (Wolf 2001) at 4 weeks post intervention (n = 77) there is still a tendency towards better balance ability in the exercise group but this does not appear to be maintained at 1 year post intervention (n = 49).

There was no evidence of effect on average across all other outcome measures.

02. Strengthening exercise versus control (Analyses 02.01 to 02.11)

Six trials (Boshuizen 2005; Buchner 1997a; Cress 1999; Krebs 1998; Rooks 1997a; Wolfson 1996) investigated the effect of exercise programmes involving strengthening exercises versus controls. Eleven different outcome measures representative of direct and indirect quantifiable measures were used to evaluate these interventions. Statistically significant differences were observed in four of these measures.

02.03 Tilt board time

One study (Buchner 1997a) provided data on ability to stand on a tilt board. A statistically significant mean difference of 4.00 s (95% CI -7.89 to -0.11) was observed for omnidirectional tilt indicating better balance ability in the control group. However, no statistically significant differences were observed for anteroposterior tilt.

02.04 Single legged stance eyes open

Three studies (Buchner 1997a; Rooks 1997a; Wolfson 1996) provided data on single legged stance time with eyes open (n = 170). A meta-analysis of standardised differences in means gave a statistically significant increase of 0.39 standard deviations immediately after the exercise intervention (95% CI 0.08 to 0.70) indicating better balance ability across the exercise groups.

02.06 Tandem walk

A trend towards better balance in the exercise group (P = 0.10) (95% CI -4.40 to 0.40) was observed for one study (Rooks 1997a) in time to walk 10 feet.

02.08 Functional Reach Test

One study (Cress 1999) reported data on the functional reach of participants (n = 49) immediately post intervention. A statistically significant difference of 4.33 cm (95% CI 8.00 to 0.66) was observed indicating better balance ability in the exercise group.

02.10 Gait speed

Five studies (Boshuizen 2005; Buchner 1997a; Cress 1999; Krebs 1998; Wolfson 1996) provided data on gait speed (n = 304). A meta-analysis of standardised differences in means gave a statistically significant increase of 0.25 standard deviations immediately after the exercise intervention (95% CI 0.2 to 0.48), indicating better balance ability across the exercise groups.

There was no evidence of effect on average across all other outcome measures.

03. 3D exercise versus control (Analyses 03.01 to 03.16)

Four studies (Buchner 1997b; Shigematsu 2002; Wolf 1997; Zhang 2006) involving 265 participants at entry investigated the effects of exercise programmes involving 3D exercise versus controls. Fifteen different outcome measures representative of direct and indirect quantifiable measures were used to evaluate these interventions. Statistically significant differences were observed in only one of these measures.

03.10 Single leg stance eyes open

Two studies (Shigematsu 2002; Zhang 2006) provided data on this outcome measure (n = 85). A trend towards better balance ability in the exercise group was observed immediately after the exercise intervention (P = 0.09) (95% CI -0.17 to 2.44).

03.14 and 03.15 Walking on beams

One study (Buchner 1997b) provided data for participants walking on a wide and narrow balance beams (n = 52). For the wide balance beam a statistically significant difference in velocity of 0.10 m/s (95% CI -0.16 to 0.04) was observed immediately post intervention indicating better balance ability in the control group and this trend was observed at 3 months follow up (95% CI -0.17 to 0.03). However for the narrow balance beam, a trend towards better balance ability in the exercise group (95% CI -0.01 to 1.61) was observed immediately post intervention and this was maintained at 3 months follow up.

There was no evidence of effect on average across all other outcome measures.

04. General physical activity versus control (Analyses 04.01 to 04.03)

Two studies (McMurdo 1993; Okumiya 1996) involving 83 participants at entry investigated the effects of exercise programmes involving 3D exercise versus controls. Three different outcome measures representative of direct and indirect quantifiable measures were used to evaluate these interventions. Statistically significant differences were observed in two of these measures.

04.02 Functional Reach Test

One study (Okumiya 1996) provided data for 42 participants performing the functional reach test. A statistically significant difference of 11.80 cm (95% CI 7.75 to 15.85) was observed immediately post intervention indicating better balance ability in the exercise group.

04.03 Timed up-and-go test

One study (Okumiya 1996) provided data for 42 participants performing the timed up-and-go test. A statistically significant difference in time taken -3.90 s (95% CI -5.83 to -1.97) was observed immediately post intervention indicating better balance ability in the exercise group.

There was no evidence of effect on average in the other outcome measure postural sway double stance.

05. General physical activity (walking) versus control (Analyses 05.01 to 05.15)

Four studies (Buchner 1997b; Paillard 2004; Rooks 1997a; Shimada 2004) involving 235 participants at entry investigated the effects of exercise programmes involving walking as general physical activity versus controls. Sixteen different outcome measures representative of direct and indirect quantifiable measures were used to evaluate these interventions. Statistically significant differences were observed in five of these measures.

05.03 Area during narrow stance eyes closed

One study (Buchner 1997b) provided data for participants in quiet narrow stance with eyes closed. A statistically significant difference of 102 mm^2 (95% CI 28.58 to 175.42) was observed immediately post intervention (n = 52) and a statistically significant difference

of 118 mm^2 (95% CI 46.83 to 189.17) was maintained at 3 months post intervention (n = 51) indicating better balance ability in the control group.

05.04 Angular radius during narrow stance eyes closed

There was a tendency towards better balance in the control group immediately and 3 months after the intervention for angular radius during narrow stance with eyes open (Buchner 1997b) (P = 0.10) (95%CI -0.26 to 3.06).

05.06 Dynamic balance lateral axis

One study (Paillard 2004) provided data for this outcome measure (n = 21). No statistically significant difference was observed immediately post intervention but a statistically significant difference of -2.5 degrees (95% CI -4.01 to -0.99) was observed between the groups at 3 months post intervention, indicating a better balance ability in the control group.

05.11 Tandem walk

One study (Rooks 1997a) provided data on this outcome measure (n = 69). A statistically significant difference of 2.30 s (95% CI 0.55 to 4.05) was observed immediately post intervention indicating better balance ability in the exercise group.

05.12 Tandem stance

One study (Rooks 1997a) provided data on this outcome measure (n = 69). A statistically significant difference of 12.90 s (95% CI 3.91 to 21.89) was observed immediately post intervention, indicating better balance ability in the exercise group.

05.13 Functional Reach Test

One study (Shimada 2004) provided data for 26 participants performing the functional reach test. A statistically significant difference of 10.92 cm (95% CI 5.03 to 16.81) between the groups was observed immediately post intervention indicating better balance ability in the exercise group.

05.15 & 05.16 Walking on wide and narrow beams

Buchner 1997b provided data for ability to walk on a wide beam. A trend towards better balance ability in the exercise group was observed immediately post intervention (n = 52) (95% CI -0.01 to 0.13) and at 3 months post intervention (n = 51) (95% CI -0.01 to 0.17).

Buchner 1997b also provided data for ability to walk on a narrow beam. A statistically significant difference of 0.50 m/s (95% CI -0.07 to 1.07) was observed immediately post intervention (n = 52) indicating a better balance ability in the exercise group but this was not maintained at 3 months post intervention (n = 51). There was no evidence of effect on average across all other outcome measures.

06. General physical activity (cycling) versus control (Analyses 06.01 to 06.09)

One study (Buchner 1997b) involving 106 participants at entry investigated the effects of exercise programmes involving cycling as general physical activity versus controls. Nine different outcome measures representative of direct and indirect quantifiable measures were used to evaluate these interventions. There was no statistically significant effect on average across all outcome measures for which data was provided. However, a trend towards better balance ability in the exercise group was observed for the following outcome measures; 06.01 area during narrow stance eyes open; 06.02 angular radius during narrow stance eyes open; 06.07 self paced gait velocity. A trend towards better balance ability in the control group was observed for the following outcomes; 06.03 area narrow stance eyes closed, 06.04 angular radius during narrow stance eyes closed.

07. Multiple exercise types versus control (Analyses 07.01 to 07.16)

Twelve studies (Jessup 2003; Johansson 1991; Lord 1995; Lord 2003; Lord 2005; Nelson 2004; Ramsbottom 2004; Rubenstein 2000; Sauvage 1992; Schoenfelder 2004; Suzuki 2004; Wolfson 1996) involving 1559 participants at entry investigated the effects of exercise programmes involving multiple exercise types versus controls. Sixteen different outcome measures, representative of direct and indirect quantifiable measures, were used to evaluate these interventions. Statistically significant differences were observed in seven of these measures.

07.01 Functional base of support during a dynamic test

One study (Wolfson 1996) provided data for this outcome measure. A statistically significant difference of 0.09 proportion of foot length (95% CI 0.03 to 0.15) was observed between the groups immediately post intervention (n = 32) and 0.09 proportion of foot length (95% CI 0.02 to 0.16) at 6 months post intervention (n = 26) indicating better balance ability in the exercise group.

07.03 Total distance travelled by COP during quiet stance

One study (Sauvage 1992) provided data for this outcome measure for 14 participants under eyes open and eyes closed conditions. Statistically significant differences were observed between the groups immediately post intervention of 97.15 mm (95% CI 18.59 to 175.71) with eyes open and 212.52 mm (95% CI 114.79 to 310.25) with eyes closed indicating better balance ability in the exercise group.

07.05 Body sway

Two studies (Jessup 2003; Ramsbottom 2004) provided data for this outcome measure. A statistically significant decrease of 0.87 standard deviations across the two studies (n = 35) was observed immediately after the exercise intervention (95% CI -1.60 to -0.13) indicating better balance ability in the exercise group.

07.12 Tandem stance time

One study (Schoenfelder 2004) provided data for this outcome for 67 participants. A statistically significant difference of 0.80 s (95% CI -0.47 to 2.07) was observed indicating better balance ability in the exercise group.

07.13 Tandem walking (number of steps)

One study (Suzuki 2004) provided data for the number of steps able to be made during tandem walking (n = 39). A statistically significant difference of 3.39 steps (95% CI 1.75 to 5.03) was observed between the groups immediately post intervention indicating better balance ability in the exercise group.

07.14 Tandem walking time

One study (Nelson 2004) provided data for tandem walk time. A statistically significant difference of 8.10 s (95% CI 2.49 to 13.71) was observed between the groups (n = 70) immediately post intervention indicating better balance ability in the exercise group.

07.15 Functional Reach Test

Two studies (Ramsbottom 2004; Suzuki 2004) provided data on distance reached during the functional reach test. A statistically significant difference of 5.80 (95% CI 3.37 to 8.23) across the two studies (n = 60) was observed immediately after the exercise intervention indicating better balance ability in the exercise group.

There was no evidence of effect on average across all other outcome measures.

08. Sensitivity analyses for effect of clustering (Analyses 08.01 to 08.02)

08.01 Gait, balance, co-ordination, functional task exercise versus control (01.10) Single leg stance time eyes open

Two cluster randomised studies were removed from the meta-analysis (MacRae 1994; Reinsch 1992). Two studies (Johansson 1991; Wolfson 1996) provided data on 72 participants single legged stance time with eyes open. A meta-analysis of standardised differences in means demonstrated a trend towards an improvement in balance in favour of exercise immediately after the exercise intervention (P = 0.07, 95% CI -0.04 to 0.90).

08.02 Gait, balance, co-ordination, functional task exercise versus control (01.14) Self paced gait speed

One cluster randomised study was removed from the meta-analysis (MacRae 1994). Three studies (Brouwer 2003; Johansson 1991; Wolfson 1996) provided data on 117 participants self paced gait speed. A meta-analysis of standardised differences in means gave a statistically significant increase of 0.45 standard deviations immediately after the exercise intervention (P = 0.02, 95% CI 0.08 to 0.82).

DISCUSSION

Summary of main results

Statistically significant improvements were observed in balance ability assessed across a variety of outcome measures for exercise interventions compared to control (usual, recreational or attentional activity). Exercise interventions were heterogeneous and were categorised into seven types. They took place mainly in gym/clinic or community settings in supervised groups delivered predominantly by healthcare professionals or fitness instructors. The duration of the exercise programmes ranged from 4 weeks to 12 months, the most frequent being 3 months. The frequency of the individual sessions ranged from once every two weeks to every day, typically three times per week for one hour.

Gait, balance, co-ordination and functional tasks exercise interventions (Analysis 01) showed statistically significant improvements compared with control in direct measures of balance including: AP stability during stance (quiet and dynamic) with eyes open; maximum excursion of locus of support (LOS) test; and functional base of support distance during a dynamic test. Statistically significant improvements in favour of the exercise intervention were also observed in single legged stance time with eyes open (indirect quantifiable measure) and the Berg Balance score (indirect observational measure). A trend towards an improvement in balance in favour of exercise was observed for two other measures.

Strengthening exercise interventions (Analysis 02) showed statistically significant positive effects on time for omnidirectional tilt (direct measure) and on the following indirect quantifiable measures of balance; functional reach, single legged stance with eyes open, tandem stance, and gait speed. A trend towards an improvement in balance was observed for tandem walk.

3D exercise, including Tai Chi and dance (Analysis 03), demonstrated statistically significant improvements in favour of control in walking on a wide balance beam (indirect quantifiable measure). A trend towards an improvement in balance in favour of exercise was observed for single leg stance eyes open. No other improvements were observed in other outcomes relating to direct measures or indirect observational measures.

General physical activity (Analysis 04) demonstrated statistically significant improvements in indirect quantifiable measures of balance; timed up-and-go test and functional reach.

Walking as a general physical activity (Analysis 05) showed statistically significant improvements in favour of exercise for the indirect quantifiable balance measures; tandem walk, tandem stance, walking on wide beams and functional reach. However, statistically significant improvements in favour of the control was observed for area during narrow stance (direct quantifiable balance measure).

There was trend towards improvement of balance in favour of cycling (Analysis 06) this lack of significant improvement could be due to the task specific nature of cycling, any improvements in neuromuscular control and conditioning not translating directly into balance ability. However these results are based on one study.

Interventions of multiple exercise types (Analysis 07) demonstrated statistically significant improvements in direct quantifiable balance measures including: body sway, centre of pressure excursion during quiet stance and functional base of support. Indirect quantifiable measures such as functional reach, tandem stance and

tandem walking also improved.

Indirect quantifiable measures of balance such as the functional reach test (FRT), timed up and go test and tandem walking require minimal equipment and are easy to use in the clinical and community environments. The interventions examined demonstrated clinically important improvements compared with control in some of these measures, for example differences of 11.80, 10.92 and 5.80 cm in FRT for Analyses 04.02, 05.13 and 07.15 respectively.

In the main where differences were observed immediately post intervention there was limited evidence to suggest that these effects were maintained over longer periods of time.

Overall completeness and applicability of evidence

The 34 studies included in this review were predominantly in the English language and originate mainly from North America and Europe (n = 25). Whilst this may be seen to limit the applicability of the evidence to these healthcare systems and social environments the evidence has potential generalisability. The majority of participants were healthy community dwelling women and may not have had impairment or activity limitation at baseline. This may have impacted on the capacity of these mainly small studies to reveal any differences, whether positive or negative, between the exercise intervention and control groups. However the majority of participants were on average over 75 years and some studies included participants described as frail or with activity limitations. The interventions investigated included many commonly utilised categories of exercise such as gait, balance, function, muscle strengthening, walking, cycling, tai chi and dance. The definition of adherence or compliance with the exercise intervention and the method of recording and reporting varied considerably across trials and thus these data are difficult to interpret. However none of the studies included information indicating enthusiasm for uptake of exercise or long term uptake among participants in the programmes.

The wide range of interventions and outcome measures reported across the studies made it difficult to combine outcomes in meta-analysis. The lack of longer term follow-up of outcomes made it difficult to determine any lasting effects. Furthermore the lack of standardisation of measures and their relative validity limit the interpretation of these results. For example, direct measures of balance use force platforms and sway meters. Typically when these tests are performed under static conditions (e.g. quiet stance, one leg stance) lower values indicate better balance ability but when performed under dynamic conditions (e.g. leaning forwards, backwards and sideways) higher values indicate better balance ability. However, there are difficulties in the interpretation of this type of data as in some populations an increased sway under static conditions may indicate better dynamic control whereas less sway may indicate that the individual has an over stiffened system in an effort to maintain stability. Furthermore, for some timed measures of balance, authors applied ceiling effects stipulating a maximum time allowed for the test, and this was not adjusted for in the analysis.

Quality of the evidence

The overall quality of current evidence about the effectiveness of exercise interventions designed to improve balance in older people living in the community or in institutional care is mixed. Of the 34 included trials there were 2883 participants at entry, only nine trials had more than 100 participants at entry, most were small, ten trials had less than 40 participants. Many studies identified demonstrate a range of methodological weaknesses that are exacerbated by inadequate reporting resulting in a large number of studies being placed in 'Studies awaiting assessment'. The main weaknesses were the lack of information about randomisation methods and allocation concealment, blinding of assessors and intention-to-treat analyses. There was limited follow-up data to demonstrate the extent to which the effects of programmes were maintained. Some included studies reported findings based on change scores. This requires measurement of the outcome twice and can result in bias for outcomes that are difficult to measure precisely as the measurement error may be larger than true between person baseline variability. These issues make it difficult to draw firm conclusions.

Potential biases in the review process

There are several potential sources of bias in this review. Although we attempted to extract direct and indirect measures of balance there is a possibility that the measures reported are a biased representation of those collected by the study authors (selective reporting). Indeed there were 11 broad categories of outcome measures used across the studies, some of which were used under a variety of conditions, e.g. eyes open, eyes closed, different surfaces. Only eight studies undertook intention-to-treat analyses the remainder reporting the results for only those participants who completed all post-treatment assessments. The seven studies that were cluster randomised trials did not appear to make adjustments for the cluster effect. As a result, these studies may have overly narrow confidence intervals and will receive more weight than is appropriate in a meta-analysis. Sensitivity analyses were performed to account for this effect. An effect was observed in only two comparisons where a significant difference became a trend (08.01 for 01.10) and a trend became significant (08.02 for 01.14) both in favour of exercise. There are several studies for which the data were inadequately reported and therefore were unable to be included in the analyses.

Agreements and disagreements with other studies or reviews

The objective of this review was to present the best evidence for effectiveness of exercise interventions designed to improve balance in older people living in the community or in institutional care. The general direction of findings presented is in keeping with those of other related systematic reviews: 'Progressive resistance training for physical disability in older people' (Latham 2004) and 'Interventions for preventing falls in elderly people' (Gillespie 2004) where the positive effects of exercise on balance were secondary findings.

AUTHORS' CONCLUSIONS

Implications for practice

A substantial amount of research has been undertaken to assess the effects of exercise on balance and functional ability in older people. Exercise appears to have statistically significant beneficial effects on balance ability compared to usual activity. Interventions involving gait, balance, co-ordination and functional exercises; muscle strengthening; and multiple exercise types, appear to have the greatest impact on indirect measures of balance. However, there was limited evidence that effects were long lasting. The strength of evidence contained within these randomised controlled trials is limited. The failure across the included studies to apply a core set of standardised outcome measures to determine balance ability restricts the capacity to compare or pool different trials from which firm conclusions regarding efficacy can be made. Further standardisation in timing of outcome assessment is also required as is longer term follow-up of outcomes to determine any lasting effects of regular physical activity.

Implications for research

The most important implication for research in this area is for better documenting and reporting of study design and execution. In future trials, the CONSORT statement should be used as a guide for both designing and reporting (www.consort-statement.org). The benefits of exercise interventions on balance may be relatively small. Sample sizes should be reported and have adequate power to answer the research question allowing the detection of clinically significant differences between groups. Reporting should include the method of randomisation and treatment allocation concealment and an intention-to-treat analysis performed. The history and reasons for drop-outs and exclusions throughout the trial should be ascertained and reported so that factors affecting exercise adherence can be further explored. Ideally trials should wherever possible, follow-up participants for at least one year, rather than focussing on immediate post intervention.

To enable comparison and pooling of the results of RCTs, we suggest that future trials report means with standard deviations for continuous measures or number of events and total numbers analysed for dichotomous measures. Furthermore, we recommend that a consensus of outcome measures for evaluating the effects of interventions on balance ability that have been demonstrated as sensitive to change be developed similar to the work being undertaken by ProFaNE for falls prevention.

ACKNOWLEDGEMENTS

We would like to thank Lesley Gillespie for her valuable assistance with the search strategy, Joanne Elliott, Bill Gillespie, Peter Herbison, Vicki Livingstone, Rajan Madhok, Lindsey Shaw, Janet Wale and Wiebren Zijlstra for critical comments and the stimulating discussions that resulted from these, Mark Waters for input into the protocol, Sallie Lamb for assistance with the taxonomy of exercise interventions, Philip Rowe and Danny Rafferty for advice on outcome measures and Daniel Soule for drafting the plain language summary. In addition, we would like to thank the valuable contributions of Jayne Elms who co-ordinated data collection, searching and retrieval of papers and additional information, entered data into RevMan and commented on drafts and Pam Dawson who screened search results, appraised quality and extracted data from papers.

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* *Indicates the major publication for the study*

CHARACTERISTICS OF STUDIES

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

Boshuizen 2005

Methods	RCT. Method of randomisation not known. Assessors blinded. Losses: 23 of 72 from 3 arms.
Participants	N = 33 completers in two arms Age: mean (SD) 80.0 (6.7) exercise group, 77.2 (6.5) control group. Sex: high guidance group - all female, medium guidance group - 2 male, control group 2 male. Setting: Netherlands. Inclusion: difficulty getting up from chair. Exclusion: maximum knee extensor torque over 87.5 Nm, self reported disease adversely affected by exercise.
Interventions	Exercise group (STRENGTH) (n = 16): strengthening exercises of lower limbs with theraband and increasing resistance in sitting and standing. Control group (n = 17): usual activity. Duration and intensity: 10 weeks of 2 x 1hour supervised classes per week and 1 self supervised home session. Supervisor: physical therapist for exercise groups. Supervision: group exercise classes for exercise groups and self home exercises. Setting: community.
Outcomes	20 metre walk test (s). TUG (s). Tandem stance (s).
Notes	Trial had 3 arms but NSD between 2 interventions therefore data taken from 'High guidance' group Compliance in exercise group 73%

Risk of bias

Item	Authors' judgement	Description
Allocation concealment?	Unclear	B - Unclear

Brouwer 2003

Methods	RCT. Method of randomisation not known. Blinding not known. Losses: 4 of 38.

Brouwer 2003 (*Continued*)

Participants	N= 38 Age: mean (SD) 77.1 (5.1) - exercise group, 78.0 (5.5) - control group. Sex: 5 male, 12 female - exercise group, 4 male, 13 female - control group. Setting: Canada. Inclusion: fear of falling. Exclusion: co-morbidities (neuropathy, vestibular deficits, mobility arthritis, neurological conditions).
Interventions	Exercise group (GBFT): low resistance exercises against gravity, theraband for legs and trunk, reaching, weight shifting, marching on spot, and home exercise programme. Control group: discussion about concerns relating to falling, education about environment. Duration and intensity: 1 hour per week x 8 weeks both groups. Exercise group additional 40 minutes x 2 week home exercise programme. Supervisor: physiotherapist. Supervision: group. Setting: gym.
Outcomes	Force platform - LOS AP and ML (cm). Walking speed (middle 10 of 20 metres) (m/s).
Notes	

Risk of bias

Item	Authors' judgement	Description
Allocation concealment?	Unclear	B - Unclear

Buchner 1997a

Methods	RCT. Random permuted blocks. Assessors blinded. Losses: 5 of 105. Intention to treat analysis.
Participants	N = 105, Factorial design 51 allocated to relevant arms. Age: mean 75 range 68 - 85. Sex: 51% female. Setting: USA. Inclusion: 68 - 85 years unable to do 8 step tandem gait with no errors, below 50th centile for knee extensor strength for height and weight. Exclusion: cardiovascular, pulmonary, vestibular and bone disease, dependency terminal illness, unable to speak English, positive cardiac stress test, body weight greater than 180% of ideal.
Interventions	Strength group (STRENGTH): free weights and gym equipment Control group: usual activities. Duration and intensity: intervention groups - 1 hour x 3 days a week (24 - 26 weeks). Supervisor: not stated.

Buchner 1997a (*Continued*)

	Supervision: group. Setting: gym/ clinic.
Outcomes	Ability to walk on wide and narrow beams. Balance in parallel, semi tandem and tandem stance (s). Single legged stance (s) Gait speed (m/min). Tilt board AP and OMNI directional (s).
Notes	Trial had 4 arms. Part of FICSIT study see Buchner 1993

Risk of bias

Item	Authors' judgement	Description
Allocation concealment?	Unclear	B - Unclear

Buchner 1997b

Methods	RCT. Method of randomisation not known. Assessors blinded. Losses: 4 of 106. Intention to treat analysis.
Participants	N = 106. Age: mean 75 control, 75 cycle, 74 walk, 75 aerobic. Sex: females - 50% control, 54% cycle, 54% walk, 54% aerobic. Setting: USA. Inclusion: sedentary, 68 - 85 years, mild balance deficit. Exclusion: regular exercise, cardiovascular, pulmonary, vestibular and bone disease, dependency terminal illness, unable to speak English, positive cardiac stress test, body weight greater than 180% of ideal.
Interventions	Control group: usual activity Cycling group (CYCLING): static cycle Walking group (WALKING): outdoors Dance movement group (3D): to music Duration and intensity: intervention groups - 1 hour x 3 per week for 3 months. Supervisor: not stated. Supervision: group. Setting: gym/clinic.
Outcomes	OMNI tilt board (s). Walking on wide beam (m/s). Walking on narrow beam (m/s). Force plate - eyes open, eyes closed (area mm2/s: average radius mm). AP tilt board (s) Gait speed (m/min)

Buchner 1997b (*Continued*)

Notes	Part of FICSIT study see Buchner 1993	
Risk of bias		
Item	**Authors' judgement**	**Description**
Allocation concealment?	Unclear	B - Unclear

Cress 1999

Methods	RCT. Method of randomisation not known. Blinding not known. Losses: 7 of 56. Intention to treat analysis.
Participants	N = 56 Age: mean (SD) 76 (4). Sex: not stated. Setting: USA. Inclusion: 70 years and above, good health, living in retirement community or apartment. Exclusion: unstable cardiovascular or metabolic disease, recent unhealed fractures, other disorders, life expectancy less than 1 year, excessive alcohol, non English speaking.
Interventions	Exercise group (STRENGTH): combined endurance and resistance. Control group: none exercising. Duration and intensity: 1 hour x 3 per week for 6 months. Supervisor: not stated. Supervision: group. Setting: community.
Outcomes	Usual walking speed (m/s). Time on 9 m beam (s). FRT (cm).
Notes	
Risk of bias	

Item	**Authors' judgement**	**Description**
Allocation concealment?	Unclear	B - Unclear

Crilly 1989

Methods	RCT. Randomised by random tables. Blinding not known. Losses: 14 of 50
Participants	N = 50 Age: mean 82, range 71 - 92. Sex: female. Setting: Canada. Inclusion: over 70 years, ability to ambulate independently, good eyesight and hearing, understand instruction, ability to participate in exercise programmes. Exclusion: no specific criteria.
Interventions	Exercise group (GBFT): exercise aimed at improving breathing, single and double limb balance, coordination, flexibility, strength and relaxation. Control group: usual activity. Duration and intensity: exercise group - 15 - 35 minutes x 3 week for 3 months. Supervisor: physiotherapist. Supervision: group. Setting: institutional.
Outcomes	Postural sway during quiet standing on force plate - eyes open, eyes closed - RMS ML and AP (mm)
Notes	

Risk of bias

Item	Authors' judgement	Description
Allocation concealment?	Unclear	B - Unclear

Islam 2004

Methods	RCT. Method of randomisation not known. Blinding not known. Losses: 4 prior to testing
Participants	N = 43 Age: 69 - 89 years Sex: 20 male, 19 female. Setting: Japan Inclusion: healthy Exclusion: taking medication, signs or symptoms of diagnosed disease.
Interventions	Exercise group (GBFT): balance exercises designed to challenge the visual (e.g. opened /closed eyes), vestibular (e.g. move head), somatosensory (e.g. stand on foam) and muscular (e.g. standing on one leg, bending body in different directions)systems. Exercises were initially performed while standing on the floor (first 4 weeks) and then progressed to standing.

Islam 2004 (*Continued*)

	Control group: usual activity. Duration and intensity: 2 sessions per week for 60 minutes for 12 weeks. Supervisor: fitness instructor Supervision: individual Setting: gym
Outcomes	Maximum excursion of LOS (forward, backward, right, left)
Notes	

Risk of bias

Item	Authors' judgement	Description
Allocation concealment?	Unclear	B - Unclear

Jessup 2003

Methods	RCT. Method of randomisation - parallel design, random number table designed by Burns and Grove. Assessors blinded to randomisation but aware of which group participants were allocated to. Losses: 2 of 18.
Participants	N = 18 Age: mean (SD) 69.2 (3.5). Sex: female. Setting: USA Inclusion: healthy women not taking hormone or osteoporosis medication, or done so in the last 12 months, no regular exercise in the last 12 months. Exclusion: medical history or physical examination revealing cardiac or pulmonary, endocrine, neuromuscular or orthopaedic conditions or dextra results indicating contra indication, visual acuity test less than 20/50, mini mental test less than 20, inability to retain Romberg stance for 20 seconds without losing balance, alcohol or drug abuse, smokers, psychiatric conditions.
Interventions	Exercise group (MULTIPLE): Strength exercises began with 8 to 10 repetitions at 50% of pretest 1RM score on progressed to 75%. Load-bearing walking, stair-climbing and balance -training exercises, wearing weighted vests after 2 weeks. Balance-training exercises, in walking. Control group: usual activities of daily living. Duration and intensity: 3 sessions (60 - 90 mins) per week for 32 weeks Supervisor: research assistant and co investigator Supervision: group Setting: gym
Outcomes	Body sway (cm)
Notes	

Risk of bias

Jessup 2003 (*Continued*)

Item	Authors' judgement	Description
Allocation concealment?	Yes	A - Adequate

Johansson 1991

Methods	RCT. Method of randomisation not known. Assessors blinded to experimental design and pre test scores. Losses: 1 of 34.
Participants	N = 34 Age: 70 years old Sex: female Setting: Sweden Inclusion: healthy volunteers aged 70 years. Exclusion: neurological disease, amputation, severe pain in legs.
Interventions	Exercise group (MULTIPLE): walking different directions at different speeds, combined with movement of the arms, neck and trunk. Exercise to music including weight transfer exercises while sitting and standing and rising from and sitting down in a chair, were performed. Control group: usual activity Duration and intensity: exercise group - 1 hour, twice a week, for 5 weeks. Supervisor: physiotherapist Supervision: group Setting: gym
Outcomes	Single legged stance - eyes open, eyes closed (s) Walking along a beam (m) Walking for 30 metres (s)
Notes	

Risk of bias

Item	Authors' judgement	Description
Allocation concealment?	Unclear	B - Unclear

Krebs 1998

Methods	RCT. Method of randomisation: not known. Assessors blinded. Losses: 12 of 132

Krebs 1998 (*Continued*)

Participants	N = 132 Age: mean 74.3 years Sex: 31 male, 89 female. Setting: USA Inclusion: Community dwelling, 60 years plus, reported one or more functional limitations on SF36 physical function scale, no medical history contraindicating exercise, no current rehab. Exclusion:
Interventions	Exercise group (STRENGTH): strong for life programme, 35 minute video of 11 exercises, resistance elastic bands, functional movement patterns simulate to PNF, arms and legs, therapists supervised 2 home visits then telephone contact. Control group: usual activity Duration and intensity: 6 months Supervisor: therapist Supervision: self and therapist (therapists supervised 2 home visits then telephone contact). Setting: home
Outcomes	Gait velocity (cm/s).
Notes	Compliance 78%

Risk of bias

Item	Authors' judgement	Description
Allocation concealment?	Unclear	B - Unclear

Lichtenstein 1989

Methods	Quasi RCT. Method of randomisation: Random Number table to recruit participants from sample then group randomised by apartment building n = 2 by coin toss. Assessors blinded. Losses: 7 of 50
Participants	N = 50 Age: mean 76.7 Sex: Female Setting: USA Inclusion: Women, 65 years or older, single (never married, divorced, separated, widowed) and living alone Exclusion: History of Parkinson or Stroke, had any loss of limb, were unable to walk independently or with use of cane
Interventions	Exercise group (GBFT): stretching, "static balance" (e.g. standing on one leg), "active balance" (e.g. using tandem heel/toe gait, walking along a line), "response exercises" (e.g. performing maneuvers in response to changing colour signals), walking and cool-down and relaxation. Control group: usual activity

Lichtenstein 1989 (*Continued*)

	Duration and intensity: sessions were 1 hr, 3 x week for 16 weeks. Supervisor: investigator Supervision: group Setting: community	
Outcomes	Single legged stance - eyes open, eyes closed on force platform Average XY area per second (square inches/s Average radial area per second (square inches/s) Average velocity (inches/s)	
Notes	Compliance median 85% range 0-142%	
Risk of bias		
Item	**Authors' judgement**	**Description**
Allocation concealment?	Yes	A - Adequate

Lord 1995

Methods	RCT. Method of randomisation. Participants were drawn from a health insurance membership database in Northern Sydney. They were randomised in matched blocks n = 20. Assessors blinded. Losses: 46 of 197.
Participants	N = 197. Age: 60 - 85 years mean (SD) 71.6 (5.4) Sex: females Setting: Australia Inclusion: 60 years plus in community dwelling. Exclusion: not living at dwelling of time of study, little English.
Interventions	Exercise group (MULTIPLE): improving strength, flexibility, co-ordination, and balance, the individualised exercise regimes were based on participant's falls risk profile. Control group: no information assumed usual activity Duration and intensity: sessions 1 hr 2 x week for 12 months Supervisor: accredited fitness instructor Supervision: group Setting: community
Outcomes	Postural sway eyes open and eyes closed on floor and foam (cm) (Lord sway meter) Maximal balance range (cm) Co-ordinated stability test (errors)
Notes	Compliance: mean 73.2% across the groups
Risk of bias	

Lord 1995 (*Continued*)

Item	Authors' judgement	Description
Allocation concealment?	Unclear	B - Unclear

Lord 2003

Methods	Cluster RCT. Randomisation was stratified by accommodation status (self care of intermediate care) and cluster size. There were 20 clusters 7 self care and 3 intermediate care exercise clusters 20 clusters 7 self care and 3 intermediate care control clusters. Blinded person organising randomisation not involved in rest of trial Losses: 43 out of 551
Participants	N = 551, factorial design 280 allocated to relevant arms Age: range 62-95 mean (sd) 79.5 (6.4) years Sex: 77 male, 474 female Setting: Australia Inclusion: living in retirement village, Exclusion: mini mental score <20, mental condition involving neuromuscular, skeletal, or cardiovascular system, in hospital or not present at the time of recruitment, already attending exercise class of equivalent intensity
Interventions	Exercise group (MULTIPLE): warm-up period, conditioning period including aerobic exercises, specific strengthening exercises, and activities for balance, hand-eye and foot-eye coordination, and flexibility. Control group 1: Took part in a flexibility and relaxation program. Control group 2: No input assumed usual activity Duration and intensity: exercise group and control group 1: sessions 1 hour twice a week for 12 months. Supervisor: exercise group: trained instructor, control group 1 - yoga instructor. Supervision: group Setting: community
Outcomes	Postural sway on floor and foam eyes open and eyes closed (mm) (Lord sway meter) Co-ordinated stability test (errors). Maximum balance range (cm)
Notes	

Risk of bias

Item	Authors' judgement	Description
Allocation concealment?	Yes	A - Adequate

Lord 2005

Methods	RCT. Randomised in matched blocks using concealed allocation, drawing lots. Assessors blinded. Losses: 144 of 620 Intention to treat analysis.
Participants	N = 620 Age: 75 - 98, mean (SD) 80.4 (4.5). Sex: females 409, males 211. Setting: Australia Inclusion: 75 years plus, community living Exclusion: minimal English language skills, blind, Parkinson, short portable mini mental test less than 7, and not considered risk of falling.
Interventions	Exercise group (MULTIPLE): based on falls risk profile, individualised exercises aimed at improving strength, and balance and or vision if a problem, peripheral warm up, conditioning, strength, flexibility, coordination and balance. Minimal intervention group: instruction sheets for home exercise. Control group: usual activity Duration and intensity: sessions 1hr x 2 week for 12 months (only data for initial 6 months reported) Supervisor: trained supervisor Supervision: group Setting: community
Outcomes	Postural sway on floor and foam eyes open and eyes closed (mm) (Lord sway meter) Co-ordinated stability test (errors)
Notes	Three arms to this study: we have reported the enhanced intervention group only data on balance outcomes for initial 6 months reported. Compliance with exercise: median 21 of 78.

Risk of bias

Item	Authors' judgement	Description
Allocation concealment?	Yes	A - Adequate

MacRae 1994

Methods	RCT. Quasi-randomised by senior centre. Assessors blinded. Losses: 21 of 80.
Participants	N = 80 Age: exercise group - mean 72.4, control group - mean 70. Sex: females Setting: USA

MacRae 1994 (*Continued*)

	Inclusion: medical clearance, 60 years plus attending a senior centre. Exclusion: physicians advice.
Interventions	Exercise group (GBFT): stand up/step up routine designed to improve strength and balance with warm up and cool down. Control group: attention control group Duration and intensity: exercise group - 1 hour sessions 3 days a week for 12 months, control group - one hour weekly for 12 months. Supervisor: exercise instructor Supervision: group Setting: gym
Outcomes	One legged stance (s) Self paced gait velocity (m/s)
Notes	

Risk of bias

Item	Authors' judgement	Description
Allocation concealment?	Yes	A - Adequate

McGarry 2001

Methods	RCT Method of randomisation not known. Blinding not known. Loss: not stated
Participants	N=22 Age: mean 74.77 (range 60-87) years Sex: 16 female, 6 males Setting: USA Inclusion: not stated Exclusion: not stated
Interventions	Exercise group (GBFT): "Get off your Rocker" balance class, including single leg stance, Swiss ball, tandem walking. Control group: usual activity. Duration and intensity: 3 sessions per week for 6 weeks. Supervisor: physical therapist Supervision: group Setting: ?gym
Outcomes	BBS (score) FRT (cm) TUG (s)

McGarry 2001 (*Continued*)

Notes	Abstract only	
Risk of bias		
Item	**Authors' judgement**	**Description**
Allocation concealment?	Unclear	D - Not used

McMurdo 1993

Methods	RCT Randomised homes by sealed envelopes based on computer generated numbers, participants allocated in blocks of 4 by gender and age (70-79 and 80+) Assessors blinded. Losses: 8 of 49.
Participants	N = 49 Age: mean 81 (range 64 - 91) years. Sex: 33 females, 8 males. Setting: UK Inclusion: in residential care Exclusion: residents with severe communication difficulties.
Interventions	Exercise group (GEN ACTIVITY): All exercises were performed seated. Warm-up, exercises designed to put joints in upper and lower limbs through their full range of movements. As the study progressed participants were encouraged to sustain muscle contractions for longer and increase number of repetitions. Control group: attended reminiscence sessions Duration and intensity: exercise group - 45 minutes twice weekly for six months, control group - for 45 mins twice weekly for 6 months. Supervisor: not stated. Supervision: group Setting: residential home
Outcomes	Postural sway - eyes open and eyes closed.
Notes	Compliance mean 91% exercise sessions
Risk of bias	

Item	**Authors' judgement**	**Description**
Allocation concealment?	Unclear	B - Unclear

Nelson 2004

Methods	RCT. Stratified block randomisation by gender and age (70 - 79, 80 plus) Assessors blinded. Losses: 4 of 72.
Participants	N = 72 Age: over 70 years Sex: 27 female Setting: USA Inclusion: > 70 exercising no more than 1 day/week community dwelling must have 2 functional limitations and score 10 or less on EPESE. Exclusion: Unstable cardiovascular disease, psychiatric disorders, neurological or muscular diseases, terminal illness, cognitive impairment.
Interventions	Exercise group (MULTIPLE): balance and strength using free weights working at 7/8 on a 10 point Borg Scale, tandem walks, running etc, plus 120 minutes physical activity per week . Control group: attention via nutritional education booklet. Duration and intensity: exercise programme - 3 times a week for 6 months plus 120 minutes physical activity per week. Supervisor: exercise physiologist Supervision: exercise group - individual self paced, 6 home visits in the 1st month and then monthly, attention control - 2 home visits in 1st month and then monthly. Setting: home.
Outcomes	Tandem walk (over 20 feet) (s). One legged stance (max 30 s). Maximum gait speed (over 2 m).
Notes	Compliance mean 82%. Adverse events 1 fell in exercise group and 1 food poisoning in control group.

Risk of bias

Item	Authors' judgement	Description
Allocation concealment?	Unclear	B - Unclear

Okumiya 1996

Methods	RCT. Method of randomisation not known. Assessors blinded. Losses: 6 of 42
Participants	N = 42 Age: 75 - 87 years, mean 79 Sex: 18 males, 24 females. Setting: Japan. Inclusion: 75 years and over.

Okumiya 1996 (*Continued*)

	Exclusion: evidence of coronary artery disease or severe obstructive airways.
Interventions	Exercise group (GEN ACTIVITY): warm up, light aerobic exercise, exercises aimed at improving neuro-motor co-ordination, and muscle-strengthening exercises, cool down. Control group: usual activity. Duration and intensity: exercise group - 60 minute session twice a week for 24 weeks. Supervisor: one physical educator, one medical doctor, and 5 nurses. Supervision: group Setting: community
Outcomes	TUG (s) Functional Reach Test (cm)
Notes	Compliance mean 86% (59-100%)

Risk of bias

Item	Authors' judgement	Description
Allocation concealment?	Unclear	B - Unclear

Paillard 2004

Methods	RCT. Method of randomisation not known. Blinded not known. Losses: not stated.
Participants	N = 21 Age: 63 - 72 years Sex: males Setting: France Inclusion: active in physical exercise 3 hours per week, good condition for their age. Exclusion: medical contra indications.
Interventions	Exercise group (WALKING): individual walking programme determined by lactate levels during VO2 max test Control group: usual activities Duration and intensity: 45 - 60 minutes x 5 times a week x 12 weeks. Supervisor: not stated. Supervision: self. Setting: home.
Outcomes	Force platform - dynamic test, lateral and AP.
Notes	

Risk of bias

Paillard 2004 (*Continued*)

Item	Authors' judgement	Description
Allocation concealment?	Unclear	B - Unclear

Ramsbottom 2004

Methods	RCT. Randomised by random number tables. Assessors not blinded. Losses: 8 of 22. Intention to treat analysis.
Participants	N = 22 Age: over 70 years. Sex: 7 males, 15 females. Setting: UK. Inclusion: Normal, sedentary over 70 years, community dwelling. Exclusion: risk of taking PRE, physically active.
Interventions	Exercise group (MULTIPLE): free weights to strengthen and develop power in shoulder, hip adductors/abductors/flexors/extensors, knee flexor/extensors, increasing in repetitions, functional mobility, stretching and balance exercises. Control group: usual activities. Duration and intensity: 2 x a week for 24 weeks. Supervisor: keep fit association registered teacher. Supervision: group. Setting: community.
Outcomes	Postural sway on BPM TUG (s) FRT (cm)
Notes	Adherence - mean (SD) 43 (3) classes (max 48)

Risk of bias

Item	Authors' judgement	Description
Allocation concealment?	Yes	A - Adequate

Reinsch 1992

Methods	RCT. Randomised by senior centre (n = 16). Blinding not known. Losses: 46 of 230. Intention to treat analysis.
Participants	N = 230. Age: 60 years plus. Sex: 185 female, 45 male. Setting: USA. Inclusion: 60 years and over, attending senior centres (n = 16). Exclusion: none reported.
Interventions	Exercise group (GBFT): stand up and step ups functional exercises. Control group: discussion. Duration and intensity: both groups 1 hour, 3 times per week for 12 months. Supervisor: college students. Supervision: group Setting: community in senior centres.
Outcomes	Single legged stance (s).
Notes	Trial had 4 arms: others included CBT only, exercise plus CBT.

Risk of bias

Item	**Authors' judgement**	**Description**
Allocation concealment?	Unclear	B - Unclear

Rooks 1997a

Methods	RCT. Randomised by unbalanced 3 group block randomisation (due to expected higher attrition rate in control group every 13th volunteer was allocated to control group). Blinded not known. Losses: 38 of 131. Intention to treat analysis.
Participants	N = 131. Age: 65 - 95 years. Sex: % female = 59 resistance group, 52 walking group, 82 control group. Setting: USA Inclusion: 65 years plus, climb a flight of stairs, participate in regular activities outside home a minimum 2 x week, transport to community centre. Exclusion: use of medication comprising safety or ability to complete study, uncontrolled or unstable chronic conditions.

Rooks 1997a (*Continued*)

Interventions	Resistance training group (STRENGTH): stair climbing with resistance, seated knee extension, standing, standing knee extension. Walking group (WALKING): walking own pace on level ground. Control group: on a waiting list for exercise programme. Duration and intensity: resistance training group and walking group - 1 hour, 3 times per week for 10 months. Supervisor: research assistant. Supervision: group (5-6). Setting: community.
Outcomes	Tandem stance (s). Single legged stance - eyes open and eyes closed (s). Timed forward tandem walk (10 feet).
Notes	% Compliance resistance training group - 85 (47 - 100), walking group - 82 (29 - 97)

Risk of bias

Item	Authors' judgement	Description
Allocation concealment?	Unclear	B - Unclear

Rubenstein 2000

Methods	RCT. Randomly generated sequence of cards in sealed envelopes. Assessors blinded. Losses: 4 - 7 of 59.
Participants	N = 59. Age: mean (SD) 74.4 (43.4) - control group, 76.4 (4.9) - exercise group. Sex: male. Setting: USA. Inclusion: 70 years plus, lower extremity weakness, impaired gait, impaired balance, one fall in previous 6 months. Exclusion: regular exercises, severe cardiac or pulmonary disease, terminal illness, severe joint pain, dementia, medical unresponsive depression, progressive neurological disease.
Interventions	Exercise group (MULTIPLE): PRE, hip, knee and ankle, endurance training bike, treadmill, indoor walking and balance training. Control group: usual activities. Duration and intensity: exercise group - 90 minutes, 3 times per week x 12 weeks. Supervisor: exercise physiology students. Supervision: group. Setting: clinic.
Outcomes	Single legged stance (s) (for max 15 s)

Rubenstein 2000 (*Continued*)

Notes	SD 43.4 years for control group age, might be a typo in original paper	
Risk of bias		
Item	**Authors' judgement**	**Description**
Allocation concealment?	Yes	A - Adequate

Sauvage 1992

Methods	RCT. Method of randomisation not known. Assessors blinded. Losses: 2 of 14.
Participants	N = 14 Age: mean (SD) exercise group - 73.38 (4.04), control group - 73.83 (4.74). Sex: male. Setting: USA. Inclusion: Recruited from Veterans Nursing Home. Aged over 60 years, independently mobile, gait and balance difficulties (Tinetti score greater than 30), lower extremity weakness. Exclusion: moderate to severe dementia, asymmetrical focal neurolic deficits, lower extremity amputation, leg length discrepancies, significant systemic disease.
Interventions	Exercise group (MULTIPLE): PRE and aerobic conditioning (>70% exercise stress tested maximal HR) using gym equipment and ergometers. Control group: usual activity. Duration and intensity: 45 - 75 minutes, 3 times per week x 12 weeks. Supervisor: not stated Supervision: group (3 -4). Setting: Institutional.
Outcomes	Average gait velocity (cm/s) over 20 feet. (right and left). COP movement during quiet stance - eyes open, eyes closed (mm).
Notes	Compliance 95% for exercise group

Risk of bias		
Item	**Authors' judgement**	**Description**
Allocation concealment?	Unclear	B - Unclear

Schoenfelder 2004

Methods	RCT. Method of randomisation not known (matched pairs by risk assessment for falls). Assessors blinded. Losses: 37 of 81.
Participants	N = 81 Age: 64 - 100 years, mean 84.1. Sex: 62 female, 19 male. Setting: USA. Inclusion: Recruited from nursing homes, 65 years and over, independent ambulators, English speakers, scored 20 plus on MMSE. Exclusion: unstable physical conditions.
Interventions	Exercise group (MULTIPLE): strength and endurance training plus 10 minutes walking. Control group: attention placebo. Duration and intensity: exercise group - 15 -20 minutes, 3 times per week x 3 months. Control group - 30 minutes weekly x 3 months. Supervisor: student nurses. Supervision: individual. Setting: institutional.
Outcomes	Parallel stance (max 10s) (s). Semi tandem stance (max 10s) (s). Tandem stance (max 10s) (s). Walking speed over 6 metres (m/s).
Notes	

Risk of bias

Item	Authors' judgement	Description
Allocation concealment?	Unclear	B - Unclear

Shigematsu 2002

Methods	RCT. Randomised by centre. Blinding not known. Losses: none reported.
Participants	N = 38 Age: 72 - 87 years (mean 78.6 exercise group, 79.8 control group) Sex: female Setting: Japan. Inclusion: over 70 years, living independently, no cardiovascular problems, not exercising regularly, must be attending silver club. Exclusion:

Shigematsu 2002 (*Continued*)

Interventions	Exercise group (3D): aerobic dance to music Control group - not stated (assumed usual activity). Duration and intensity: 1 hour 3 times per week x 3 months. Supervisor: exercise specialist. Supervision: group. Setting: community.
Outcomes	Single legged stance - eyes open, eyes closed (s). Functional reach test (cm).
Notes	Compliance with exercise 78.8% Measures reported in Shigematsu 2000 - Age scale for assessing functional fitness in older Japanese ambulatory women. Ageing Clin Ex Res 12, 256-263.

Risk of bias

Item	Authors' judgement	Description
Allocation concealment?	Yes	A - Adequate

Shimada 2004

Methods	RCT. Randomised by random number tables. Assessors not blind. Losses: 6 of 32
Participants	N = 32 Age: 66 -98 years Sex: 25 female, 7 male. Setting: Japan. Inclusion: ambulatory residents or attending a geriatric health facility, high risk for falls, decreased balance, gait and muscle strength Exclusion: unable to walk for 3 mins at 0.5 km/hr, health problems or dementia
Interventions	Exercise group (WALKING):- gait training on a bilateral separated treadmill Control group: usual care Duration and intensity: 1-3 times per week for 6 months Supervisor: physiotherapist. Supervision: individual. Setting: institutional.
Outcomes	Single legged stance (s). FRT (cm). Walking speed over 10 m (m/s)
Notes	Data not reported appropriately for walking speed.

Shimada 2004 (*Continued*)

Risk of bias		
Item	**Authors' judgement**	**Description**
Allocation concealment?	Unclear	D - Not used

Sihvonen 2004

Methods	RCT. Randomised in blocks by drawing lots. Blinding not known. Losses:1 of 28.
Participants	N = 28 Age: mean (SD) 80.7 (6.1) - exercise group, 82.9 (4.2) control group. Sex: female. Setting: Finland. Inclusion: resident at two care homes, 70 years and over, able to stand and walk without walking aid. Exclusion: health problems.
Interventions	Exercise group (GBFT): dynamic exercise on force platform and training device with visual feedback on movement on COP. Control group - usual activity. Duration and intensity: 20 - 30 minutes session, 3 times per week for 4 weeks. Supervisor: not stated. Supervision: individual. Setting: institutional.
Outcomes	AP and ML velocities of sway and velocity moment in 6 standing balance tests. Performance time and distance in 3 dynamic balance tests. BBS (points).
Notes	

Risk of bias		
Item	**Authors' judgement**	**Description**
Allocation concealment?	Unclear	B - Unclear

Suzuki 2004

Methods	RCT Randomisation by random number tables Assessors blinded. Losses: 8 of 52 Intention to treat analysis
Participants	N=52 Sex: female Age: mean (SD) 77.31 (3.4) exercise, 78.64 (4.39) control Setting: Japan Inclusion: 73-90 years, participants in longitudinal study on aging. Exclusion: marked decline in ADL, hemiplegia, missing baseline data.
Interventions	Exercise group (MULTIPLE): exercise centred falls prevention programme with home based exercise aimed at enhancing muscle strength, balance and gait. Included resistance exercise and Tai Chi. Control group: usual activity and a pamphlet and advice on falls prevention. Duration and intensity: 1 exercise session every 2 weeks for 6 months (10 hours). Supervisor: not stated. Supervision: group and self. Setting: community
Outcomes	Single legged stance (s), eyes open (max 1 min), eyes closed (max 30 sec) (s) Walking speed (over 11 m) (m/s). Tandem walk (over 2.5m) (steps)
Notes	

Risk of bias

Item	Authors' judgement	Description
Allocation concealment?	Unclear	B - Unclear

Wolf 1997

Methods	RCT. Method of randomisation not known. Blinding not known. Losses not stated.
Participants	N = 72. Age: mean (SD) 77.7 (6.5) balance group, 75.2 (4.9) education group, 77.7 (5.2) Tai Chi group. Sex: 60 females, 12 males. Setting: USA. Inclusion: over 70 years, free from progressive debilitating processes, able to walk across a room independently, residing in independent living centre. Exclusion:

Wolf 1997 (*Continued*)

Interventions	Balance group (GBFT): force platform standing moving target via cursor excursions eyes open and closed. Control group - discussion of topics and socialisation. Tai Chi group (3D): Tai Chi quan - 10 forms. Duration and intensity: 1 hour every week x 15 weeks. Supervisor: instructor. Supervision: group. Setting: gym.	
Outcomes	Chattex balance system to measure: quiet standing eyes open, eyes closed	
Notes	Part of Atlanta FICSIT site study.	
Risk of bias		
Item	**Authors' judgement**	**Description**
Allocation concealment?	Unclear	B - Unclear

Wolf 2001

Methods	RCT. Randomised by sealed envelopes post stratification, selected by blind folded person. Assessors blinded. Losses: 45 of 94. Intention to treat analysis.
Participants	N = 94. Age: mean (SD) exercise group - 84.5 (6.1), control group - 83.6(5.1). Sex: 56 female, 21 male. Setting: Netherlands. Inclusion: 75 years and over, minimal loss of visual acuity, no acute illness, no physical therapy in previous month, minimum of 17 on MMSE, BBS < 52, impaired balance during function. Exclusion:
Interventions	Exercise group (GBFT): exercise in sitting, standing and walking, in a variety of situations to test balance. Control group - reading and board games. Duration and intensity: 30 minutes 2-3 times per week x 4-6 weeks (10 sessions). Supervisor: therapist and trainers. Supervision: individual. Setting: gym or home.
Outcomes	BBS (points) out of 56.
Notes	
Risk of bias	

Wolf 2001 (*Continued*)

Item	Authors' judgement	Description
Allocation concealment?	Yes	A - Adequate

Wolfson 1996

Methods	RCT. Randomised by blocked allocation schedule stratified by gender using the Moses - Oakford algorithm. Assessors blinded. Losses: unclear.
Participants	N = 110. Age: mean (SD) 79 (5). Sex: 58% male. Setting: USA. Inclusion: 75 years and over, community dwelling, free of clinically detectable disease affecting balance. Exclusion: inability to walk 8 metres without assistance, other diseased affecting mobility, dementia.
Interventions	Balance group (GBFT): PRObalancemaster with COP feedback, standing and sitting including gym ball eyes open and eyes closed with and without perturbations and gait on foam and narrow beams. Strength group (STRENGTH): stretching and PRE with sand bags for hip and knee. Balance and strength group (MULTIPLE): PRObalancemaster with COP feedback, standing and sitting including gym ball eyes open and eyes closed with and without perturbations and gait on foam and narrow beams and stretching and PRE with sand bags for hip and knee. Educational control group: usual activities, sessions on fall prevention and stress management. Duration and intensity: balance only and strength only groups 45 mins x 3 times per week x 3 months. Balance and strength group - 45 mins (strength) plus 45 mins (balance) x 3 times per week x 3 months. Educational control group - 5 x 90 minute education sessions. All groups - 6 months Tai Chi maintenance. Supervisor: not stated. Supervision: balance training - individual, strength training - group. Setting: gym.
Outcomes	Loss of Balance during sensory organisation test. Functional base of support. Single legged stance time (s). Usual gait velocity (m/s).
Notes	Part of FICSIT trials. Compliance - mean (SD) balance 74 % (26), strength 82 % (21), balance and strength 82 % (16), control near perfect. All subjects including those in control group participated in 6 month Tai Chi following the 3 month intervention phase.

Risk of bias

Item	Authors' judgement	Description

Wolfson 1996 (*Continued*)

Allocation concealment?	Yes	A - Adequate

Zhang 2006

Methods	RCT. Randomised by tossing a coin after pairing by sex, falls and exercise habits. Blinding not known. Losses: 2 of 49.
Participants	N = 49. Age: mean (SD) 70.2 (3.6) Tai Chi, 70.6 (4.9) control. Sex: 25 male, 24 female. Setting: Japan. Inclusion: Community dwelling, scoring 20 -25 seconds on one legged stance time. Exclusion:
Interventions	Exercise group (3D): Tai Chi simplified form of 24 forms plus 11 easy forms at home. Control group - usual activities. Duration and intensity: 1 hour, 7 times per week for 8 weeks. Supervisor: Tai Chi instructor. Supervision: group and self. Setting: community in park and home.
Outcomes	One legged stance eyes open (max 60 s). Walking speed (10 metres).
Notes	Subjects from earlier study by Zhang et al 2003 Compliance - 91.7% practiced 4 plus hours per week.

Risk of bias

Item	**Authors' judgement**	**Description**
Allocation concealment?	Unclear	B - Unclear

ABBREVIATIONS AND ACRONYMS:
1RM - One repetition maximum score
3D - 3D exercise including tai chi, qi gong, dance, yoga
ADL - Activities of Daily Living.
AP - Anterior - Posterior
BBS - Berg Balance Scale
BPM - Balance Performance Monitor
cm - centimetres
CoM: Body's centre of mass
COP - Centre of Pressure.
COPD - Chronic Obstructive Pulmonary Disease
EPESE - Established Populations for the Epidemiologic Studies of the Elderly short physical performance battery

Ex - Exercise
FRT - Function Reach Test
GBFT - Gait, balance, functional tasks
GEN ACTIVITY - general physical activity
HR - Heart Rate
Hr - hour
Km- kilometres
LOS - Locus Of Support
min - minute
ML - medio-lateral
mm - millimetres
MMSE - Mini Mental Status Examination.
m/s - metres per second
NSD - no significant difference
PNF - proprioceptive neuromuscular facilitation
PRE - Progressive Resistance Exercise.
RCT - Randomised Controlled Trial
RMS - root mean squared
s - seconds
SD - Standard Deviation
SLS - Single Legged Stance
SMD - standardised mean difference
STRENGTH - strength training including resistance or power training
TUG - Timed up and go test
WMD - weighted mean difference

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

Alexander 2001a	RCT but no specific balance outcomes
Alexander 2001b	RCT no suitable outcome measures
Allen 1999	Description of study no data reported
Anonymous 2002	Summary of Day 2002
Au-Yeung 2002	Control group received some exercise
Ballard 2004	Control group received some exercise
Barnett 2003	Control group had home exercise
Barrett 2002	Control group received some exercise
Bean 2004	Comparison of different exercise types , no control group
Binder 2002	Control group had home exercise
Bonnefoy 2003	Trial of energy supplements all participants received supplement or placebo

(*Continued*)

Brown 2000	Control group received some exercise
Bruyere 2005	Intervention not exercise
Buchner 1993	Description of methodology no data
Campbell 1999	No suitable balance outcome measures
Cornillon 2002	Not appropriate outcome measures
Day 2002	No control group
De Vreede 2004	Comparison of exercise types, no control group
Devereux 2005	osteoporotic participants
DeVito 2003	No measures
Dyer 2004	Multifactorial falls programme
Earles 2001	No control group
Fiatarone 1993	FICSIT study multi-nutrient supplementation no data presented
Gill 2002	No specific balance outcome measures
Gras 2004	No control group
Greendale 2000	Comparison of weighted vests
Hauer 2003	61% of participants had hip fracture or lower extremity fracture
Helbostad 2004a	No specific balance outcome measures
Helbostad 2004b	No control group
Hinman 2002	No control group
Hornbrook 1993	Description of study
Hu 1994	No exercise intervention
Jones 1992	No appropriate outcome measures of balance
Judge 1993a	Control group received flexibility training
Judge 1993b	No specific balance outcome measures

(*Continued*)

Judge 1994	No specific balance outcome measures
King 2002	Control group had home exercise
Kovacs 2004	No specific balance outcome measures
Kutner 1997	No specific balance outcome measures
LaStayo 2003	Participants had received cardiopulmonary rehabilitation for prior medical conditions.
Latham 2001	Control group had PT
Lazowski 1999	Control group had exercise
Li 2002	No specific balance outcome measures
Li 2005a	Intervention under investigation cobblestone mat
Li 2005b	Control group had stretching
Lindemann 2004	Control group had exercise programme
Liu-Ambrose 2004	all participants had low bone mass
Marigold 2005	Participants were chronic stroke patients
McMurdo 1994	No measures
McMurdo 2000	Primary outcome falls no primary outcome measure for balance
Means 1996	No specific balance outcome measures
Means 2005	No specific balance outcome measures
Messier 2000	Participants had osteoarthritis
Morgan 2004	No measures
Mulrow 1994	No measures
Nitz 2004	Control group had exercise
Ourania 2003	Not randomised
Paillard 2005	Investigating effects of electrical stimulation
Prasansuk 2004	Participants had balance disorders

(*Continued*)

Ramsey 2003	Participants were visually impaired
Robbins 2001	Commentary on Robertson 2001
Rooks 1997b	No control group
Ryushi 2000	Age range from 41 years to 53 years.
Shaughnessy 1998	Commentary on Campbell 1997
Shimada 2003	Control groups received exercise
Signorile 2002	No specific balance outcome measures
Simmons 1996	Water versus land based exercise
Simons 2006	No appropriate outcome measures of balance
Skelton 1999	Description of FAME programme no data reported
Sohng 2003	Control group had video programme
Steadman 2003	Control group had PT
Steinberg 2000	No specific balance outcome measures
Szturm 1994	Participants with chronic peripheral vestibular disfunction
Timonen 2002	Control group had home exercise
Tinetti 1994	No specific balance outcome measures
Udani 1998	Commentary on Wolf 1996
Verfaillie 1997	No control group
Williams 2002	Control group had exercise
Wolf 1996	No specific balance outcome measures
Wolf 2003	No specific balance outcome measures
Yates 2001	Multifactorial intervention

DATA AND ANALYSES

Comparison 1. Gait, balance, co-ordination, functional tasks exercise versus control

Outcome or subgroup title	No. of studies	No. of participants	Statistical method	Effect size
1 AP stability during stance (quiet and dynamic) eyes open: lower values indicate better balance ability	3		Std. Mean Difference (IV, Random, 95% CI)	Subtotals only
1.1 Immediately post intervention	3	116	Std. Mean Difference (IV, Random, 95% CI)	-0.71 [-1.33, -0.09]
1.2 Follow-up @ 6 weeks post intervention	1	30	Std. Mean Difference (IV, Random, 95% CI)	-0.63 [-1.37, 0.10]
1.3 Follow-up @ 4 months post intervention	1	35	Std. Mean Difference (IV, Random, 95% CI)	-0.96 [-1.67, -0.26]
2 Mediolateral stability during stance (quiet and dynamic) eyes open: lower values indicate better balance	3		Std. Mean Difference (IV, Random, 95% CI)	Subtotals only
2.1 Immediately post intervention	3	116	Std. Mean Difference (IV, Random, 95% CI)	-0.39 [-0.98, 0.20]
2.2 Follow-up @ 6 weeks post intervention	1	30	Std. Mean Difference (IV, Random, 95% CI)	-0.68 [-1.42, 0.06]
2.3 Follow-up @ 4 months post intervention	1	35	Std. Mean Difference (IV, Random, 95% CI)	1.09 [0.37, 1.81]
3 AP stability during quiet stance eyes closed: lower values indicate better balance ability	2		Std. Mean Difference (IV, Fixed, 95% CI)	Subtotals only
3.1 Immediately post intervention	2	82	Std. Mean Difference (IV, Fixed, 95% CI)	-0.32 [-0.77, 0.12]
3.2 Follow up @ 4months post intervention	1	35	Std. Mean Difference (IV, Fixed, 95% CI)	-0.13 [-0.79, 0.54]
4 Mediolateral stability during quiet stance eyes closed: lower values indicate better balance ability	2		Std. Mean Difference (IV, Fixed, 95% CI)	Subtotals only
4.1 Immediately post intervention	2	82	Std. Mean Difference (IV, Fixed, 95% CI)	-0.17 [-0.60, 0.27]
4.2 Follow up @ 4 months post intervention	1	35	Std. Mean Difference (IV, Fixed, 95% CI)	-0.15 [-0.82, 0.51]
5 Functional base of support during dynamic test (distance): higher values indicate greater balance ability	1		Mean Difference (IV, Fixed, 95% CI)	Subtotals only
5.1 Immediately post intervention	1	35	Mean Difference (IV, Fixed, 95% CI)	0.12 [0.05, 0.19]

5.2 Follow-up @ 6 months post intervention	1	33	Mean Difference (IV, Fixed, 95% CI)	0.08 [0.01, 0.15]
6 Loss of balance during sensory organisation test (errors): less errors indicate better balance ability	1		Mean Difference (IV, Fixed, 95% CI)	Subtotals only
6.1 Immediately post intervention	1	53	Mean Difference (IV, Fixed, 95% CI)	-1.1 [-2.24, 0.04]
6.2 Follow-up @ 6 months post intervention	1	47	Mean Difference (IV, Fixed, 95% CI)	-1.1 [-2.16, -0.04]
7 Maxium excursion of limits of stability (LOS) test: higher values indicate better balance ability	1		Mean Difference (IV, Fixed, 95% CI)	Subtotals only
7.1 Forward	1	29	Mean Difference (IV, Fixed, 95% CI)	20.10 [8.66, 31.54]
7.2 Backward	1	29	Mean Difference (IV, Fixed, 95% CI)	8.90 [-1.77, 19.57]
7.3 Right	1	29	Mean Difference (IV, Fixed, 95% CI)	19.0 [9.02, 28.98]
7.4 Left	1	29	Mean Difference (IV, Fixed, 95% CI)	12.80 [4.10, 21.50]
8 Single leg stance eyes open (force platform measures): lower values indicate better balance ability	1		Mean Difference (IV, Fixed, 95% CI)	Subtotals only
8.1 Average XY area per second (square inches per second)	1	42	Mean Difference (IV, Fixed, 95% CI)	0.02 [-0.57, 0.61]
8.2 Average radial area per second (square inches per second)	1	42	Mean Difference (IV, Fixed, 95% CI)	-0.05 [-0.26, 0.16]
8.3 Average velocity (inches per second)	1	42	Mean Difference (IV, Fixed, 95% CI)	0.12 [-0.62, 0.86]
9 Single leg stance eyes closed (force platform measures): lower values indicate better balance ability	1		Mean Difference (IV, Fixed, 95% CI)	Subtotals only
9.1 Average XY area per second (square inches per second)	1	39	Mean Difference (IV, Fixed, 95% CI)	-0.41 [-1.85, 1.03]
9.2 Average radial area per second (square inches per second)	1	39	Mean Difference (IV, Fixed, 95% CI)	-0.93 [-2.05, 0.19]
9.3 Average velocity (inches per second)	1	39	Mean Difference (IV, Fixed, 95% CI)	-0.55 [-2.04, 0.94]
10 Single leg stance time eyes open (s): higher values indicate better balance ability	4		Std. Mean Difference (IV, Fixed, 95% CI)	Subtotals only
10.1 Immediately post intervention	4	164	Std. Mean Difference (IV, Fixed, 95% CI)	0.33 [0.02, 0.64]
10.2 Follow up @ 6 months post intervention	1	37	Std. Mean Difference (IV, Fixed, 95% CI)	0.32 [-0.33, 0.97]

11 Single leg stance time eyes closed (s): higher values indicate better balance ability	1	33	Mean Difference (IV, Fixed, 95% CI)	Not estimable
12 Functional Reach Test: higher values indicate better balance ability	1	22	Mean Difference (IV, Fixed, 95% CI)	0.60 [-1.71, 2.91]
13 Timed up and go test (s): lower values indicate better balance ability	1	22	Mean Difference (IV, Fixed, 95% CI)	-1.5 [-3.49, 0.49]
14 Self paced gait speed: higher values indicate better balance ability	4		Std. Mean Difference (IV, Fixed, 95% CI)	Subtotals only
14.1 Immediately post intervention	4	176	Std. Mean Difference (IV, Fixed, 95% CI)	0.23 [-0.07, 0.53]
14.2 Follow-up @ 6 months post intervention	1	45	Std. Mean Difference (IV, Fixed, 95% CI)	0.31 [-0.28, 0.90]
14.3 Follow-up @ 6 weeks post intervention	1	30	Std. Mean Difference (IV, Fixed, 95% CI)	0.30 [-0.42, 1.03]
15 Walking on a beam (m): higher values indicate better balance ability	1	33	Mean Difference (IV, Fixed, 95% CI)	Not estimable
16 Berg Balance Scale (score out of 56) higher values indicate better balance ability	3		Mean Difference (IV, Fixed, 95% CI)	Subtotals only
16.1 Immediately post intervention	3	126	Mean Difference (IV, Fixed, 95% CI)	2.72 [0.94, 4.50]
16.2 Follow up @ 4 weeks post intervention	1	77	Mean Difference (IV, Fixed, 95% CI)	3.60 [-1.96, 9.16]
16.3 Follow up @ 1 year post intervention	1	49	Mean Difference (IV, Fixed, 95% CI)	0.67 [-7.29, 8.63]

Comparison 2. Strengthening exercise versus control

Outcome or subgroup title	No. of studies	No. of participants	Statistical method	Effect size
1 Functional base of support during dynamic test (distance): higher values indicate better balance ability	1		Mean Difference (IV, Fixed, 95% CI)	Subtotals only
1.1 Immediately post intervention	1	34	Mean Difference (IV, Fixed, 95% CI)	-0.01 [-0.09, 0.07]
1.2 Follow-up @ 6 months post intervention	1	27	Mean Difference (IV, Fixed, 95% CI)	Not estimable
2 Loss of balance during sensory organisation test (errors): less errors indicate better balance ability	1		Mean Difference (IV, Fixed, 95% CI)	Subtotals only

2.1 Immediately post intervention	1	52	Mean Difference (IV, Fixed, 95% CI)	-0.40 [-1.66, 0.86]
2.2 Follow-up @ 6 months post intervention	1	42	Mean Difference (IV, Fixed, 95% CI)	-0.10 [-1.63, 1.43]
3 Tilt board (s) post-pre change scores: higher values indicate better balance ability	1		Mean Difference (IV, Fixed, 95% CI)	Subtotals only
3.1 Omnidirectional tilt board (s)	1	51	Mean Difference (IV, Fixed, 95% CI)	-4.0 [-7.89, -0.11]
3.2 AP tilt board (s)	1	51	Mean Difference (IV, Fixed, 95% CI)	-1.0 [-4.32, 2.32]
4 Single leg stance time eyes open (s): higher values indicate better balance ability	3	170	Std. Mean Difference (IV, Fixed, 95% CI)	0.39 [0.08, 0.70]
5 Single leg stance time eyes closed (s): higher values indicate better balance ability	2		Std. Mean Difference (IV, Random, 95% CI)	Subtotals only
5.1 Immediately post intervention	2	119	Std. Mean Difference (IV, Random, 95% CI)	0.51 [-0.31, 1.32]
5.2 Follow up @ 6 months post intervention	1	31	Std. Mean Difference (IV, Random, 95% CI)	-0.09 [-0.80, 0.63]
6 Tandem walk over 10 feet (s): higher values indicate better balance ability	1	81	Mean Difference (IV, Fixed, 95% CI)	-2.0 [-4.40, 0.40]
7 Tandem stance (s): higher values indicate better balance ability	3	165	Std. Mean Difference (IV, Random, 95% CI)	0.24 [-0.34, 0.82]
8 Functional Reach Test (FRT) (cm) pre-post change scores: lower values indicate better balance ability	1	49	Mean Difference (IV, Fixed, 95% CI)	-4.33 [-6.00, -0.66]
9 Timed up and go test (TUG) (s): lower values indicate better balance ability	1	33	Mean Difference (IV, Fixed, 95% CI)	-3.5 [-9.70, 2.70]
10 Gait speed: higher values indicate better balance ability	5		Std. Mean Difference (IV, Fixed, 95% CI)	Subtotals only
10.1 Immediately post intervention	5	304	Std. Mean Difference (IV, Fixed, 95% CI)	0.25 [0.02, 0.48]
10.2 Follow-up @ 6 months post intervention	1	42	Std. Mean Difference (IV, Fixed, 95% CI)	0.24 [-0.37, 0.85]
11 Balance beam: post-pre change scores (s): higher values indicate better balance ability	2		Mean Difference (IV, Fixed, 95% CI)	Subtotals only
11.1 Wide beam	2	100	Mean Difference (IV, Fixed, 95% CI)	-0.14 [-0.55, 0.26]
11.2 Narrow beam	1	51	Mean Difference (IV, Fixed, 95% CI)	0.5 [-0.14, 1.14]

Comparison 3. 3D (Tai Chi, Gi Gong, dance, yoga) versus control

Outcome or subgroup title	No. of studies	No. of participants	Statistical method	Effect size
1 AP stability during stance (quiet and dynamic) eyes open: lower values indicate better balance ability	2		Std. Mean Difference (IV, Fixed, 95% CI)	Subtotals only
1.1 Immediately post intervention	2	87	Std. Mean Difference (IV, Fixed, 95% CI)	-0.24 [-0.66, 0.19]
1.2 Follow-up @ 3 months post intervention	1	48	Std. Mean Difference (IV, Fixed, 95% CI)	0.17 [-0.40, 0.75]
1.3 Follow-up @ 4 months post intervention	1	35	Std. Mean Difference (IV, Fixed, 95% CI)	-0.15 [-0.82, 0.52]
2 Mediolateral stability during stance (quiet and dynamic) eyes open: lower values indicate better balance	1		Std. Mean Difference (IV, Fixed, 95% CI)	Subtotals only
2.1 Immediately post intervention	1	38	Std. Mean Difference (IV, Fixed, 95% CI)	0.30 [-0.34, 0.94]
2.3 Follow-up @ 4 months post intervention	1	38	Std. Mean Difference (IV, Fixed, 95% CI)	0.30 [-0.34, 0.94]
3 AP stability during quiet stance eyes closed: lower values indicate better balance ability	1		Std. Mean Difference (IV, Fixed, 95% CI)	Subtotals only
3.1 Immediately post intervention	1	38	Std. Mean Difference (IV, Fixed, 95% CI)	0.21 [-0.43, 0.84]
3.2 Follow up @ 4months post intervention	1	38	Std. Mean Difference (IV, Fixed, 95% CI)	0.35 [-0.29, 0.99]
4 Mediolateral stability during quiet stance eyes closed: lower values indicate better balance ability	1		Std. Mean Difference (IV, Fixed, 95% CI)	Subtotals only
4.1 Immediately post intervention	1	38	Std. Mean Difference (IV, Fixed, 95% CI)	0.00 [-0.63, 0.64]
4.2 Follow up @ 4 months post intervention	1	38	Std. Mean Difference (IV, Fixed, 95% CI)	0.06 [-0.57, 0.70]
5 Area during narrow stance eyes open post-pre change scores (mm2/s): lower values indicate better balance	1		Mean Difference (IV, Fixed, 95% CI)	Subtotals only
5.1 Immediately post intervention	1	52	Mean Difference (IV, Fixed, 95% CI)	-2.0 [-21.89, 17.89]
5.2 Follow-up @ 3 months post intervention	1	48	Mean Difference (IV, Fixed, 95% CI)	3.0 [-17.47, 23.47]
6 Angular radius narrow stance eyes open post-pre change scores (mm): lower values indicate better balance	1		Mean Difference (IV, Fixed, 95% CI)	Subtotals only

6.1 Immediately post intervention	1	52	Mean Difference (IV, Fixed, 95% CI)	-0.10 [-1.14, 0.94]
6.2 Follow-up @ 3 months post intervention	1	48	Mean Difference (IV, Fixed, 95% CI)	Not estimable
7 Area during narrow stance eyes closed post-pre change scores (mm2/s): lower values indicate better balance	1		Mean Difference (IV, Fixed, 95% CI)	Subtotals only
7.1 Immediately post intervention	1	52	Mean Difference (IV, Fixed, 95% CI)	29.00 [-28.94, 86.94]
7.2 Follow-up @ 3 months post intervention	1	48	Mean Difference (IV, Fixed, 95% CI)	39.0 [-19.01, 97.01]
8 Angular radius narrow stance eyes closed post-pre change scores (mm): lower values indicate better balance	1		Mean Difference (IV, Fixed, 95% CI)	Subtotals only
8.1 Immediately post intervention	1	52	Mean Difference (IV, Fixed, 95% CI)	0.4 [-1.23, 2.03]
8.2 Follow-up @ 3 months post intervention	1	48	Mean Difference (IV, Fixed, 95% CI)	0.40 [-1.28, 2.08]
9 Omnidirectional tilt board post-pre change scores (s): higher values indicate better balance ability	1		Mean Difference (IV, Fixed, 95% CI)	Subtotals only
9.1 Immediately post intervention	1	52	Mean Difference (IV, Fixed, 95% CI)	-1.00 [-7.08, 1.08]
9.2 Follow-up @ 3 months post intervention	1	48	Mean Difference (IV, Fixed, 95% CI)	-3.0 [-7.54, 1.54]
10 Single leg stance time eyes open (s): higher values indicate better balance ability	2	85	Std. Mean Difference (IV, Random, 95% CI)	1.13 [-0.17, 2.44]
11 Single leg stance time eyes closed (s): higher values indicate better balance ability	1	38	Mean Difference (IV, Fixed, 95% CI)	-1.20 [-3.80, 1.40]
12 Functional Reach Test (cm): higher values indicate better balance ability	1	38	Mean Difference (IV, Fixed, 95% CI)	2.80 [-1.05, 6.65]
13 Gait speed: higher values indicate better balance ability	2		Std. Mean Difference (IV, Fixed, 95% CI)	Subtotals only
13.1 Immediately post intervention	2	99	Std. Mean Difference (IV, Fixed, 95% CI)	0.05 [-0.34, 0.45]
13.2 Follow-up @ 3 months post intervention	1	48	Std. Mean Difference (IV, Fixed, 95% CI)	0.10 [-0.48, 0.68]
14 Wide balance beam post-pre change scores (m/s): higher values indicate better balance ability	1		Mean Difference (IV, Fixed, 95% CI)	Subtotals only
14.1 Immediately post intervention	1	52	Mean Difference (IV, Fixed, 95% CI)	-0.1 [-0.16, -0.04]
14.2 Follow-up @3 months post intervention	1	48	Mean Difference (IV, Fixed, 95% CI)	-0.07 [-0.17, 0.03]

15 Narrow balance beam post-pre change scores (m/s): higher values indicate better balance ability	1		Mean Difference (IV, Fixed, 95% CI)	Subtotals only
15.1 Immediately post intervention	1	52	Mean Difference (IV, Fixed, 95% CI)	0.8 [-0.01, 1.61]
15.2 Follow-up @3 months post intervention	1	48	Mean Difference (IV, Fixed, 95% CI)	0.70 [-0.08, 1.48]

Comparison 4. General physical activity versus control

Outcome or subgroup title	No. of studies	No. of participants	Statistical method	Effect size
1 Postural sway double stance (post-pre change scores): lower values indicate better balance ability	1		Mean Difference (IV, Fixed, 95% CI)	Subtotals only
1.1 Eyes open	1	41	Mean Difference (IV, Fixed, 95% CI)	-6.70 [-17.59, 4.19]
1.2 Eyes closed	1	41	Mean Difference (IV, Fixed, 95% CI)	-5.70 [-26.82, 15.42]
2 Functional Reach Test (cm): higher values indicate better balance ability	1	42	Mean Difference (IV, Fixed, 95% CI)	11.8 [7.75, 15.85]
3 Timed up and go test (s): lower values indicate better balance ability	1	42	Mean Difference (IV, Fixed, 95% CI)	-3.9 [-5.83, -1.97]

Comparison 5. General physical activity (walking) versus control

Outcome or subgroup title	No. of studies	No. of participants	Statistical method	Effect size
1 Area during narrow stance eyes open post-pre change scores (mm2/s): lower values indicate better balance	1		Mean Difference (IV, Fixed, 95% CI)	Subtotals only
1.1 Immediately post intervention	1	52	Mean Difference (IV, Fixed, 95% CI)	-4.0 [-24.10, 16.10]
1.2 Follow-up @ 3 months post intervention	1	51	Mean Difference (IV, Fixed, 95% CI)	1.0 [-19.26, 21.26]
2 Angular radius narrow stance eyes open post-pre change scores (mm): lower values indicate better balance	1		Mean Difference (IV, Fixed, 95% CI)	Subtotals only
2.1 Immediately post intervention	1	52	Mean Difference (IV, Fixed, 95% CI)	-0.5 [-1.54, 0.54]

2.2 Follow-up @ 3 months post intervention	1	51	Mean Difference (IV, Fixed, 95% CI)	-0.4 [-1.47, 0.67]
3 Area during narrow stance eyes closed post-pre change scores (mm2/s): lower values indicate better balance	1		Mean Difference (IV, Fixed, 95% CI)	Subtotals only
3.1 Immediately post intervention	1	52	Mean Difference (IV, Fixed, 95% CI)	102.0 [28.58, 175.42]
3.2 Follow-up @ 3 months post intervention	1	51	Mean Difference (IV, Fixed, 95% CI)	118.00 [46.83, 189.17]
4 Angular radius narrow stance eyes closed post-pre change scores (mm): lower values indicate better balance	1		Mean Difference (IV, Fixed, 95% CI)	Subtotals only
4.1 Immediately post intervention	1	52	Mean Difference (IV, Fixed, 95% CI)	1.4 [-0.26, 3.06]
4.2 Follow-up @ 3 months post intervention	1	51	Mean Difference (IV, Fixed, 95% CI)	1.6 [-0.05, 3.25]
6 Dynamic balance lateral axis (degrees): higher values indicate better balance ability	1		Mean Difference (IV, Fixed, 95% CI)	Subtotals only
6.1 Average position (degrees)	1	21	Mean Difference (IV, Fixed, 95% CI)	-0.20 [-0.46, 0.06]
6.2 Amplitude (degrees)	1	21	Mean Difference (IV, Fixed, 95% CI)	-2.50 [-4.01, -0.99]
7 Omnidirectional tilt board post-pre change scores (s): higher values indicate better balance ability	1		Mean Difference (IV, Fixed, 95% CI)	Subtotals only
7.1 Immediately post intervention	1	52	Mean Difference (IV, Fixed, 95% CI)	-1.00 [-7.08, 1.08]
7.2 Follow-up @ 3 months post intervention	1	51	Mean Difference (IV, Fixed, 95% CI)	-1.00 [-7.12, 1.12]
8 AP tilt board post-pre change score (s): higher values indicate better balance ability	1		Mean Difference (IV, Fixed, 95% CI)	Subtotals only
8.1 Immediately post intervention	1	52	Mean Difference (IV, Fixed, 95% CI)	1.0 [-1.20, 3.20]
8.2 Follow-up @ 3 months post intervention	1	51	Mean Difference (IV, Fixed, 95% CI)	-1.0 [-3.75, 1.75]
9 Single leg stance time eyes open (s): Higher values indicate better balance ability	2	95	Std. Mean Difference (IV, Fixed, 95% CI)	0.15 [-0.26, 0.57]
10 Single leg stance time eyes closed (s): higher values indicate better balance ability	1	69	Mean Difference (IV, Fixed, 95% CI)	0.40 [-0.89, 1.69]
11 Tandem walk over 10 feet (s): lower values indicate better balance ability	1	69	Mean Difference (IV, Fixed, 95% CI)	-2.30 [-4.05, -0.55]
12 Tandem stance (s): higher values indicate better balance ability	1	69	Mean Difference (IV, Fixed, 95% CI)	12.90 [3.91, 21.89]

13 Functional Reach Test (cm): higher values indicate better balance ability	1	26	Mean Difference (IV, Fixed, 95% CI)	10.92 [5.03, 16.81]
14 Self paced gait velocity (m/min): higher values indicate better balance ability	2		Std. Mean Difference (IV, Fixed, 95% CI)	Subtotals only
14.1 Immediately post intervention	2	73	Std. Mean Difference (IV, Fixed, 95% CI)	0.21 [-0.26, 0.67]
14.2 Follow-up @ 3 months post intervention	1	51	Std. Mean Difference (IV, Fixed, 95% CI)	0.44 [-0.12, 1.00]
15 Wide balance beam post-pre change scores (m/s): higher values indicate better balance ability	1		Mean Difference (IV, Fixed, 95% CI)	Subtotals only
15.1 Immediately post intervention	1	52	Mean Difference (IV, Fixed, 95% CI)	0.06 [-0.01, 0.13]
15.2 Follow-up @3 months post intervention	1	51	Mean Difference (IV, Fixed, 95% CI)	0.08 [-0.01, 0.17]
16 Narrow balance beam post-pre change scores (m/s): higher values indicate better balance ability	1		Mean Difference (IV, Fixed, 95% CI)	Subtotals only
16.1 Immediately post intervention	1	52	Mean Difference (IV, Fixed, 95% CI)	0.5 [-0.07, 1.07]
16.2 Follow-up @3 months post intervention	1	51	Mean Difference (IV, Fixed, 95% CI)	0.3 [-0.37, 0.97]

Comparison 6. General physical activity (cycling) versus control

Outcome or subgroup title	No. of studies	No. of participants	Statistical method	Effect size
1 Area during narrow stance eyes open post-pre change scores (mm2/s): lower values indicate better balance	1		Mean Difference (IV, Fixed, 95% CI)	Subtotals only
1.1 Immediately post intervention	1	51	Mean Difference (IV, Fixed, 95% CI)	-15.0 [-32.22, 2.22]
1.2 Follow-up @ 3 months post intervention	1	49	Mean Difference (IV, Fixed, 95% CI)	-12.0 [-33.05, 9.05]
2 Angular radius narrow stance eyes open post-pre change scores (mm): lower values indicate better balance	1		Mean Difference (IV, Fixed, 95% CI)	Subtotals only
2.1 Immediately post intervention	1	51	Mean Difference (IV, Fixed, 95% CI)	-0.8 [-2.12, 0.52]
2.2 Follow-up @ 3 months post intervention	1	49	Mean Difference (IV, Fixed, 95% CI)	-0.80 [0.00, 0.40]

3 Area narrow stance eyes closed post-pre change scores (mm2/s): lower values indicate better balance	1		Mean Difference (IV, Fixed, 95% CI)	Subtotals only
3.1 Immediately post intervention	1	51	Mean Difference (IV, Fixed, 95% CI)	38.0 [-19.93, 95.93]
3.2 Follow-up @ 3 months post intervention	1	49	Mean Difference (IV, Fixed, 95% CI)	55.00 [-1.38, 111.38]
4 Angular radius narrow stance eyes closed post-pre change scores (mm): lower values indicate better balance	1		Mean Difference (IV, Fixed, 95% CI)	Subtotals only
4.1 Immediately post intervention	1	51	Mean Difference (IV, Fixed, 95% CI)	1.0 [-0.87, 2.87]
4.2 Follow-up @ 3 months post intervention	1	49	Mean Difference (IV, Fixed, 95% CI)	1.30 [-0.66, 3.26]
5 AP tilt board post-pre change score (s): higher values indicate better balance ability	1		Mean Difference (IV, Fixed, 95% CI)	Subtotals only
5.1 Immediately post intervention	1	51	Mean Difference (IV, Fixed, 95% CI)	Not estimable
5.2 Follow-up @ 3 months post intervention	1	49	Mean Difference (IV, Fixed, 95% CI)	-2.0 [-5.09, 1.09]
6 Omnidirectional tilt board post-pre change scores (s): higher values indicate better balance ability	1		Mean Difference (IV, Fixed, 95% CI)	Subtotals only
6.1 Immediately post intervention	1	51	Mean Difference (IV, Fixed, 95% CI)	-1.0 [-4.87, 2.87]
6.2 Follow-up @ 3 months post intervention	1	49	Mean Difference (IV, Fixed, 95% CI)	-5.0 [-10.13, 0.13]
7 Self paced gait velocity post-pre change scores (m/min): higher values indicate better balance ability	1		Mean Difference (IV, Fixed, 95% CI)	Subtotals only
7.1 Immediately post intervention	1	51	Mean Difference (IV, Fixed, 95% CI)	3.00 [-3.77, 9.77]
7.2 Follow-up @ 3 months post intervention	1	49	Mean Difference (IV, Fixed, 95% CI)	3.0 [-1.20, 7.20]
8 Wide balance beam post-pre change scores (m/s): higher values indicate better balance ability	1		Mean Difference (IV, Fixed, 95% CI)	Subtotals only
8.1 Immediately post intervention	1	51	Mean Difference (IV, Fixed, 95% CI)	Not estimable
8.2 Follow-up @3 months post intervention	1	49	Mean Difference (IV, Fixed, 95% CI)	0.07 [-0.02, 0.16]
9 Narrow balance beam post-pre change scores (m/s): higher values indicate better balance ability	1		Mean Difference (IV, Fixed, 95% CI)	Subtotals only

9.1 Immediately post intervention	1	51	Mean Difference (IV, Fixed, 95% CI)	0.1 [-0.62, 0.82]
9.2 Follow-up @3 months post intervention	1	49	Mean Difference (IV, Fixed, 95% CI)	0.3 [-0.47, 1.07]

Comparison 7. Multiple exercise types versus control

Outcome or subgroup title	No. of studies	No. of participants	Statistical method	Effect size
1 Functional base of support (distance) during dynamic test: higher values indicate better balance ability	1		Mean Difference (IV, Fixed, 95% CI)	Subtotals only
1.1 Immediately post intervention	1	32	Mean Difference (IV, Fixed, 95% CI)	0.09 [0.03, 0.15]
1.2 Follow-up @ 6 months post intervention	1	26	Mean Difference (IV, Fixed, 95% CI)	0.09 [0.02, 0.16]
2 Maximal balance range (cm) during dynamic test: higher values indicate better balance ability	2	595	Mean Difference (IV, Random, 95% CI)	0.76 [-1.29, 2.81]
3 Total distance travelled by COP during quiet stance (mm): lower values indicate better balance ability	1		Mean Difference (IV, Fixed, 95% CI)	Subtotals only
3.1 Eyes open	1	14	Mean Difference (IV, Fixed, 95% CI)	97.15 [18.59, 175.71]
3.2 Eyes closed	1	14	Mean Difference (IV, Fixed, 95% CI)	212.52 [114.79, 310.25]
4 Sway (mm) during dynamic test: higher values indicate better balance ability	3		Std. Mean Difference (IV, Random, 95% CI)	Subtotals only
4.1 Floor, eyes open (immediately post intervention)	3	893	Std. Mean Difference (IV, Random, 95% CI)	-0.08 [-0.41, 0.24]
4.2 Floor, eyes closed (immediately post intervention)	3	893	Std. Mean Difference (IV, Random, 95% CI)	-0.10 [-0.24, 0.04]
4.3 Foam, eyes open (immediately post intervention)	3	893	Std. Mean Difference (IV, Random, 95% CI)	-0.18 [-0.59, 0.23]
4.4 Foam, eyes closed (immediately post intervention)	3	893	Std. Mean Difference (IV, Random, 95% CI)	-0.10 [-0.31, 0.11]
5 Body sway (cm): lower values indicate better balance ability	2	35	Std. Mean Difference (IV, Fixed, 95% CI)	-0.87 [-1.60, -0.13]
6 Loss of balance during sensory organisation test (errors): less errors indicate better balance ability	1		Mean Difference (IV, Fixed, 95% CI)	Subtotals only
6.1 Immediately post intervention	1	53	Mean Difference (IV, Fixed, 95% CI)	-0.60 [-1.86, 0.66]

6.2 Follow-up @ 6 months post intervention	1	43	Mean Difference (IV, Fixed, 95% CI)	-0.20 [-1.59, 1.19]
7 Co-ordinated stability (errors): less errors indicate better balance ability	3	829	Mean Difference (IV, Fixed, 95% CI)	-0.76 [-1.97, 0.44]
8 Single leg stance time eyes open (s): higher values indicate better balance ability	4		Mean Difference (IV, Fixed, 95% CI)	Subtotals only
8.1 Immediately post intervention	4	202	Mean Difference (IV, Fixed, 95% CI)	1.30 [-0.85, 3.44]
8.2 Follow up @ 6 months post intervention	1	33	Mean Difference (IV, Fixed, 95% CI)	2.80 [-4.73, 10.33]
9 Single leg stance time eyes closed (s): higher values indicate better balance ability	1	39	Mean Difference (IV, Fixed, 95% CI)	2.03 [-0.29, 4.35]
10 Semitandem stance time (s): higher values indicate better balance ability	1		Mean Difference (IV, Fixed, 95% CI)	Subtotals only
10.1 Immediately post intervention	1	67	Mean Difference (IV, Fixed, 95% CI)	1.0 [-0.52, 2.52]
10.2 Follow-up @ 3 months post intervention	1	58	Mean Difference (IV, Fixed, 95% CI)	1.40 [-0.63, 3.43]
11 Parallel stance time (s): higher values indicate better balance ability	1		Mean Difference (IV, Fixed, 95% CI)	Subtotals only
11.1 Immediately post intervention	1	67	Mean Difference (IV, Fixed, 95% CI)	0.80 [-0.47, 2.07]
11.2 Follow-up @ 3 months post intervention	1	58	Mean Difference (IV, Fixed, 95% CI)	-0.30 [-1.66, 1.06]
12 Tandem stance time (s): higher values indicate better balance ability	1		Mean Difference (IV, Fixed, 95% CI)	Subtotals only
12.1 Immediately post intervention	1	67	Mean Difference (IV, Fixed, 95% CI)	1.90 [0.06, 3.74]
12.2 Follow-up @ 3 months post intervention	1	58	Mean Difference (IV, Fixed, 95% CI)	1.20 [-0.64, 3.04]
13 Tandem walk (number of steps): higher values indicate better balance ability	1	39	Mean Difference (IV, Fixed, 95% CI)	3.39 [1.75, 5.03]
14 Tandem walk (s): lower values indicate better balance ability	1	70	Mean Difference (IV, Fixed, 95% CI)	-8.10 [-13.71, -2.49]
15 Functional Reach Test (cm): higher values indicate better balance ability	2	60	Mean Difference (IV, Fixed, 95% CI)	5.80 [3.37, 8.23]
16 Gait speed: higher values indicate better balance ability	6		Std. Mean Difference (IV, Fixed, 95% CI)	Subtotals only
16.1 Immediately post intervention	6	264	Std. Mean Difference (IV, Fixed, 95% CI)	-0.14 [-0.38, 0.11]
16.2 Follow-up @ 6 months post intervention	1	50	Std. Mean Difference (IV, Fixed, 95% CI)	0.37 [-0.19, 0.93]

16.3 Follow-up @ 3 months post intervention	1	58	Std. Mean Difference (IV, Fixed, 95% CI)	-0.11 [-0.63, 0.40]

Comparison 8. Sensitivity analyses for effect of clustering

Outcome or subgroup title	No. of studies	No. of participants	Statistical method	Effect size
1 (01.10) Single leg stance time eyes open (s): higher values indicate better balance ability	4		Std. Mean Difference (IV, Fixed, 95% CI)	Subtotals only
1.1 Immediately post intervention	4	164	Std. Mean Difference (IV, Fixed, 95% CI)	0.33 [0.02, 0.64]
2 (01.14) Self paced gait speed: higher values indicate better balance ability	4		Std. Mean Difference (IV, Fixed, 95% CI)	Subtotals only
2.1 Immediately post intervention	4	176	Std. Mean Difference (IV, Fixed, 95% CI)	0.23 [-0.07, 0.53]

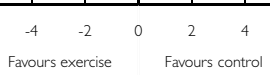
Analysis 1.1. Comparison 1 Gait, balance, co-ordination, functional tasks exercise versus control, Outcome 1 AP stability during stance (quiet and dynamic) eyes open: lower values indicate better balance ability.

Review: Exercise for improving balance in older people

Comparison: 1 Gait, balance, co-ordination, functional tasks exercise versus control

Outcome: 1 AP stability during stance (quiet and dynamic) eyes open: lower values indicate better balance ability

Study or subgroup	Exercise N	Mean(SD)	Control N	Mean(SD)	Std. Mean Difference IV,Random,95% CI	Weight	Std. Mean Difference IV,Random,95% CI
1 Immediately post intervention							
Brouwer 2003	17	-10.51 (2.1)	17	-8.04 (3.26)		30.5 %	-0.88 [-1.59, -0.17]
Crilly 1989	23	4.34 (1.58)	24	4.65 (2.01)		40.2 %	-0.17 [-0.74, 0.40]
Wolf 1997	16	1.26 (0.93)	19	4.98 (4.07)		29.3 %	-1.18 [-1.91, -0.46]
Subtotal (95% CI)	**56**		**60**			**100.0 %**	**-0.71 [-1.33, -0.09]**
Heterogeneity: Tau^2 = 0.18; Chi^2 = 5.19, df = 2 (P = 0.07); I^2 =61%							
Test for overall effect: Z = 2.24 (P = 0.025)							
2 Follow-up @ 6 weeks post intervention							
Brouwer 2003	14	-9.95 (2.09)	16	-8.18 (3.17)		100.0 %	-0.63 [-1.37, 0.10]
Subtotal (95% CI)	**14**		**16**			**100.0 %**	**-0.63 [-1.37, 0.10]**



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Study or subgroup	Exercise N	Mean(SD)	Control N	Mean(SD)	Std. Mean Difference IV,Random,95% CI	Weight	Std. Mean Difference IV,Random,95% CI
Heterogeneity: not applicable							
Test for overall effect: Z = 1.68 (P = 0.093)							
3 Follow-up @ 4 months post intervention							
Wolf 1997	16	1.86 (1.57)	19	4.52 (3.36)		100.0 %	-0.96 [-1.67, -0.26]
Subtotal (95% CI)	**16**		**19**			**100.0 %**	**-0.96 [-1.67, -0.26]**
Heterogeneity: not applicable							
Test for overall effect: Z = 2.67 (P = 0.0076)							

Analysis 1.2. Comparison 1 Gait, balance, co-ordination, functional tasks exercise versus control, Outcome 2 Mediolateral stability during stance (quiet and dynamic) eyes open: lower values indicate better balance.

Review: Exercise for improving balance in older people

Comparison: 1 Gait, balance, co-ordination, functional tasks exercise versus control

Outcome: 2 Mediolateral stability during stance (quiet and dynamic) eyes open: lower values indicate better balance

Study or subgroup	Exercise N	Mean(SD)	Control N	Mean(SD)	Std. Mean Difference IV,Random,95% CI	Weight	Std. Mean Difference IV,Random,95% CI
1 Immediately post intervention							
Brouwer 2003	17	-18.46 (3.53)	17	-14.84 (4.72)		32.3 %	-0.85 [-1.55, -0.14]
Crilly 1989	23	4.26 (2.54)	24	3.97 (1.86)		34.9 %	0.13 [-0.44, 0.70]
Wolf 1997	16	1.52 (1.12)	19	2.48 (2.09)		32.8 %	-0.55 [-1.22, 0.13]
Subtotal (95% CI)	**56**		**60**			**100.0 %**	**-0.39 [-0.98, 0.20]**
Heterogeneity: Tau^2 = 0.16; Chi^2 = 4.92, df = 2 (P = 0.09); I^2 =59%							
Test for overall effect: Z = 1.31 (P = 0.19)							
2 Follow-up @ 6 weeks post intervention							
Brouwer 2003	14	-18.72 (4.06)	16	-16.01 (3.75)		100.0 %	-0.68 [-1.42, 0.06]
Subtotal (95% CI)	**14**		**16**			**100.0 %**	**-0.68 [-1.42, 0.06]**
Heterogeneity: not applicable							
Test for overall effect: Z = 1.79 (P = 0.073)							
3 Follow-up @ 4 months post intervention							
Wolf 1997	16	5.63 (4.27)	19	2.06 (1.88)		100.0 %	1.09 [0.37, 1.81]
Subtotal (95% CI)	**16**		**19**			**100.0 %**	**1.09 [0.37, 1.81]**
Heterogeneity: not applicable							
Test for overall effect: Z = 2.98 (P = 0.0029)							

Analysis 1.3. Comparison 1 Gait, balance, co-ordination, functional tasks exercise versus control, Outcome 3 AP stability during quiet stance eyes closed: lower values indicate better balance ability.

Review: Exercise for improving balance in older people

Comparison: 1 Gait, balance, co-ordination, functional tasks exercise versus control

Outcome: 3 AP stability during quiet stance eyes closed: lower values indicate better balance ability

Study or subgroup	Exercise N	Mean(SD)	Control N	Mean(SD)	Std. Mean Difference IV,Fixed,95% CI	Weight	Std. Mean Difference IV,Fixed,95% CI
1 Immediately post intervention							
Crilly 1989	23	5.32 (1.82)	24	5.44 (3.67)		59.3 %	-0.04 [-0.61, 0.53]
Wolf 1997	16	5.14 (4.35)	19	11.04 (9.79)		40.7 %	-0.74 [-1.43, -0.05]
Subtotal (95% CI)	**39**		**43**			**100.0 %**	**-0.32 [-0.77, 0.12]**
Heterogeneity: Chi^2 = 2.33, df = 1 (P = 0.13); I^2 =57%							
Test for overall effect: Z = 1.45 (P = 0.15)							
2 Follow up @ 4months post intervention							
Wolf 1997	16	5.7 (4.87)	19	6.51 (7.22)		100.0 %	-0.13 [-0.79, 0.54]
Subtotal (95% CI)	**16**		**19**			**100.0 %**	**-0.13 [-0.79, 0.54]**
Heterogeneity: not applicable							
Test for overall effect: Z = 0.37 (P = 0.71)							
Test for subgroup differences: Chi^2 = 0.24, df = 1 (P = 0.63), I^2 =0.0%							

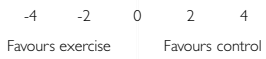
Analysis 1.4. Comparison 1 Gait, balance, co-ordination, functional tasks exercise versus control, Outcome 4 Mediolateral stability during quiet stance eyes closed: lower values indicate better balance ability.

Review: Exercise for improving balance in older people

Comparison: 1 Gait, balance, co-ordination, functional tasks exercise versus control

Outcome: 4 Mediolateral stability during quiet stance eyes closed: lower values indicate better balance ability

Study or subgroup	Exercise N	Mean(SD)	Control N	Mean(SD)	Std. Mean Difference IV,Fixed,95% CI	Weight	Std. Mean Difference IV,Fixed,95% CI
1 Immediately post intervention							
Crilly 1989	23	4.38 (2.11)	24	4.46 (2.11)		57.9 %	-0.04 [-0.61, 0.53]
Wolf 1997	16	3.75 (4.16)	19	5.39 (4.99)		42.1 %	-0.35 [-1.02, 0.32]
Subtotal (95% CI)	**39**		**43**			**100.0 %**	**-0.17 [-0.60, 0.27]**
Heterogeneity: Chi² = 0.47, df = 1 (P = 0.49); I² =0.0%							
Test for overall effect: Z = 0.75 (P = 0.45)							
2 Follow up @ 4 months post intervention							
Wolf 1997	16	5.63 (4.27)	19	6.41 (5.58)		100.0 %	-0.15 [-0.82, 0.51]
Subtotal (95% CI)	**16**		**19**			**100.0 %**	**-0.15 [-0.82, 0.51]**
Heterogeneity: not applicable							
Test for overall effect: Z = 0.45 (P = 0.66)							
Test for subgroup differences: Chi² = 0.00, df = 1 (P = 0.97), I² =0.0%							



Analysis 1.5. Comparison 1 Gait, balance, co-ordination, functional tasks exercise versus control, Outcome 5 Functional base of support during dynamic test (distance): higher values indicate greater balance ability.

Review: Exercise for improving balance in older people

Comparison: 1 Gait, balance, co-ordination, functional tasks exercise versus control

Outcome: 5 Functional base of support during dynamic test (distance): higher values indicate greater balance ability

Study or subgroup	Exercise N	Mean(SD)	Control N	Mean(SD)	Mean Difference IV,Fixed,95% CI	Weight	Mean Difference IV,Fixed,95% CI
1 Immediately post intervention							
Wolfson 1996	19	0.52 (0.09)	16	0.4 (0.12)		100.0 %	0.12 [0.05, 0.19]
Subtotal (95% CI)	**19**		**16**			**100.0 %**	**0.12 [0.05, 0.19]**
Heterogeneity: not applicable							
Test for overall effect: Z = 3.30 (P = 0.00098)							
2 Follow-up @ 6 months post intervention							
Wolfson 1996	18	0.45 (0.08)	15	0.37 (0.12)		100.0 %	0.08 [0.01, 0.15]
Subtotal (95% CI)	**18**		**15**			**100.0 %**	**0.08 [0.01, 0.15]**
Heterogeneity: not applicable							
Test for overall effect: Z = 2.21 (P = 0.027)							
Test for subgroup differences: Chi^2 = 0.61, df = 1 (P = 0.44), I^2 =0.0%							

Analysis 1.6. Comparison 1 Gait, balance, co-ordination, functional tasks exercise versus control, Outcome 6 Loss of balance during sensory organisation test (errors): less errors indicate better balance ability.

Review: Exercise for improving balance in older people

Comparison: 1 Gait, balance, co-ordination, functional tasks exercise versus control

Outcome: 6 Loss of balance during sensory organisation test (errors): less errors indicate better balance ability

Study or subgroup	Exercise N	Mean(SD)	Control N	Mean(SD)	Mean Difference IV,Fixed,95% CI	Weight	Mean Difference IV,Fixed,95% CI
1 Immediately post intervention							
Wolfson 1996	27	1.4 (1.56)	26	2.5 (2.55)		100.0 %	-1.10 [-2.24, 0.04]
Subtotal (95% CI)	**27**		**26**			**100.0 %**	**-1.10 [-2.24, 0.04]**
Heterogeneity: not applicable							
Test for overall effect: Z = 1.89 (P = 0.059)							
2 Follow-up @ 6 months post intervention							
Wolfson 1996	24	1 (0.98)	23	2.1 (2.4)		100.0 %	-1.10 [-2.16, -0.04]
Subtotal (95% CI)	**24**		**23**			**100.0 %**	**-1.10 [-2.16, -0.04]**
Heterogeneity: not applicable							
Test for overall effect: Z = 2.04 (P = 0.041)							
Test for subgroup differences: Chi^2 = 0.0, df = 1 (P = 1.00), I^2 =0.0%							

Analysis 1.7. Comparison 1 Gait, balance, co-ordination, functional tasks exercise versus control, Outcome 7 Maxium excursion of limits of stability (LOS) test: higher values indicate better balance ability.

Review: Exercise for improving balance in older people

Comparison: 1 Gait, balance, co-ordination, functional tasks exercise versus control

Outcome: 7 Maxium excursion of limits of stability (LOS) test: higher values indicate better balance ability

Study or subgroup	Exercise N	Mean(SD)	Control N	Mean(SD)	Mean Difference IV,Fixed,95% CI	Weight	Mean Difference IV,Fixed,95% CI
1 Forward							
Islam 2004	15	96.4 (11.5)	14	76.3 (18.8)		100.0 %	20.10 [8.66, 31.54]
Subtotal (95% CI)	**15**		**14**			**100.0 %**	**20.10 [8.66, 31.54]**
Heterogeneity: not applicable							
Test for overall effect: Z = 3.44 (P = 0.00057)							
2 Backward							
Islam 2004	15	67.2 (16.8)	14	58.3 (12.3)		100.0 %	8.90 [-1.77, 19.57]
Subtotal (95% CI)	**15**		**14**			**100.0 %**	**8.90 [-1.77, 19.57]**
Heterogeneity: not applicable							
Test for overall effect: Z = 1.64 (P = 0.10)							
3 Right							
Islam 2004	15	106.9 (5.8)	14	87.9 (18.2)		100.0 %	19.00 [9.02, 28.98]
Subtotal (95% CI)	**15**		**14**			**100.0 %**	**19.00 [9.02, 28.98]**
Heterogeneity: not applicable							
Test for overall effect: Z = 3.73 (P = 0.00019)							
4 Left							
Islam 2004	15	107.9 (11.2)	14	95.1 (12.6)		100.0 %	12.80 [4.10, 21.50]
Subtotal (95% CI)	**15**		**14**			**100.0 %**	**12.80 [4.10, 21.50]**
Heterogeneity: not applicable							
Test for overall effect: Z = 2.88 (P = 0.0039)							
Test for subgroup differences: Chi^2 = 2.88, df = 3 (P = 0.41), I^2 =0.0%							

Analysis 1.8. Comparison 1 Gait, balance, co-ordination, functional tasks exercise versus control, Outcome 8 Single leg stance eyes open (force platform measures): lower values indicate better balance ability.

Review: Exercise for improving balance in older people

Comparison: 1 Gait, balance, co-ordination, functional tasks exercise versus control

Outcome: 8 Single leg stance eyes open (force platform measures): lower values indicate better balance ability

Study or subgroup	Exercise N	Mean(SD)	Control N	Mean(SD)	Mean Difference IV,Fixed,95% CI	Weight	Mean Difference IV,Fixed,95% CI
1 Average XY area per second (square inches per second)							
Lichtenstein 1989	21	1.43 (1.07)	21	1.41 (0.87)		100.0 %	0.02 [-0.57, 0.61]
Subtotal (95% CI)	**21**		**21**			**100.0 %**	**0.02 [-0.57, 0.61]**
Heterogeneity: not applicable							
Test for overall effect: Z = 0.07 (P = 0.95)							
2 Average radial area per second (square inches per second)							
Lichtenstein 1989	21	0.48 (0.37)	21	0.53 (0.33)		100.0 %	-0.05 [-0.26, 0.16]
Subtotal (95% CI)	**21**		**21**			**100.0 %**	**-0.05 [-0.26, 0.16]**
Heterogeneity: not applicable							
Test for overall effect: Z = 0.46 (P = 0.64)							
3 Average velocity (inches per second)							
Lichtenstein 1989	21	4.77 (1.24)	21	4.65 (1.22)		100.0 %	0.12 [-0.62, 0.86]
Subtotal (95% CI)	**21**		**21**			**100.0 %**	**0.12 [-0.62, 0.86]**
Heterogeneity: not applicable							
Test for overall effect: Z = 0.32 (P = 0.75)							
Test for subgroup differences: Chi^2 = 0.22, df = 2 (P = 0.90), I^2 =0.0%							

Analysis 1.9. Comparison 1 Gait, balance, co-ordination, functional tasks exercise versus control, Outcome 9 Single leg stance eyes closed (force platform measures): lower values indicate better balance ability.

Review: Exercise for improving balance in older people

Comparison: 1 Gait, balance, co-ordination, functional tasks exercise versus control

Outcome: 9 Single leg stance eyes closed (force platform measures): lower values indicate better balance ability

Study or subgroup	Exercise N	Mean(SD)	Control N	Mean(SD)	Mean Difference IV,Fixed,95% CI	Weight	Mean Difference IV,Fixed,95% CI
1 Average XY area per second (square inches per second)							
Lichtenstein 1989	19	3.03 (1.97)	20	3.44 (2.59)		100.0 %	-0.41 [-1.85, 1.03]
Subtotal (95% CI)	**19**		**20**			**100.0 %**	**-0.41 [-1.85, 1.03]**
Heterogeneity: not applicable							
Test for overall effect: Z = 0.56 (P = 0.58)							
2 Average radial area per second (square inches per second)							
Lichtenstein 1989	19	1.25 (0.76)	20	2.18 (2.44)		100.0 %	-0.93 [-2.05, 0.19]
Subtotal (95% CI)	**19**		**20**			**100.0 %**	**-0.93 [-2.05, 0.19]**
Heterogeneity: not applicable							
Test for overall effect: Z = 1.62 (P = 0.10)							
3 Average velocity (inches per second)							
Lichtenstein 1989	19	5.93 (2.17)	20	6.48 (2.56)		100.0 %	-0.55 [-2.04, 0.94]
Subtotal (95% CI)	**19**		**20**			**100.0 %**	**-0.55 [-2.04, 0.94]**
Heterogeneity: not applicable							
Test for overall effect: Z = 0.72 (P = 0.47)							
Test for subgroup differences: Chi^2 = 0.35, df = 2 (P = 0.84), I^2 =0.0%							

Analysis 1.10. Comparison 1 Gait, balance, co-ordination, functional tasks exercise versus control, Outcome 10 Single leg stance time eyes open (s): higher values indicate better balance ability.

Review: Exercise for improving balance in older people

Comparison: 1 Gait, balance, co-ordination, functional tasks exercise versus control

Outcome: 10 Single leg stance time eyes open (s): higher values indicate better balance ability

Study or subgroup	Exercise N	Mean(SD)	Control N	Mean(SD)	Std. Mean Difference IV,Fixed,95% CI	Weight	Std. Mean Difference IV,Fixed,95% CI
1 Immediately post intervention							
Johansson 1991	18	20.7 (10.2)	15	19.5 (10.9)		20.5 %	0.11 [-0.57, 0.80]
MacRae 1994	28	14.7 (12.17)	31	14 (11.14)		37.0 %	0.06 [-0.45, 0.57]
Reinsch 1992	17	17.01 (10.6)	16	10.4 (10.5)		19.7 %	0.61 [-0.09, 1.31]
Wolfson 1996	20	16.6 (10.73)	19	9.4 (8.72)		22.8 %	0.72 [0.07, 1.37]
Subtotal (95% CI)	**83**		**81**			**100.0 %**	**0.33 [0.02, 0.64]**
Heterogeneity: Chi^2 = 3.47, df = 3 (P = 0.33); I^2 =13%							
Test for overall effect: Z = 2.08 (P = 0.038)							
2 Follow up @ 6 months post intervention							
Wolfson 1996	19	13.7 (11.33)	18	10.2 (10.18)		100.0 %	0.32 [-0.33, 0.97]
Subtotal (95% CI)	**19**		**18**			**100.0 %**	**0.32 [-0.33, 0.97]**
Heterogeneity: not applicable							
Test for overall effect: Z = 0.96 (P = 0.34)							
Test for subgroup differences: Chi^2 = 0.00, df = 1 (P = 0.97), I^2 =0.0%							

Analysis 1.11. Comparison 1 Gait, balance, co-ordination, functional tasks exercise versus control, Outcome 11 Single leg stance time eyes closed (s): higher values indicate better balance ability.

Review: Exercise for improving balance in older people

Comparison: 1 Gait, balance, co-ordination, functional tasks exercise versus control

Outcome: 11 Single leg stance time eyes closed (s): higher values indicate better balance ability

Study or subgroup	Exercise N	Mean(SD)	Control N	Mean(SD)	Mean Difference IV,Fixed,95% CI	Weight	Mean Difference IV,Fixed,95% CI
Johansson 1991	18	4.1 (1.7)	15	4.1 (1.8)		100.0 %	0.0 [-1.20, 1.20]
Total (95% CI)	**18**		**15**			**100.0 %**	**0.0 [-1.20, 1.20]**
Heterogeneity: not applicable							
Test for overall effect: Z = 0.0 (P = 1.0)							

Analysis 1.12. Comparison 1 Gait, balance, co-ordination, functional tasks exercise versus control, Outcome 12 Functional Reach Test: higher values indicate better balance ability.

Review: Exercise for improving balance in older people

Comparison: 1 Gait, balance, co-ordination, functional tasks exercise versus control

Outcome: 12 Functional Reach Test: higher values indicate better balance ability

Study or subgroup	Treatment N	Mean(SD)	Control N	Mean(SD)	Mean Difference IV,Fixed,95% CI	Weight	Mean Difference IV,Fixed,95% CI
McGarry 2001	12	10.3 (2.1)	10	9.7 (3.2)		100.0 %	0.60 [-1.71, 2.91]
Total (95% CI)	**12**		**10**			**100.0 %**	**0.60 [-1.71, 2.91]**

Heterogeneity: not applicable

Test for overall effect: Z = 0.51 (P = 0.61)

Analysis 1.13. Comparison 1 Gait, balance, co-ordination, functional tasks exercise versus control, Outcome 13 Timed up and go test (s): lower values indicate better balance ability.

Review: Exercise for improving balance in older people

Comparison: 1 Gait, balance, co-ordination, functional tasks exercise versus control

Outcome: 13 Timed up and go test (s): lower values indicate better balance ability

Study or subgroup	Exercise N	Mean(SD)	Control N	Mean(SD)	Mean Difference IV,Fixed,95% CI	Weight	Mean Difference IV,Fixed,95% CI
McGarry 2001	12	9.5 (1.9)	10	11 (2.7)		100.0 %	-1.50 [-3.49, 0.49]
Total (95% CI)	**12**		**10**			**100.0 %**	**-1.50 [-3.49, 0.49]**

Heterogeneity: not applicable

Test for overall effect: Z = 1.48 (P = 0.14)

Analysis 1.14. Comparison 1 Gait, balance, co-ordination, functional tasks exercise versus control, Outcome 14 Self paced gait speed: higher values indicate better balance ability.

Review: Exercise for improving balance in older people

Comparison: 1 Gait, balance, co-ordination, functional tasks exercise versus control

Outcome: 14 Self paced gait speed: higher values indicate better balance ability

Study or subgroup	Exercise N	Mean(SD)	Control N	Mean(SD)	Std. Mean Difference IV,Fixed,95% CI	Weight	Std. Mean Difference IV,Fixed,95% CI
1 Immediately post intervention							
Brouwer 2003	17	1.21 (0.19)	17	1.11 (0.26)		19.4 %	0.43 [-0.25, 1.11]
Johansson 1991	18	-15.7 (1.8)	15	-17.8 (3)		17.4 %	0.85 [0.13, 1.57]
MacRae 1994	28	1.1 (0.32)	31	1.16 (0.33)		34.3 %	-0.18 [-0.69, 0.33]
Wolfson 1996	24	1.18 (0.2)	26	1.14 (0.15)		29.0 %	0.22 [-0.33, 0.78]
Subtotal (95% CI)	**87**		**89**			**100.0 %**	**0.23 [-0.07, 0.53]**
Heterogeneity: Chi^2 = 5.65, df = 3 (P = 0.13); I^2 =47%							
Test for overall effect: Z = 1.52 (P = 0.13)							
2 Follow-up @ 6 months post intervention							
Wolfson 1996	22	1.18 (0.19)	23	1.12 (0.19)		100.0 %	0.31 [-0.28, 0.90]
Subtotal (95% CI)	**22**		**23**			**100.0 %**	**0.31 [-0.28, 0.90]**
Heterogeneity: not applicable							
Test for overall effect: Z = 1.03 (P = 0.30)							
3 Follow-up @ 6 weeks post intervention							
Brouwer 2003	14	1.18 (0.19)	16	1.11 (0.25)		100.0 %	0.30 [-0.42, 1.03]
Subtotal (95% CI)	**14**		**16**			**100.0 %**	**0.30 [-0.42, 1.03]**
Heterogeneity: not applicable							
Test for overall effect: Z = 0.82 (P = 0.41)							
Test for subgroup differences: Chi^2 = 0.07, df = 2 (P = 0.96), I^2 =0.0%							

Analysis 1.15. Comparison 1 Gait, balance, co-ordination, functional tasks exercise versus control, Outcome 15 Walking on a beam (m): higher values indicate better balance ability.

Review: Exercise for improving balance in older people

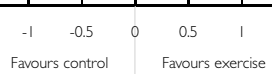
Comparison: 1 Gait, balance, co-ordination, functional tasks exercise versus control

Outcome: 15 Walking on a beam (m): higher values indicate better balance ability

Study or subgroup	Exercise N	Mean(SD)	Control N	Mean(SD)	Mean Difference IV,Fixed,95% CI	Weight	Mean Difference IV,Fixed,95% CI
Johansson 1991	18	7.9 (0.2)	15	7.9 (0.3)		100.0 %	0.0 [-0.18, 0.18]
Total (95% CI)	**18**		**15**			**100.0 %**	**0.0 [-0.18, 0.18]**

Heterogeneity: not applicable

Test for overall effect: Z = 0.0 (P = 1.0)



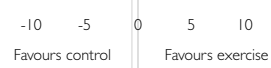
Analysis 1.16. Comparison 1 Gait, balance, co-ordination, functional tasks exercise versus control, Outcome 16 Berg Balance Scale (score out of 56) higher values indicate better balance ability.

Review: Exercise for improving balance in older people

Comparison: 1 Gait, balance, co-ordination, functional tasks exercise versus control

Outcome: 16 Berg Balance Scale (score out of 56) higher values indicate better balance ability

Study or subgroup	Exercise N	Mean(SD)	Control N	Mean(SD)	Mean Difference IV,Fixed,95% CI	Weight	Mean Difference IV,Fixed,95% CI
1 Immediately post intervention							
McGarry 2001	12	53.8 (2.1)	10	51.6 (2.5)		83.4 %	2.20 [0.25, 4.15]
Sihvonen 2004	20	51.95 (4.3)	7	44.9 (10)		5.4 %	7.05 [-0.59, 14.69]
Wolf 2001	37	42.5 (11.11)	40	38 (12.75)		11.2 %	4.50 [-0.83, 9.83]
Subtotal (95% CI)	**69**		**57**			**100.0 %**	**2.72 [0.94, 4.50]**
Heterogeneity: Chi^2 = 1.93, df = 2 (P = 0.38); I^2 =0.0%							
Test for overall effect: Z = 2.99 (P = 0.0028)							
2 Follow up @ 4 weeks post intervention							
Wolf 2001	37	41.5 (10.93)	40	37.9 (13.87)		100.0 %	3.60 [-1.96, 9.16]
Subtotal (95% CI)	**37**		**40**			**100.0 %**	**3.60 [-1.96, 9.16]**
Heterogeneity: not applicable							
Test for overall effect: Z = 1.27 (P = 0.20)							



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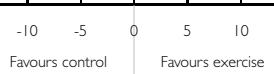
Study or subgroup	Exercise N	Mean(SD)	Control N	Mean(SD)	Mean Difference IV,Fixed,95% CI	Weight	Mean Difference IV,Fixed,95% CI
3 Follow up @ 1 year post intervention							
Wolf 2001	24	36.79 (14.86)	25	36.12 (13.51)		100.0 %	0.67 [-7.29, 8.63]
Subtotal (95% CI)	**24**		**25**			**100.0 %**	**0.67 [-7.29, 8.63]**

Heterogeneity: not applicable

Test for overall effect: Z = 0.16 (P = 0.87)

Test for subgroup differences: Chi^2 = 0.35, df = 2 (P = 0.84), I^2 =0.0%



Analysis 2.1. Comparison 2 Strengthening exercise versus control, Outcome 1 Functional base of support during dynamic test (distance): higher values indicate better balance ability.

Review: Exercise for improving balance in older people

Comparison: 2 Strengthening exercise versus control

Outcome: 1 Functional base of support during dynamic test (distance): higher values indicate better balance ability

Study or subgroup	Exercise N	Mean(SD)	Control N	Mean(SD)	Mean Difference IV,Fixed,95% CI	Weight	Mean Difference IV,Fixed,95% CI
1 Immediately post intervention							
Wolfson 1996	18	0.39 (0.13)	16	0.4 (0.12)		100.0 %	-0.01 [-0.09, 0.07]
Subtotal (95% CI)	**18**		**16**			**100.0 %**	**-0.01 [-0.09, 0.07]**

Heterogeneity: not applicable

Test for overall effect: Z = 0.23 (P = 0.82)

2 Follow-up @ 6 months post intervention							
Wolfson 1996	12	0.37 (0.14)	15	0.37 (0.12)		100.0 %	0.0 [-0.10, 0.10]
Subtotal (95% CI)	**12**		**15**			**100.0 %**	**0.0 [-0.10, 0.10]**

Heterogeneity: not applicable

Test for overall effect: Z = 0.0 (P = 1.0)

Test for subgroup differences: Chi^2 = 0.02, df = 1 (P = 0.88), I^2 =0.0%

Analysis 2.2. Comparison 2 Strengthening exercise versus control, Outcome 2 Loss of balance during sensory organisation test (errors): less errors indicate better balance ability.

Review: Exercise for improving balance in older people

Comparison: 2 Strengthening exercise versus control

Outcome: 2 Loss of balance during sensory organisation test (errors): less errors indicate better balance ability

Study or subgroup	Exercise N	Mean(SD)	Control N	Mean(SD)	Mean Difference IV,Fixed,95% CI	Weight	Mean Difference IV,Fixed,95% CI
1 Immediately post intervention							
Wolfson 1996	26	2.1 (2.04)	26	2.5 (2.55)		100.0 %	-0.40 [-1.66, 0.86]
Subtotal (95% CI)	**26**		**26**			**100.0 %**	**-0.40 [-1.66, 0.86]**
Heterogeneity: not applicable							
Test for overall effect: Z = 0.62 (P = 0.53)							
2 Follow-up @ 6 months post intervention							
Wolfson 1996	19	2 (2.62)	23	2.1 (2.4)		100.0 %	-0.10 [-1.63, 1.43]
Subtotal (95% CI)	**19**		**23**			**100.0 %**	**-0.10 [-1.63, 1.43]**
Heterogeneity: not applicable							
Test for overall effect: Z = 0.13 (P = 0.90)							
Test for subgroup differences: Chi^2 = 0.09, df = 1 (P = 0.77), I^2 =0.0%							

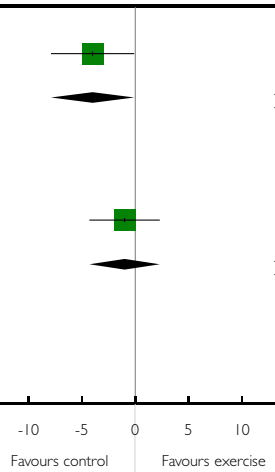
Analysis 2.3. Comparison 2 Strengthening exercise versus control, Outcome 3 Tilt board (s) post-pre change scores: higher values indicate better balance ability.

Review: Exercise for improving balance in older people

Comparison: 2 Strengthening exercise versus control

Outcome: 3 Tilt board (s) post-pre change scores: higher values indicate better balance ability

Study or subgroup	Exercise N	Mean(SD)	Control N	Mean(SD)	Mean Difference IV,Fixed,95% CI	Weight	Mean Difference IV,Fixed,95% CI
1 Omnidirectional tilt board (s)							
Buchner 1997a	22	0 (5)	29	4 (9)		100.0 %	-4.00 [-7.89, -0.11]
Subtotal (95% CI)	**22**		**29**			**100.0 %**	**-4.00 [-7.89, -0.11]**
Heterogeneity: not applicable							
Test for overall effect: Z = 2.02 (P = 0.044)							
2 AP tilt board (s)							
Buchner 1997a	22	1 (6)	29	2 (6)		100.0 %	-1.00 [-4.32, 2.32]
Subtotal (95% CI)	**22**		**29**			**100.0 %**	**-1.00 [-4.32, 2.32]**
Heterogeneity: not applicable							
Test for overall effect: Z = 0.59 (P = 0.56)							
Test for subgroup differences: Chi^2 = 1.32, df = 1 (P = 0.25), I^2 =24%							



Analysis 2.4. Comparison 2 Strengthening exercise versus control, Outcome 4 Single leg stance time eyes open (s): higher values indicate better balance ability.

Review: Exercise for improving balance in older people

Comparison: 2 Strengthening exercise versus control

Outcome: 4 Single leg stance time eyes open (s): higher values indicate better balance ability

Study or subgroup	Exercise N	Mean(SD)	Control N	Mean(SD)	Std. Mean Difference IV,Fixed,95% CI	Weight	Std. Mean Difference IV,Fixed,95% CI
Buchner 1997a	22	2 (7)	29	1 (8)		30.6 %	0.13 [-0.42, 0.68]
Rooks 1997a	37	39.1 (22.8)	44	22.5 (22.4)		46.1 %	0.73 [0.28, 1.18]
Wolfson 1996	19	10 (10.9)	19	9.4 (8.72)		23.3 %	0.06 [-0.58, 0.70]
Total (95% CI)	**78**		**92**			**100.0 %**	**0.39 [0.08, 0.70]**
Heterogeneity: Chi^2 = 4.03, df = 2 (P = 0.13); I^2 =50%							
Test for overall effect: Z = 2.49 (P = 0.013)							

Analysis 2.5. Comparison 2 Strengthening exercise versus control, Outcome 5 Single leg stance time eyes closed (s): higher values indicate better balance ability.

Review: Exercise for improving balance in older people

Comparison: 2 Strengthening exercise versus control

Outcome: 5 Single leg stance time eyes closed (s): higher values indicate better balance ability

Study or subgroup	Exercise N	Mean(SD)	Control N	Mean(SD)	Std. Mean Difference IV,Random,95% CI	Weight	Std. Mean Difference IV,Random,95% CI
1 Immediately post intervention							
Rooks 1997a	37	3.6 (2.4)	44	1.9 (1.3)		53.9 %	0.89 [0.43, 1.35]
Wolfson 1996	19	10 (10.9)	19	9.4 (8.72)		46.1 %	0.06 [-0.58, 0.70]
Subtotal (95% CI)	**56**		**63**			**100.0 %**	**0.51 [-0.31, 1.32]**
Heterogeneity: Tau^2 = 0.27; Chi^2 = 4.35, df = 1 (P = 0.04); I^2 =77%							
Test for overall effect: Z = 1.22 (P = 0.22)							
2 Follow up @ 6 months post intervention							
Wolfson 1996	13	9.3 (9.73)	18	10.2 (10.18)		100.0 %	-0.09 [-0.80, 0.63]
Subtotal (95% CI)	**13**		**18**			**100.0 %**	**-0.09 [-0.80, 0.63]**
Heterogeneity: not applicable							
Test for overall effect: Z = 0.24 (P = 0.81)							

Analysis 2.6. Comparison 2 Strengthening exercise versus control, Outcome 6 Tandem walk over 10 feet (s): higher values indicate better balance ability.

Review: Exercise for improving balance in older people

Comparison: 2 Strengthening exercise versus control

Outcome: 6 Tandem walk over 10 feet (s): higher values indicate better balance ability

Study or subgroup	Exercise N	Mean(SD)	Control N	Mean(SD)	Mean Difference IV,Fixed,95% CI	Weight	Mean Difference IV,Fixed,95% CI
Rooks 1997a	37	10.2 (6.2)	44	12.2 (4.5)		100.0 %	-2.00 [-4.40, 0.40]
Total (95% CI)	**37**		**44**			**100.0 %**	**-2.00 [-4.40, 0.40]**

Heterogeneity: not applicable

Test for overall effect: Z = 1.63 (P = 0.10)

Analysis 2.7. Comparison 2 Strengthening exercise versus control, Outcome 7 Tandem stance (s): higher values indicate better balance ability.

Review: Exercise for improving balance in older people

Comparison: 2 Strengthening exercise versus control

Outcome: 7 Tandem stance (s): higher values indicate better balance ability

Study or subgroup	Execise N	Mean(SD)	Control N	Mean(SD)	Std. Mean Difference IV,Random,95% CI	Weight	Std. Mean Difference IV,Random,95% CI
Boshuizen 2005	16	3.9 (4.3)	17	4.6 (4.9)		29.0 %	-0.15 [-0.83, 0.54]
Buchner 1997a	22	0 (2.8)	29	0 (3.2)		33.6 %	0.0 [-0.55, 0.55]
Rooks 1997a	37	54.3 (14.5)	44	39.5 (22.9)		37.4 %	0.75 [0.30, 1.20]
Total (95% CI)	**75**		**90**			**100.0 %**	**0.24 [-0.34, 0.82]**

Heterogeneity: Tau^2 = 0.18; Chi^2 = 6.55, df = 2 (P = 0.04); I^2 =69%

Test for overall effect: Z = 0.80 (P = 0.42)

Analysis 2.8. Comparison 2 Strengthening exercise versus control, Outcome 8 Functional Reach Test (FRT) (cm) pre-post change scores: lower values indicate better balance ability.

Review: Exercise for improving balance in older people

Comparison: 2 Strengthening exercise versus control

Outcome: 8 Functional Reach Test (FRT) (cm) pre-post change scores: lower values indicate better balance ability

Study or subgroup	Exercise N	Mean(SD)	Control N	Mean(SD)	Mean Difference IV,Fixed,95% CI	Weight	Mean Difference IV,Fixed,95% CI
Cress 1999	23	-2.14 (6.9)	26	2.19 (6.1)		100.0 %	-4.33 [-8.00, -0.66]
Total (95% CI)	**23**		**26**			**100.0 %**	**-4.33 [-8.00, -0.66]**

Heterogeneity: not applicable

Test for overall effect: Z = 2.31 (P = 0.021)

Analysis 2.9. Comparison 2 Strengthening exercise versus control, Outcome 9 Timed up and go test (TUG) (s): lower values indicate better balance ability.

Review: Exercise for improving balance in older people

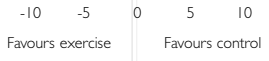
Comparison: 2 Strengthening exercise versus control

Outcome: 9 Timed up and go test (TUG) (s): lower values indicate better balance ability

Study or subgroup	Exercise N	Mean(SD)	Control N	Mean(SD)	Mean Difference IV,Fixed,95% CI	Weight	Mean Difference IV,Fixed,95% CI
Boshuizen 2005	16	14 (7.5)	17	17.5 (10.5)		100.0 %	-3.50 [-9.70, 2.70]
Total (95% CI)	**16**		**17**			**100.0 %**	**-3.50 [-9.70, 2.70]**

Heterogeneity: not applicable

Test for overall effect: Z = 1.11 (P = 0.27)



Analysis 2.10. Comparison 2 Strengthening exercise versus control, Outcome 10 Gait speed: higher values indicate better balance ability.

Review: Exercise for improving balance in older people

Comparison: 2 Strengthening exercise versus control

Outcome: 10 Gait speed: higher values indicate better balance ability

Study or subgroup	Exercise N	Mean(SD)	Control N	Mean(SD)	Std. Mean Difference IV,Fixed,95% CI	Weight	Std. Mean Difference IV,Fixed,95% CI
1 Immediately post intervention							
Boshuizen 2005	16	-25.27 (8.2)	17	-31.9 (20.4)		10.8 %	0.41 [-0.28, 1.10]
Buchner 1997a	22	2 (9)	29	0.2 (9)		16.7 %	0.20 [-0.36, 0.75]
Cress 1999	23	0.06 (0.16)	26	-0.01 (0.13)		15.9 %	0.48 [-0.09, 1.05]
Krebs 1998	54	108.1 (23.9)	66	103.6 (27.6)		39.7 %	0.17 [-0.19, 0.53]
Wolfson 1996	25	1.17 (0.2)	26	1.14 (0.15)		17.0 %	0.17 [-0.38, 0.72]
Subtotal (95% CI)	**140**		**164**			**100.0 %**	**0.25 [0.02, 0.48]**
Heterogeneity: Chi^2 = 1.11, df = 4 (P = 0.89); I^2 =0.0%							
Test for overall effect: Z = 2.15 (P = 0.031)							
2 Follow-up @ 6 months post intervention							
Wolfson 1996	19	1.17 (0.22)	23	1.12 (0.19)		100.0 %	0.24 [-0.37, 0.85]
Subtotal (95% CI)	**19**		**23**			**100.0 %**	**0.24 [-0.37, 0.85]**
Heterogeneity: not applicable							
Test for overall effect: Z = 0.77 (P = 0.44)							
Test for subgroup differences: Chi^2 = 0.00, df = 1 (P = 0.98), I^2 =0.0%							

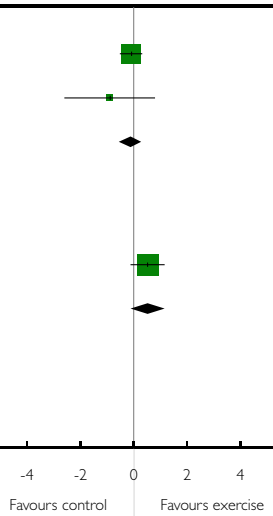
Analysis 2.11. Comparison 2 Strengthening exercise versus control, Outcome 11 Balance beam: post-pre change scores (s): higher values indicate better balance ability.

Review: Exercise for improving balance in older people

Comparison: 2 Strengthening exercise versus control

Outcome: 11 Balance beam: post-pre change scores (s): higher values indicate better balance ability

Study or subgroup	Exercise N	Mean(SD)	Control N	Mean(SD)	Mean Difference IV,Fixed,95% CI	Weight	Mean Difference IV,Fixed,95% CI
1 Wide beam							
Buchner 1997a	22	0.2 (0.6)	29	0.3 (0.9)		94.4 %	-0.10 [-0.51, 0.31]
Cress 1999	23	1.8 (0.01)	26	2.7 (4.4)		5.6 %	-0.90 [-2.59, 0.79]
Subtotal (95% CI)	**45**		**55**			**100.0 %**	**-0.14 [-0.55, 0.26]**
Heterogeneity: Chi² = 0.81, df = 1 (P = 0.37); I² =0.0%							
Test for overall effect: Z = 0.71 (P = 0.48)							
2 Narrow beam							
Buchner 1997a	22	0.5 (1.2)	29	0 (1.1)		100.0 %	0.50 [-0.14, 1.14]
Subtotal (95% CI)	**22**		**29**			**100.0 %**	**0.50 [-0.14, 1.14]**
Heterogeneity: not applicable							
Test for overall effect: Z = 1.53 (P = 0.13)							
Test for subgroup differences: Chi² = 2.79, df = 1 (P = 0.09), I² =64%							



Analysis 3.1. Comparison 3 3D (Tai Chi, Gi Gong, dance, yoga) versus control, Outcome 1 AP stability during stance (quiet and dynamic) eyes open: lower values indicate better balance ability.

Review: Exercise for improving balance in older people

Comparison: 3 3D (Tai Chi, Gi Gong, dance, yoga) versus control

Outcome: 1 AP stability during stance (quiet and dynamic) eyes open: lower values indicate better balance ability

Study or subgroup	Exercise N	Mean(SD)	Control N	Mean(SD)	Std. Mean Difference IV,Fixed,95% CI	Weight	Std. Mean Difference IV,Fixed,95% CI
1 Immediately post intervention							
Buchner 1997b	22	-1 (6)	30	0 (4)		59.5 %	-0.20 [-0.75, 0.35]
Wolf 1997	16	3.69 (4.48)	19	4.98 (4.07)		40.5 %	-0.30 [-0.96, 0.37]
Subtotal (95% CI)	**38**		**49**			**100.0 %**	**-0.24 [-0.66, 0.19]**
Heterogeneity: Chi^2 = 0.05, df = 1 (P = 0.83); I^2 =0.0%							
Test for overall effect: Z = 1.10 (P = 0.27)							
2 Follow-up @ 3 months post intervention							
Buchner 1997b	19	-1 (5)	29	-2 (6)		100.0 %	0.17 [-0.40, 0.75]
Subtotal (95% CI)	**19**		**29**			**100.0 %**	**0.17 [-0.40, 0.75]**
Heterogeneity: not applicable							
Test for overall effect: Z = 0.59 (P = 0.55)							
3 Follow-up @ 4 months post intervention							
Wolf 1997	16	4.02 (3.11)	19	4.52 (3.36)		100.0 %	-0.15 [-0.82, 0.52]
Subtotal (95% CI)	**16**		**19**			**100.0 %**	**-0.15 [-0.82, 0.52]**
Heterogeneity: not applicable							
Test for overall effect: Z = 0.44 (P = 0.66)							
Test for subgroup differences: Chi^2 = 1.29, df = 2 (P = 0.52), I^2 =0.0%							

Analysis 3.2. Comparison 3 3D (Tai Chi, Gi Gong, dance, yoga) versus control, Outcome 2 Mediolateral stability during stance (quiet and dynamic) eyes open: lower values indicate better balance.

Review: Exercise for improving balance in older people

Comparison: 3 3D (Tai Chi, Gi Gong, dance, yoga) versus control

Outcome: 2 Mediolateral stability during stance (quiet and dynamic) eyes open: lower values indicate better balance

Study or subgroup	Exercise N	Mean(SD)	Control N	Mean(SD)	Std. Mean Difference IV,Fixed,95% CI	Weight	Std. Mean Difference IV,Fixed,95% CI
1 Immediately post intervention							
Wolf 1997	19	3.42 (3.86)	19	2.48 (2.09)		100.0 %	0.30 [-0.34, 0.94]
Subtotal (95% CI)	**19**		**19**			**100.0 %**	**0.30 [-0.34, 0.94]**
Heterogeneity: not applicable							
Test for overall effect: Z = 0.91 (P = 0.36)							
3 Follow-up @ 4 months post intervention							
Wolf 1997	19	2.69 (2.19)	19	2.06 (1.88)		100.0 %	0.30 [-0.34, 0.94]
Subtotal (95% CI)	**19**		**19**			**100.0 %**	**0.30 [-0.34, 0.94]**
Heterogeneity: not applicable							
Test for overall effect: Z = 0.93 (P = 0.35)							
Test for subgroup differences: Chi^2 = 0.00, df = 1 (P = 0.99), I^2 =0.0%							

Analysis 3.3. Comparison 3 3D (Tai Chi, Gi Gong, dance, yoga) versus control, Outcome 3 AP stability during quiet stance eyes closed: lower values indicate better balance ability.

Review: Exercise for improving balance in older people

Comparison: 3 3D (Tai Chi, Gi Gong, dance, yoga) versus control

Outcome: 3 AP stability during quiet stance eyes closed: lower values indicate better balance ability

Study or subgroup	Exercise N	Mean(SD)	Control N	Mean(SD)	Std. Mean Difference IV,Fixed,95% CI	Weight	Std. Mean Difference IV,Fixed,95% CI
1 Immediately post intervention							
Wolf 1997	19	12.86 (7.35)	19	11.04 (9.79)		100.0 %	0.21 [-0.43, 0.84]
Subtotal (95% CI)	**19**		**19**			**100.0 %**	**0.21 [-0.43, 0.84]**
Heterogeneity: not applicable							
Test for overall effect: Z = 0.63 (P = 0.53)							
2 Follow up @ 4months post intervention							
Wolf 1997	19	9.18 (7.75)	19	6.51 (7.22)		100.0 %	0.35 [-0.29, 0.99]
Subtotal (95% CI)	**19**		**19**			**100.0 %**	**0.35 [-0.29, 0.99]**
Heterogeneity: not applicable							
Test for overall effect: Z = 1.07 (P = 0.29)							
Test for subgroup differences: Chi^2 = 0.10, df = 1 (P = 0.76), I^2 =0.0%							

Analysis 3.4. Comparison 3 3D (Tai Chi, Gi Gong, dance, yoga) versus control, Outcome 4 Mediolateral stability during quiet stance eyes closed: lower values indicate better balance ability.

Review: Exercise for improving balance in older people

Comparison: 3 3D (Tai Chi, Gi Gong, dance, yoga) versus control

Outcome: 4 Mediolateral stability during quiet stance eyes closed: lower values indicate better balance ability

Study or subgroup	Exercise N	Mean(SD)	Control N	Mean(SD)	Std. Mean Difference IV,Fixed,95% CI	Weight	Std. Mean Difference IV,Fixed,95% CI
1 Immediately post intervention							
Wolf 1997	19	5.4 (5.32)	19	5.39 (4.99)		100.0 %	0.00 [-0.63, 0.64]
Subtotal (95% CI)	**19**		**19**			**100.0 %**	**0.00 [-0.63, 0.64]**
Heterogeneity: not applicable							
Test for overall effect: Z = 0.01 (P = 1.0)							
2 Follow up @ 4 months post intervention							
Wolf 1997	19	6.78 (5.7)	19	6.41 (5.58)		100.0 %	0.06 [-0.57, 0.70]
Subtotal (95% CI)	**19**		**19**			**100.0 %**	**0.06 [-0.57, 0.70]**
Heterogeneity: not applicable							
Test for overall effect: Z = 0.20 (P = 0.84)							
Test for subgroup differences: Chi^2 = 0.02, df = 1 (P = 0.89), I^2 =0.0%							

Analysis 3.5. Comparison 3 3D (Tai Chi, Gi Gong, dance, yoga) versus control, Outcome 5 Area during narrow stance eyes open post-pre change scores (mm2/s): lower values indicate better balance.

Review: Exercise for improving balance in older people

Comparison: 3 3D (Tai Chi, Gi Gong, dance, yoga) versus control

Outcome: 5 Area during narrow stance eyes open post-pre change scores (mm2/s): lower values indicate better balance

Study or subgroup	Exercise N	Mean(SD)	Control N	Mean(SD)	Mean Difference IV,Fixed,95% CI	Weight	Mean Difference IV,Fixed,95% CI
1 Immediately post intervention							
Buchner 1997b	22	4 (24)	30	6 (48)		100.0 %	-2.00 [-21.89, 17.89]
Subtotal (95% CI)	**22**		**30**			**100.0 %**	**-2.00 [-21.89, 17.89]**
Heterogeneity: not applicable							
Test for overall effect: Z = 0.20 (P = 0.84)							
2 Follow-up @ 3 months post intervention							
Buchner 1997b	19	5 (25)	29	2 (47)		100.0 %	3.00 [-17.47, 23.47]
Subtotal (95% CI)	**19**		**29**			**100.0 %**	**3.00 [-17.47, 23.47]**
Heterogeneity: not applicable							
Test for overall effect: Z = 0.29 (P = 0.77)							
Test for subgroup differences: Chi^2 = 0.12, df = 1 (P = 0.73), I^2 =0.0%							

Analysis 3.6. Comparison 3 3D (Tai Chi, Gi Gong, dance, yoga) versus control, Outcome 6 Angular radius narrow stance eyes open post-pre change scores (mm): lower values indicate better balance.

Review: Exercise for improving balance in older people

Comparison: 3 3D (Tai Chi, Gi Gong, dance, yoga) versus control

Outcome: 6 Angular radius narrow stance eyes open post-pre change scores (mm): lower values indicate better balance

Study or subgroup	Exercise N	Mean(SD)	Control N	Mean(SD)	Mean Difference IV,Fixed,95% CI	Weight	Mean Difference IV,Fixed,95% CI
1 Immediately post intervention							
Buchner 1997b	22	0.3 (1.8)	30	0.4 (2)		100.0 %	-0.10 [-1.14, 0.94]
Subtotal (95% CI)	**22**		**30**			**100.0 %**	**-0.10 [-1.14, 0.94]**
Heterogeneity: not applicable							
Test for overall effect: Z = 0.19 (P = 0.85)							
2 Follow-up @ 3 months post intervention							
Buchner 1997b	19	0.3 (1.8)	29	0.3 (2.1)		100.0 %	0.0 [-1.11, 1.11]
Subtotal (95% CI)	**19**		**29**			**100.0 %**	**0.0 [-1.11, 1.11]**
Heterogeneity: not applicable							
Test for overall effect: Z = 0.0 (P = 1.0)							
Test for subgroup differences: Chi^2 = 0.02, df = 1 (P = 0.90), I^2 =0.0%							

Analysis 3.7. Comparison 3 3D (Tai Chi, Gi Gong, dance, yoga) versus control, Outcome 7 Area during narrow stance eyes closed post-pre change scores (mm2/s): lower values indicate better balance.

Review: Exercise for improving balance in older people

Comparison: 3 3D (Tai Chi, Gi Gong, dance, yoga) versus control

Outcome: 7 Area during narrow stance eyes closed post-pre change scores (mm2/s): lower values indicate better balance

Study or subgroup	Exercise N	Mean(SD)	Control N	Mean(SD)	Mean Difference IV,Fixed,95% CI	Weight	Mean Difference IV,Fixed,95% CI
1 Immediately post intervention							
Buchner 1997b	22	2 (86)	30	-27 (127)		100.0 %	29.00 [-28.94, 86.94]
Subtotal (95% CI)	**22**		**30**			**100.0 %**	**29.00 [-28.94, 86.94]**
Heterogeneity: not applicable							
Test for overall effect: Z = 0.98 (P = 0.33)							
2 Follow-up @ 3 months post intervention							
Buchner 1997b	19	0 (91)	29	-39 (113)		100.0 %	39.00 [-19.01, 97.01]
Subtotal (95% CI)	**19**		**29**			**100.0 %**	**39.00 [-19.01, 97.01]**
Heterogeneity: not applicable							
Test for overall effect: Z = 1.32 (P = 0.19)							
Test for subgroup differences: Chi^2 = 0.06, df = 1 (P = 0.81), I^2 =0.0%							

Analysis 3.8. Comparison 3 3D (Tai Chi, Gi Gong, dance, yoga) versus control, Outcome 8 Angular radius narrow stance eyes closed post-pre change scores (mm): lower values indicate better balance.

Review: Exercise for improving balance in older people

Comparison: 3 3D (Tai Chi, Gi Gong, dance, yoga) versus control

Outcome: 8 Angular radius narrow stance eyes closed post-pre change scores (mm): lower values indicate better balance

Study or subgroup	Exercise N	Mean(SD)	Control N	Mean(SD)	Mean Difference IV,Fixed,95% CI	Weight	Mean Difference IV,Fixed,95% CI
1 Immediately post intervention							
Buchner 1997b	22	-0.1 (2.7)	30	-0.5 (3.3)		100.0 %	0.40 [-1.23, 2.03]
Subtotal (95% CI)	**22**		**30**			**100.0 %**	**0.40 [-1.23, 2.03]**
Heterogeneity: not applicable							
Test for overall effect: Z = 0.48 (P = 0.63)							
2 Follow-up @ 3 months post intervention							
Buchner 1997b	19	-0.3 (2.7)	29	-0.7 (3.2)		100.0 %	0.40 [-1.28, 2.08]
Subtotal (95% CI)	**19**		**29**			**100.0 %**	**0.40 [-1.28, 2.08]**
Heterogeneity: not applicable							
Test for overall effect: Z = 0.47 (P = 0.64)							
Test for subgroup differences: Chi^2 = 0.00, df = 1 (P = 1.00), I^2 =0.0%							

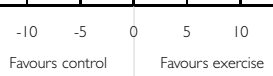
Analysis 3.9. Comparison 3 3D (Tai Chi, Gi Gong, dance, yoga) versus control, Outcome 9 Omnidirectional tilt board post-pre change scores (s): higher values indicate better balance ability.

Review: Exercise for improving balance in older people

Comparison: 3 3D (Tai Chi, Gi Gong, dance, yoga) versus control

Outcome: 9 Omnidirectional tilt board post-pre change scores (s): higher values indicate better balance ability

Study or subgroup	Exercise N	Mean(SD)	Control N	Mean(SD)	Mean Difference IV,Fixed,95% CI	Weight	Mean Difference IV,Fixed,95% CI
1 Immediately post intervention							
Buchner 1997b	22	0 (6)	30	3 (9)		100.0 %	-3.00 [-7.08, 1.08]
Subtotal (95% CI)	**22**		**30**			**100.0 %**	**-3.00 [-7.08, 1.08]**
Heterogeneity: not applicable							
Test for overall effect: Z = 1.44 (P = 0.15)							
2 Follow-up @ 3 months post intervention							
Buchner 1997b	19	1 (7)	29	4 (9)		100.0 %	-3.00 [-7.54, 1.54]
Subtotal (95% CI)	**19**		**29**			**100.0 %**	**-3.00 [-7.54, 1.54]**
Heterogeneity: not applicable							
Test for overall effect: Z = 1.29 (P = 0.20)							
Test for subgroup differences: Chi^2 = 0.00, df = 1 (P = 1.00), I^2 =0.0%							



Analysis 3.10. Comparison 3 3D (Tai Chi, Gi Gong, dance, yoga) versus control, Outcome 10 Single leg stance time eyes open (s): higher values indicate better balance ability.

Review: Exercise for improving balance in older people

Comparison: 3 3D (Tai Chi, Gi Gong, dance, yoga) versus control

Outcome: 10 Single leg stance time eyes open (s): higher values indicate better balance ability

Study or subgroup	Exercise N	Mean(SD)	Control N	Mean(SD)	Std. Mean Difference IV,Random,95% CI	Weight	Std. Mean Difference IV,Random,95% CI
Shigematsu 2002	20	24.6 (17.3)	18	16.6 (15.8)		50.4 %	0.47 [-0.17, 1.12]
Zhang 2006	24	25.7 (6.3)	23	16.1 (3.8)		49.6 %	1.81 [1.12, 2.49]
Total (95% CI)	**44**		**41**			**100.0 %**	**1.13 [-0.17, 2.44]**
Heterogeneity: Tau^2 = 0.77; Chi^2 = 7.67, df = 1 (P = 0.01); I^2 =87%							
Test for overall effect: Z = 1.70 (P = 0.089)							

Analysis 3.11. Comparison 3 3D (Tai Chi, Gi Gong, dance, yoga) versus control, Outcome 11 Single leg stance time eyes closed (s): higher values indicate better balance ability.

Review: Exercise for improving balance in older people

Comparison: 3 3D (Tai Chi, Gi Gong, dance, yoga) versus control

Outcome: 11 Single leg stance time eyes closed (s): higher values indicate better balance ability

Study or subgroup	Exercise N	Mean(SD)	Control N	Mean(SD)	Mean Difference IV,Fixed,95% CI	Weight	Mean Difference IV,Fixed,95% CI
Shigematsu 2002	20	4.1 (2)	18	5.3 (5.3)		100.0 %	-1.20 [-3.80, 1.40]
Total (95% CI)	**20**		**18**			**100.0 %**	**-1.20 [-3.80, 1.40]**

Heterogeneity: not applicable

Test for overall effect: Z = 0.90 (P = 0.37)

Analysis 3.12. Comparison 3 3D (Tai Chi, Gi Gong, dance, yoga) versus control, Outcome 12 Functional Reach Test (cm): higher values indicate better balance ability.

Review: Exercise for improving balance in older people

Comparison: 3 3D (Tai Chi, Gi Gong, dance, yoga) versus control

Outcome: 12 Functional Reach Test (cm): higher values indicate better balance ability

Study or subgroup	Exercise N	Mean(SD)	Control N	Mean(SD)	Mean Difference IV,Fixed,95% CI	Weight	Mean Difference IV,Fixed,95% CI
Shigematsu 2002	20	26.1 (3.6)	18	23.3 (7.6)		100.0 %	2.80 [-1.05, 6.65]
Total (95% CI)	**20**		**18**			**100.0 %**	**2.80 [-1.05, 6.65]**

Heterogeneity: not applicable

Test for overall effect: Z = 1.43 (P = 0.15)

Analysis 3.13. Comparison 3 3D (Tai Chi, Gi Gong, dance, yoga) versus control, Outcome 13 Gait speed: higher values indicate better balance ability.

Review: Exercise for improving balance in older people

Comparison: 3 3D (Tai Chi, Gi Gong, dance, yoga) versus control

Outcome: 13 Gait speed: higher values indicate better balance ability

Study or subgroup	Exercise N	Mean(SD)	Control N	Mean(SD)	Std. Mean Difference IV,Fixed,95% CI	Weight	Std. Mean Difference IV,Fixed,95% CI
1 Immediately post intervention							
Buchner 1997b	22	1 (8)	30	1 (6)		52.0 %	0.0 [-0.55, 0.55]
Zhang 2006	24	-7.6 (0.9)	23	-7.7 (0.9)		48.0 %	0.11 [-0.46, 0.68]
Subtotal (95% CI)	**46**		**53**			**100.0 %**	**0.05 [-0.34, 0.45]**
Heterogeneity: Chi^2 = 0.07, df = 1 (P = 0.79); I^2 =0.0%							
Test for overall effect: Z = 0.26 (P = 0.80)							
2 Follow-up @ 3 months post intervention							
Buchner 1997b	19	1 (11)	29	0 (9)		100.0 %	0.10 [-0.48, 0.68]
Subtotal (95% CI)	**19**		**29**			**100.0 %**	**0.10 [-0.48, 0.68]**
Heterogeneity: not applicable							
Test for overall effect: Z = 0.34 (P = 0.73)							
Test for subgroup differences: Chi^2 = 0.02, df = 1 (P = 0.89), I^2 =0.0%							

Analysis 3.14. Comparison 3 3D (Tai Chi, Gi Gong, dance, yoga) versus control, Outcome 14 Wide balance beam post-pre change scores (m/s): higher values indicate better balance ability.

Review: Exercise for improving balance in older people

Comparison: 3 3D (Tai Chi, Gi Gong, dance, yoga) versus control

Outcome: 14 Wide balance beam post-pre change scores (m/s): higher values indicate better balance ability

Study or subgroup	Exercise N	Mean(SD)	Control N	Mean(SD)	Mean Difference IV,Fixed,95% CI	Weight	Mean Difference IV,Fixed,95% CI
1 Immediately post intervention							
Buchner 1997b	22	-0.1 (0.11)	30	0 (0.1)		100.0 %	-0.10 [-0.16, -0.04]
Subtotal (95% CI)	**22**		**30**			**100.0 %**	**-0.10 [-0.16, -0.04]**
Heterogeneity: not applicable							
Test for overall effect: Z = 3.36 (P = 0.00077)							
2 Follow-up @3 months post intervention							
Buchner 1997b	19	-0.1 (0.16)	29	-0.03 (0.18)		100.0 %	-0.07 [-0.17, 0.03]
Subtotal (95% CI)	**19**		**29**			**100.0 %**	**-0.07 [-0.17, 0.03]**
Heterogeneity: not applicable							
Test for overall effect: Z = 1.41 (P = 0.16)							
Test for subgroup differences: Chi^2 = 0.27, df = 1 (P = 0.60), I^2 =0.0%							

Analysis 3.15. Comparison 3 3D (Tai Chi, Gi Gong, dance, yoga) versus control, Outcome 15 Narrow balance beam post-pre change scores (m/s): higher values indicate better balance ability.

Review: Exercise for improving balance in older people

Comparison: 3 3D (Tai Chi, Gi Gong, dance, yoga) versus control

Outcome: 15 Narrow balance beam post-pre change scores (m/s): higher values indicate better balance ability

Study or subgroup	Exercise N	Mean(SD)	Control N	Mean(SD)	Mean Difference IV,Fixed,95% CI	Weight	Mean Difference IV,Fixed,95% CI
1 Immediately post intervention							
Buchner 1997b	22	0.6 (1.7)	30	-0.2 (1.1)		100.0 %	0.80 [-0.01, 1.61]
Subtotal (95% CI)	**22**		**30**			**100.0 %**	**0.80 [-0.01, 1.61]**
Heterogeneity: not applicable							
Test for overall effect: Z = 1.93 (P = 0.054)							
2 Follow-up @3 months post intervention							
Buchner 1997b	19	0.7 (1.5)	29	0 (1.1)		100.0 %	0.70 [-0.08, 1.48]
Subtotal (95% CI)	**19**		**29**			**100.0 %**	**0.70 [-0.08, 1.48]**
Heterogeneity: not applicable							
Test for overall effect: Z = 1.75 (P = 0.080)							
Test for subgroup differences: Chi^2 = 0.03, df = 1 (P = 0.86), I^2 =0.0%							

Analysis 4.1. Comparison 4 General physical activity versus control, Outcome 1 Postural sway double stance (post-pre change scores): lower values indicate better balance ability.

Review: Exercise for improving balance in older people

Comparison: 4 General physical activity versus control

Outcome: 1 Postural sway double stance (post-pre change scores): lower values indicate better balance ability

Study or subgroup	Exercise N	Mean(SD)	Control N	Mean(SD)	Mean Difference IV,Fixed,95% CI	Weight	Mean Difference IV,Fixed,95% CI
1 Eyes open							
McMurdo 1993	15	-9.6 (17.7)	26	-2.9 (16.1)		100.0 %	-6.70 [-17.59, 4.19]
Subtotal (95% CI)	**15**		**26**			**100.0 %**	**-6.70 [-17.59, 4.19]**
Heterogeneity: not applicable							
Test for overall effect: Z = 1.21 (P = 0.23)							
2 Eyes closed							
McMurdo 1993	15	-16.6 (32.3)	26	-10.9 (34.8)		100.0 %	-5.70 [-26.82, 15.42]
Subtotal (95% CI)	**15**		**26**			**100.0 %**	**-5.70 [-26.82, 15.42]**
Heterogeneity: not applicable							
Test for overall effect: Z = 0.53 (P = 0.60)							
Test for subgroup differences: Chi^2 = 0.01, df = 1 (P = 0.93), I^2 =0.0%							

Analysis 4.2. Comparison 4 General physical activity versus control, Outcome 2 Functional Reach Test (cm): higher values indicate better balance ability.

Review: Exercise for improving balance in older people

Comparison: 4 General physical activity versus control

Outcome: 2 Functional Reach Test (cm): higher values indicate better balance ability

Study or subgroup	Exercise N	Mean(SD)	Control N	Mean(SD)	Mean Difference IV,Fixed,95% CI	Weight	Mean Difference IV,Fixed,95% CI
Okumiya 1996	21	33.1 (5.5)	21	21.3 (7.7)		100.0 %	11.80 [7.75, 15.85]
Total (95% CI)	**21**		**21**			**100.0 %**	**11.80 [7.75, 15.85]**
Heterogeneity: not applicable							
Test for overall effect: Z = 5.71 (P < 0.00001)							

Analysis 4.3. Comparison 4 General physical activity versus control, Outcome 3 Timed up and go test (s): lower values indicate better balance ability.

Review: Exercise for improving balance in older people

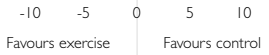
Comparison: 4 General physical activity versus control

Outcome: 3 Timed up and go test (s): lower values indicate better balance ability

Study or subgroup	Exercise N	Mean(SD)	Control N	Mean(SD)	Mean Difference IV,Fixed,95% CI	Weight	Mean Difference IV,Fixed,95% CI
Okumiya 1996	21	9.9 (1.9)	21	13.8 (4.1)		100.0 %	-3.90 [-5.83, -1.97]
Total (95% CI)	**21**		**21**			**100.0 %**	**-3.90 [-5.83, -1.97]**

Heterogeneity: not applicable

Test for overall effect: Z = 3.95 (P = 0.000077)



Analysis 5.1. Comparison 5 General physical activity (walking) versus control, Outcome 1 Area during narrow stance eyes open post-pre change scores (mm2/s): lower values indicate better balance.

Review: Exercise for improving balance in older people

Comparison: 5 General physical activity (walking) versus control

Outcome: 1 Area during narrow stance eyes open post-pre change scores (mm2/s): lower values indicate better balance

Study or subgroup	Exercise N	Mean(SD)	Control N	Mean(SD)	Mean Difference IV,Fixed,95% CI	Weight	Mean Difference IV,Fixed,95% CI
1 Immediately post intervention							
Buchner 1997b	22	2 (25)	30	6 (48)		100.0 %	-4.00 [-24.10, 16.10]
Subtotal (95% CI)	**22**		**30**			**100.0 %**	**-4.00 [-24.10, 16.10]**
Heterogeneity: not applicable							
Test for overall effect: Z = 0.39 (P = 0.70)							
2 Follow-up @ 3 months post intervention							
Buchner 1997b	22	3 (26)	29	2 (47)		100.0 %	1.00 [-19.26, 21.26]
Subtotal (95% CI)	**22**		**29**			**100.0 %**	**1.00 [-19.26, 21.26]**
Heterogeneity: not applicable							
Test for overall effect: Z = 0.10 (P = 0.92)							
Test for subgroup differences: Chi^2 = 0.12, df = 1 (P = 0.73), I^2 =0.0%							

Analysis 5.2. Comparison 5 General physical activity (walking) versus control, Outcome 2 Angular radius narrow stance eyes open post-pre change scores (mm): lower values indicate better balance.

Review: Exercise for improving balance in older people

Comparison: 5 General physical activity (walking) versus control

Outcome: 2 Angular radius narrow stance eyes open post-pre change scores (mm): lower values indicate better balance

Study or subgroup	Exercise N	Mean(SD)	Control N	Mean(SD)	Mean Difference IV,Fixed,95% CI	Weight	Mean Difference IV,Fixed,95% CI
1 Immediately post intervention							
Buchner 1997b	22	-0.1 (1.8)	30	0.4 (2)		100.0 %	-0.50 [-1.54, 0.54]
Subtotal (95% CI)	**22**		**30**			**100.0 %**	**-0.50 [-1.54, 0.54]**
Heterogeneity: not applicable							
Test for overall effect: Z = 0.94 (P = 0.35)							
2 Follow-up @ 3 months post intervention							
Buchner 1997b	22	-0.1 (1.8)	29	0.3 (2.1)		100.0 %	-0.40 [-1.47, 0.67]
Subtotal (95% CI)	**22**		**29**			**100.0 %**	**-0.40 [-1.47, 0.67]**
Heterogeneity: not applicable							
Test for overall effect: Z = 0.73 (P = 0.46)							
Test for subgroup differences: Chi^2 = 0.02, df = 1 (P = 0.90), I^2 =0.0%							

Analysis 5.3. Comparison 5 General physical activity (walking) versus control, Outcome 3 Area during narrow stance eyes closed post-pre change scores (mm2/s): lower values indicate better balance.

Review: Exercise for improving balance in older people

Comparison: 5 General physical activity (walking) versus control

Outcome: 3 Area during narrow stance eyes closed post-pre change scores (mm2/s): lower values indicate better balance

Study or subgroup	Exercise N	Mean(SD)	Control N	Mean(SD)	Mean Difference IV,Fixed,95% CI	Weight	Mean Difference IV,Fixed,95% CI
1 Immediately post intervention							
Buchner 1997b	22	75 (138)	30	-27 (127)		100.0 %	102.00 [28.58, 175.42]
Subtotal (95% CI)	**22**		**30**			**100.0 %**	**102.00 [28.58, 175.42]**
Heterogeneity: not applicable							
Test for overall effect: Z = 2.72 (P = 0.0065)							
2 Follow-up @ 3 months post intervention							
Buchner 1997b	22	79 (139)	29	-39 (113)		100.0 %	118.00 [46.83, 189.17]
Subtotal (95% CI)	**22**		**29**			**100.0 %**	**118.00 [46.83, 189.17]**
Heterogeneity: not applicable							
Test for overall effect: Z = 3.25 (P = 0.0012)							
Test for subgroup differences: Chi^2 = 0.09, df = 1 (P = 0.76), I^2 =0.0%							

Analysis 5.4. Comparison 5 General physical activity (walking) versus control, Outcome 4 Angular radius narrow stance eyes closed post-pre change scores (mm): lower values indicate better balance.

Review: Exercise for improving balance in older people

Comparison: 5 General physical activity (walking) versus control

Outcome: 4 Angular radius narrow stance eyes closed post-pre change scores (mm): lower values indicate better balance

Study or subgroup	Exercise N	Mean(SD)	Control N	Mean(SD)	Mean Difference IV,Fixed,95% CI	Weight	Mean Difference IV,Fixed,95% CI
1 Immediately post intervention							
Buchner 1997b	22	0.9 (2.8)	30	-0.5 (3.3)		100.0 %	1.40 [-0.26, 3.06]
Subtotal (95% CI)	**22**		**30**			**100.0 %**	**1.40 [-0.26, 3.06]**
Heterogeneity: not applicable							
Test for overall effect: Z = 1.65 (P = 0.099)							
2 Follow-up @ 3 months post intervention							
Buchner 1997b	22	0.9 (2.8)	29	-0.7 (3.2)		100.0 %	1.60 [-0.05, 3.25]
Subtotal (95% CI)	**22**		**29**			**100.0 %**	**1.60 [-0.05, 3.25]**
Heterogeneity: not applicable							
Test for overall effect: Z = 1.90 (P = 0.057)							
Test for subgroup differences: Chi^2 = 0.03, df = 1 (P = 0.87), I^2 =0.0%							

Analysis 5.6. Comparison 5 General physical activity (walking) versus control, Outcome 6 Dynamic balance lateral axis (degrees): higher values indicate better balance ability.

Review: Exercise for improving balance in older people

Comparison: 5 General physical activity (walking) versus control

Outcome: 6 Dynamic balance lateral axis (degrees): higher values indicate better balance ability

Study or subgroup	Exercise N	Mean(SD)	Control N	Mean(SD)	Mean Difference IV,Fixed,95% CI	Weight	Mean Difference IV,Fixed,95% CI
1 Average position (degrees)							
Paillard 2004	11	0.9 (0.3)	10	1.1 (0.3)		100.0 %	-0.20 [-0.46, 0.06]
Subtotal (95% CI)	**11**		**10**			**100.0 %**	**-0.20 [-0.46, 0.06]**
Heterogeneity: not applicable							
Test for overall effect: Z = 1.53 (P = 0.13)							
2 Amplitude (degrees)							
Paillard 2004	11	6.3 (1.1)	10	8.8 (2.2)		100.0 %	-2.50 [-4.01, -0.99]
Subtotal (95% CI)	**11**		**10**			**100.0 %**	**-2.50 [-4.01, -0.99]**
Heterogeneity: not applicable							
Test for overall effect: Z = 3.24 (P = 0.0012)							
Test for subgroup differences: Chi^2 = 8.66, df = 1 (P = 0.00), I^2 =88%							

Analysis 5.7. Comparison 5 General physical activity (walking) versus control, Outcome 7 Omnidirectional tilt board post-pre change scores (s): higher values indicate better balance ability.

Review: Exercise for improving balance in older people

Comparison: 5 General physical activity (walking) versus control

Outcome: 7 Omnidirectional tilt board post-pre change scores (s): higher values indicate better balance ability

Study or subgroup	Exercise N	Mean(SD)	Control N	Mean(SD)	Mean Difference IV,Fixed,95% CI	Weight	Mean Difference IV,Fixed,95% CI
1 Immediately post intervention							
Buchner 1997b	22	0 (6)	30	3 (9)		100.0 %	-3.00 [-7.08, 1.08]
Subtotal (95% CI)	**22**		**30**			**100.0 %**	**-3.00 [-7.08, 1.08]**
Heterogeneity: not applicable							
Test for overall effect: Z = 1.44 (P = 0.15)							
2 Follow-up @ 3 months post intervention							
Buchner 1997b	22	1 (6)	29	4 (9)		100.0 %	-3.00 [-7.12, 1.12]
Subtotal (95% CI)	**22**		**29**			**100.0 %**	**-3.00 [-7.12, 1.12]**
Heterogeneity: not applicable							
Test for overall effect: Z = 1.43 (P = 0.15)							
Test for subgroup differences: Chi^2 = 0.0, df = 1 (P = 1.00), I^2 =0.0%							

Analysis 5.8. Comparison 5 General physical activity (walking) versus control, Outcome 8 AP tilt board post-pre change score (s): higher values indicate better balance ability.

Review: Exercise for improving balance in older people

Comparison: 5 General physical activity (walking) versus control

Outcome: 8 AP tilt board post-pre change score (s): higher values indicate better balance ability

Study or subgroup	Exercise N	Mean(SD)	Control N	Mean(SD)	Mean Difference IV,Fixed,95% CI	Weight	Mean Difference IV,Fixed,95% CI
1 Immediately post intervention							
Buchner 1997b	22	1 (4)	30	0 (4)		100.0 %	1.00 [-1.20, 3.20]
Subtotal (95% CI)	**22**		**30**			**100.0 %**	**1.00 [-1.20, 3.20]**
Heterogeneity: not applicable							
Test for overall effect: Z = 0.89 (P = 0.37)							
2 Follow-up @ 3 months post intervention							
Buchner 1997b	22	1 (4)	29	2 (6)		100.0 %	-1.00 [-3.75, 1.75]
Subtotal (95% CI)	**22**		**29**			**100.0 %**	**-1.00 [-3.75, 1.75]**
Heterogeneity: not applicable							
Test for overall effect: Z = 0.71 (P = 0.48)							
Test for subgroup differences: Chi^2 = 1.24, df = 1 (P = 0.27), I^2 =19%							

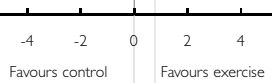
Analysis 5.9. Comparison 5 General physical activity (walking) versus control, Outcome 9 Single leg stance time eyes open (s): Higher values indicate better balance ability.

Review: Exercise for improving balance in older people

Comparison: 5 General physical activity (walking) versus control

Outcome: 9 Single leg stance time eyes open (s): Higher values indicate better balance ability

Study or subgroup	Exercise N	Mean(SD)	Control N	Mean(SD)	Std. Mean Difference IV,Fixed,95% CI	Weight	Std. Mean Difference IV,Fixed,95% CI
Rooks 1997a	25	21.8 (19.3)	44	22.5 (22.4)		72.7 %	-0.03 [-0.52, 0.46]
Shimada 2004	15	4.03 (3.43)	11	1.93 (2.6)		27.3 %	0.65 [-0.15, 1.46]
Total (95% CI)	**40**		**55**			**100.0 %**	**0.15 [-0.26, 0.57]**
Heterogeneity: Chi^2 = 2.05, df = 1 (P = 0.15); I^2 =51%							
Test for overall effect: Z = 0.72 (P = 0.47)							



Analysis 5.10. Comparison 5 General physical activity (walking) versus control, Outcome 10 Single leg stance time eyes closed (s): higher values indicate better balance ability.

Review: Exercise for improving balance in older people

Comparison: 5 General physical activity (walking) versus control

Outcome: 10 Single leg stance time eyes closed (s): higher values indicate better balance ability

Study or subgroup	Exercise N	Mean(SD)	Control N	Mean(SD)	Mean Difference IV,Fixed,95% CI	Weight	Mean Difference IV,Fixed,95% CI
Rooks 1997a	25	3.5 (2.6)	44	3.1 (2.7)		100.0 %	0.40 [-0.89, 1.69]
Total (95% CI)	**25**		**44**			**100.0 %**	**0.40 [-0.89, 1.69]**

Heterogeneity: not applicable

Test for overall effect: Z = 0.61 (P = 0.54)

Analysis 5.11. Comparison 5 General physical activity (walking) versus control, Outcome 11 Tandem walk over 10 feet (s): lower values indicate better balance ability.

Review: Exercise for improving balance in older people

Comparison: 5 General physical activity (walking) versus control

Outcome: 11 Tandem walk over 10 feet (s): lower values indicate better balance ability

Study or subgroup	Exercise N	Mean(SD)	Control N	Mean(SD)	Mean Difference IV,Fixed,95% CI	Weight	Mean Difference IV,Fixed,95% CI
Rooks 1997a	25	9.9 (2.9)	44	12.2 (4.5)		100.0 %	-2.30 [-4.05, -0.55]
Total (95% CI)	**25**		**44**			**100.0 %**	**-2.30 [-4.05, -0.55]**

Heterogeneity: not applicable

Test for overall effect: Z = 2.58 (P = 0.010)

Analysis 5.12. Comparison 5 General physical activity (walking) versus control, Outcome 12 Tandem stance (s): higher values indicate better balance ability.

Review: Exercise for improving balance in older people

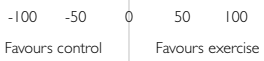
Comparison: 5 General physical activity (walking) versus control

Outcome: 12 Tandem stance (s): higher values indicate better balance ability

Study or subgroup	Execise N	Mean(SD)	Control N	Mean(SD)	Mean Difference IV,Fixed,95% CI	Weight	Mean Difference IV,Fixed,95% CI
Rooks 1997a	25	52.4 (15.1)	44	39.5 (22.9)		100.0 %	12.90 [3.91, 21.89]
Total (95% CI)	**25**		**44**			**100.0 %**	**12.90 [3.91, 21.89]**

Heterogeneity: not applicable

Test for overall effect: Z = 2.81 (P = 0.0049)



Analysis 5.13. Comparison 5 General physical activity (walking) versus control, Outcome 13 Functional Reach Test (cm): higher values indicate better balance ability.

Review: Exercise for improving balance in older people

Comparison: 5 General physical activity (walking) versus control

Outcome: 13 Functional Reach Test (cm): higher values indicate better balance ability

Study or subgroup	Treatment N	Mean(SD)	Control N	Mean(SD)	Mean Difference IV,Fixed,95% CI	Weight	Mean Difference IV,Fixed,95% CI
Shimada 2004	15	24.1 (6.16)	11	13.18 (8.45)		100.0 %	10.92 [5.03, 16.81]
Total (95% CI)	**15**		**11**			**100.0 %**	**10.92 [5.03, 16.81]**

Heterogeneity: not applicable

Test for overall effect: Z = 3.64 (P = 0.00028)

Analysis 5.14. Comparison 5 General physical activity (walking) versus control, Outcome 14 Self paced gait velocity (m/min): higher values indicate better balance ability.

Review: Exercise for improving balance in older people

Comparison: 5 General physical activity (walking) versus control

Outcome: 14 Self paced gait velocity (m/min): higher values indicate better balance ability

Study or subgroup	Exercise N	Mean(SD)	Control N	Mean(SD)	Std. Mean Difference IV,Fixed,95% CI	Weight	Std. Mean Difference IV,Fixed,95% CI
1 Immediately post intervention							
Buchner 1997b	22	4 (10)	30	1 (6)		70.5 %	0.37 [-0.18, 0.93]
Paillard 2004	11	73.94 (12.8)	10	76.46 (13.1)		29.5 %	-0.19 [-1.05, 0.67]
Subtotal (95% CI)	**33**		**40**			**100.0 %**	**0.21 [-0.26, 0.67]**
Heterogeneity: Chi^2 = 1.15, df = 1 (P = 0.28); I^2 =13%							
Test for overall effect: Z = 0.87 (P = 0.38)							
2 Follow-up @ 3 months post intervention							
Buchner 1997b	22	4 (9)	29	0 (9)		100.0 %	0.44 [-0.12, 1.00]
Subtotal (95% CI)	**22**		**29**			**100.0 %**	**0.44 [-0.12, 1.00]**
Heterogeneity: not applicable							
Test for overall effect: Z = 1.53 (P = 0.13)							
Test for subgroup differences: Chi^2 = 0.38, df = 1 (P = 0.54), I^2 =0.0%							

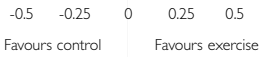
Analysis 5.15. Comparison 5 General physical activity (walking) versus control, Outcome 15 Wide balance beam post-pre change scores (m/s): higher values indicate better balance ability.

Review: Exercise for improving balance in older people

Comparison: 5 General physical activity (walking) versus control

Outcome: 15 Wide balance beam post-pre change scores (m/s): higher values indicate better balance ability

Study or subgroup	Exercise N	Mean(SD)	Control N	Mean(SD)	Mean Difference IV,Fixed,95% CI	Weight	Mean Difference IV,Fixed,95% CI
1 Immediately post intervention							
Buchner 1997b	22	0.06 (0.15)	30	0 (0.1)		100.0 %	0.06 [-0.01, 0.13]
Subtotal (95% CI)	**22**		**30**			**100.0 %**	**0.06 [-0.01, 0.13]**
Heterogeneity: not applicable							
Test for overall effect: Z = 1.63 (P = 0.10)							
2 Follow-up @3 months post intervention							
Buchner 1997b	22	0.05 (0.15)	29	-0.03 (0.18)		100.0 %	0.08 [-0.01, 0.17]
Subtotal (95% CI)	**22**		**29**			**100.0 %**	**0.08 [-0.01, 0.17]**
Heterogeneity: not applicable							
Test for overall effect: Z = 1.73 (P = 0.084)							
Test for subgroup differences: Chi^2 = 0.11, df = 1 (P = 0.74), I^2 =0.0%							



Analysis 5.16. Comparison 5 General physical activity (walking) versus control, Outcome 16 Narrow balance beam post-pre change scores (m/s): higher values indicate better balance ability.

Review: Exercise for improving balance in older people

Comparison: 5 General physical activity (walking) versus control

Outcome: 16 Narrow balance beam post-pre change scores (m/s): higher values indicate better balance ability

Study or subgroup	Exercise N	Mean(SD)	Control N	Mean(SD)	Mean Difference IV,Fixed,95% CI	Weight	Mean Difference IV,Fixed,95% CI
1 Immediately post intervention							
Buchner 1997b	22	0.3 (1)	30	-0.2 (1.1)		100.0 %	0.50 [-0.07, 1.07]
Subtotal (95% CI)	**22**		**30**			**100.0 %**	**0.50 [-0.07, 1.07]**
Heterogeneity: not applicable							
Test for overall effect: Z = 1.71 (P = 0.088)							
2 Follow-up @3 months post intervention							
Buchner 1997b	22	0.3 (1.3)	29	0 (1.1)		100.0 %	0.30 [-0.37, 0.97]
Subtotal (95% CI)	**22**		**29**			**100.0 %**	**0.30 [-0.37, 0.97]**
Heterogeneity: not applicable							
Test for overall effect: Z = 0.87 (P = 0.38)							
Test for subgroup differences: Chi^2 = 0.20, df = 1 (P = 0.66), I^2 =0.0%							

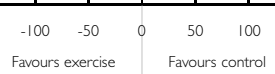
Analysis 6.1. Comparison 6 General physical activity (cycling) versus control, Outcome 1 Area during narrow stance eyes open post-pre change scores (mm2/s): lower values indicate better balance.

Review: Exercise for improving balance in older people

Comparison: 6 General physical activity (cycling) versus control

Outcome: 1 Area during narrow stance eyes open post-pre change scores (mm2/s): lower values indicate better balance

Study or subgroup	Exercise N	Mean(SD)	Control N	Mean(SD)	Mean Difference IV,Fixed,95% CI	Weight	Mean Difference IV,Fixed,95% CI
1 Immediately post intervention							
Buchner 1997b	21	-9 (2.7)	30	6 (48)		100.0 %	-15.00 [-32.22, 2.22]
Subtotal (95% CI)	**21**		**30**			**100.0 %**	**-15.00 [-32.22, 2.22]**
Heterogeneity: not applicable							
Test for overall effect: Z = 1.71 (P = 0.088)							
2 Follow-up @ 3 months post intervention							
Buchner 1997b	20	-10 (28)	29	2 (47)		100.0 %	-12.00 [-33.05, 9.05]
Subtotal (95% CI)	**20**		**29**			**100.0 %**	**-12.00 [-33.05, 9.05]**
Heterogeneity: not applicable							
Test for overall effect: Z = 1.12 (P = 0.26)							
Test for subgroup differences: Chi^2 = 0.05, df = 1 (P = 0.83), I^2 =0.0%							



Analysis 6.2. Comparison 6 General physical activity (cycling) versus control, Outcome 2 Angular radius narrow stance eyes open post-pre change scores (mm): lower values indicate better balance.

Review: Exercise for improving balance in older people

Comparison: 6 General physical activity (cycling) versus control

Outcome: 2 Angular radius narrow stance eyes open post-pre change scores (mm): lower values indicate better balance

Study or subgroup	Exercise N	Mean(SD)	Control N	Mean(SD)	Mean Difference IV,Fixed,95% CI	Weight	Mean Difference IV,Fixed,95% CI
1 Immediately post intervention							
Buchner 1997b	21	-0.4 (2.6)	30	0.4 (2)		100.0 %	-0.80 [-2.12, 0.52]
Subtotal (95% CI)	**21**		**30**			**100.0 %**	**-0.80 [-2.12, 0.52]**
Heterogeneity: not applicable							
Test for overall effect: Z = 1.19 (P = 0.24)							
2 Follow-up @ 3 months post intervention							
Buchner 1997b	20	-0.5 (2.1)	29	0.3 (2.1)		100.0 %	-0.80 [-2.00, 0.40]
Subtotal (95% CI)	**20**		**29**			**100.0 %**	**-0.80 [-2.00, 0.40]**
Heterogeneity: not applicable							
Test for overall effect: Z = 1.31 (P = 0.19)							
Test for subgroup differences: Chi^2 = 0.00, df = 1 (P = ï½), I^2 =0.0%							

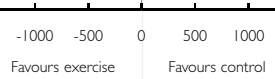
Analysis 6.3. Comparison 6 General physical activity (cycling) versus control, Outcome 3 Area narrow stance eyes closed post-pre change scores (mm2/s): lower values indicate better balance.

Review: Exercise for improving balance in older people

Comparison: 6 General physical activity (cycling) versus control

Outcome: 3 Area narrow stance eyes closed post-pre change scores (mm2/s): lower values indicate better balance

Study or subgroup	Exercise N	Mean(SD)	Control N	Mean(SD)	Mean Difference IV,Fixed,95% CI	Weight	Mean Difference IV,Fixed,95% CI
1 Immediately post intervention							
Buchner 1997b	21	11 (84)	30	-27 (127)		100.0 %	38.00 [-19.93, 95.93]
Subtotal (95% CI)	**21**		**30**			**100.0 %**	**38.00 [-19.93, 95.93]**
Heterogeneity: not applicable							
Test for overall effect: Z = 1.29 (P = 0.20)							
2 Follow-up @ 3 months post intervention							
Buchner 1997b	20	16 (88)	29	-39 (113)		100.0 %	55.00 [-1.38, 111.38]
Subtotal (95% CI)	**20**		**29**			**100.0 %**	**55.00 [-1.38, 111.38]**
Heterogeneity: not applicable							
Test for overall effect: Z = 1.91 (P = 0.056)							
Test for subgroup differences: Chi^2 = 0.17, df = 1 (P = 0.68), I^2 =0.0%							



Analysis 6.4. Comparison 6 General physical activity (cycling) versus control, Outcome 4 Angular radius narrow stance eyes closed post-pre change scores (mm): lower values indicate better balance.

Review: Exercise for improving balance in older people

Comparison: 6 General physical activity (cycling) versus control

Outcome: 4 Angular radius narrow stance eyes closed post-pre change scores (mm): lower values indicate better balance

Study or subgroup	Exercise N	Mean(SD)	Control N	Mean(SD)	Mean Difference IV,Fixed,95% CI	Weight	Mean Difference IV,Fixed,95% CI
1 Immediately post intervention							
Buchner 1997b	21	0.5 (3.4)	30	-0.5 (3.3)		100.0 %	1.00 [-0.87, 2.87]
Subtotal (95% CI)	**21**		**30**			**100.0 %**	**1.00 [-0.87, 2.87]**
Heterogeneity: not applicable							
Test for overall effect: Z = 1.05 (P = 0.30)							
2 Follow-up @ 3 months post intervention							
Buchner 1997b	20	0.6 (3.6)	29	-0.7 (3.2)		100.0 %	1.30 [-0.66, 3.26]
Subtotal (95% CI)	**20**		**29**			**100.0 %**	**1.30 [-0.66, 3.26]**
Heterogeneity: not applicable							
Test for overall effect: Z = 1.30 (P = 0.19)							
Test for subgroup differences: Chi^2 = 0.05, df = 1 (P = 0.83), I^2 =0.0%							

Analysis 6.5. Comparison 6 General physical activity (cycling) versus control, Outcome 5 AP tilt board post-pre change score (s): higher values indicate better balance ability.

Review: Exercise for improving balance in older people

Comparison: 6 General physical activity (cycling) versus control

Outcome: 5 AP tilt board post-pre change score (s): higher values indicate better balance ability

Study or subgroup	Exercise N	Mean(SD)	Control N	Mean(SD)	Mean Difference IV,Fixed,95% CI	Weight	Mean Difference IV,Fixed,95% CI
1 Immediately post intervention							
Buchner 1997b	21	0 (5)	30	0 (4)		100.0 %	0.0 [-2.57, 2.57]
Subtotal (95% CI)	**21**		**30**			**100.0 %**	**0.0 [-2.57, 2.57]**
Heterogeneity: not applicable							
Test for overall effect: Z = 0.0 (P = 1.0)							
2 Follow-up @ 3 months post intervention							
Buchner 1997b	20	0 (5)	29	2 (6)		100.0 %	-2.00 [-5.09, 1.09]
Subtotal (95% CI)	**20**		**29**			**100.0 %**	**-2.00 [-5.09, 1.09]**
Heterogeneity: not applicable							
Test for overall effect: Z = 1.27 (P = 0.21)							
Test for subgroup differences: Chi^2 = 0.95, df = 1 (P = 0.33), I^2 =0.0%							

Analysis 6.6. Comparison 6 General physical activity (cycling) versus control, Outcome 6 Omnidirectional tilt board post-pre change scores (s): higher values indicate better balance ability.

Review: Exercise for improving balance in older people

Comparison: 6 General physical activity (cycling) versus control

Outcome: 6 Omnidirectional tilt board post-pre change scores (s): higher values indicate better balance ability

Study or subgroup	Exercise N	Mean(SD)	Control N	Mean(SD)	Mean Difference IV,Fixed,95% CI	Weight	Mean Difference IV,Fixed,95% CI
1 Immediately post intervention							
Buchner 1997b	21	2 (5)	30	3 (9)		100.0 %	-1.00 [-4.87, 2.87]
Subtotal (95% CI)	**21**		**30**			**100.0 %**	**-1.00 [-4.87, 2.87]**
Heterogeneity: not applicable							
Test for overall effect: Z = 0.51 (P = 0.61)							
2 Follow-up @ 3 months post intervention							
Buchner 1997b	20	-1 (9)	29	4 (9)		100.0 %	-5.00 [-10.13, 0.13]
Subtotal (95% CI)	**20**		**29**			**100.0 %**	**-5.00 [-10.13, 0.13]**
Heterogeneity: not applicable							
Test for overall effect: Z = 1.91 (P = 0.056)							
Test for subgroup differences: Chi^2 = 1.49, df = 1 (P = 0.22), I^2 =33%							

Analysis 6.7. Comparison 6 General physical activity (cycling) versus control, Outcome 7 Self paced gait velocity post-pre change scores (m/min): higher values indicate better balance ability.

Review: Exercise for improving balance in older people

Comparison: 6 General physical activity (cycling) versus control

Outcome: 7 Self paced gait velocity post-pre change scores (m/min): higher values indicate better balance ability

Study or subgroup	Exercise N	Mean(SD)	Control N	Mean(SD)	Mean Difference IV,Fixed,95% CI	Weight	Mean Difference IV,Fixed,95% CI
1 Immediately post intervention							
Buchner 1997b	21	4 (15)	30	1 (6)		100.0 %	3.00 [-3.77, 9.77]
Subtotal (95% CI)	**21**		**30**			**100.0 %**	**3.00 [-3.77, 9.77]**
Heterogeneity: not applicable							
Test for overall effect: Z = 0.87 (P = 0.38)							
2 Follow-up @ 3 months post intervention							
Buchner 1997b	20	3 (6)	29	0 (9)		100.0 %	3.00 [-1.20, 7.20]
Subtotal (95% CI)	**20**		**29**			**100.0 %**	**3.00 [-1.20, 7.20]**
Heterogeneity: not applicable							
Test for overall effect: Z = 1.40 (P = 0.16)							
Test for subgroup differences: Chi^2 = 0.00, df = 1 (P = ï½), I^2 =0.0%							

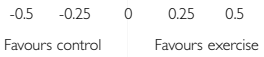
Analysis 6.8. Comparison 6 General physical activity (cycling) versus control, Outcome 8 Wide balance beam post-pre change scores (m/s): higher values indicate better balance ability.

Review: Exercise for improving balance in older people

Comparison: 6 General physical activity (cycling) versus control

Outcome: 8 Wide balance beam post-pre change scores (m/s): higher values indicate better balance ability

Study or subgroup	Exercise N	Mean(SD)	Control N	Mean(SD)	Mean Difference IV,Fixed,95% CI	Weight	Mean Difference IV,Fixed,95% CI
1 Immediately post intervention							
Buchner 1997b	21	0 (0.2)	30	0 (0.1)		100.0 %	0.0 [-0.09, 0.09]
Subtotal (95% CI)	**21**		**30**			**100.0 %**	**0.0 [-0.09, 0.09]**
Heterogeneity: not applicable							
Test for overall effect: Z = 0.0 (P = 1.0)							
2 Follow-up @3 months post intervention							
Buchner 1997b	20	0.04 (0.14)	29	-0.03 (0.18)		100.0 %	0.07 [-0.02, 0.16]
Subtotal (95% CI)	**20**		**29**			**100.0 %**	**0.07 [-0.02, 0.16]**
Heterogeneity: not applicable							
Test for overall effect: Z = 1.53 (P = 0.13)							
Test for subgroup differences: Chi^2 = 1.13, df = 1 (P = 0.29), I^2 =12%							



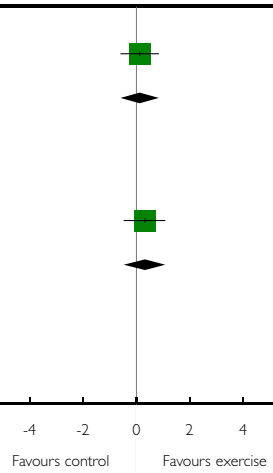
Analysis 6.9. Comparison 6 General physical activity (cycling) versus control, Outcome 9 Narrow balance beam post-pre change scores (m/s): higher values indicate better balance ability.

Review: Exercise for improving balance in older people

Comparison: 6 General physical activity (cycling) versus control

Outcome: 9 Narrow balance beam post-pre change scores (m/s): higher values indicate better balance ability

Study or subgroup	Exercise N	Mean(SD)	Control N	Mean(SD)	Mean Difference IV,Fixed,95% CI	Weight	Mean Difference IV,Fixed,95% CI
1 Immediately post intervention							
Buchner 1997b	21	-0.1 (1.4)	30	-0.2 (1.1)		100.0 %	0.10 [-0.62, 0.82]
Subtotal (95% CI)	**21**		**30**			**100.0 %**	**0.10 [-0.62, 0.82]**
Heterogeneity: not applicable							
Test for overall effect: Z = 0.27 (P = 0.78)							
2 Follow-up @3 months post intervention							
Buchner 1997b	20	0.3 (1.5)	29	0 (1.1)		100.0 %	0.30 [-0.47, 1.07]
Subtotal (95% CI)	**20**		**29**			**100.0 %**	**0.30 [-0.47, 1.07]**
Heterogeneity: not applicable							
Test for overall effect: Z = 0.76 (P = 0.44)							
Test for subgroup differences: Chi^2 = 0.14, df = 1 (P = 0.71), I^2 =0.0%							



Analysis 7.1. Comparison 7 Multiple exercise types versus control, Outcome 1 Functional base of support (distance) during dynamic test: higher values indicate better balance ability.

Review: Exercise for improving balance in older people

Comparison: 7 Multiple exercise types versus control

Outcome: 1 Functional base of support (distance) during dynamic test: higher values indicate better balance ability

Study or subgroup	Exercise N	Mean(SD)	Control N	Mean(SD)	Mean Difference IV,Fixed,95% CI	Weight	Mean Difference IV,Fixed,95% CI
1 Immediately post intervention							
Wolfson 1996	16	0.49 (0.04)	16	0.4 (0.12)		100.0 %	0.09 [0.03, 0.15]
Subtotal (95% CI)	**16**		**16**			**100.0 %**	**0.09 [0.03, 0.15]**
Heterogeneity: not applicable							
Test for overall effect: Z = 2.85 (P = 0.0044)							
2 Follow-up @ 6 months post intervention							
Wolfson 1996	11	0.46 (0.07)	15	0.37 (0.12)		100.0 %	0.09 [0.02, 0.16]
Subtotal (95% CI)	**11**		**15**			**100.0 %**	**0.09 [0.02, 0.16]**
Heterogeneity: not applicable							
Test for overall effect: Z = 2.40 (P = 0.016)							
Test for subgroup differences: Chi^2 = 0.00, df = 1 (P = 1.00), I^2 =0.0%							

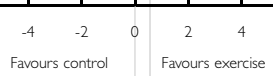
Analysis 7.2. Comparison 7 Multiple exercise types versus control, Outcome 2 Maximal balance range (cm) during dynamic test: higher values indicate better balance ability.

Review: Exercise for improving balance in older people

Comparison: 7 Multiple exercise types versus control

Outcome: 2 Maximal balance range (cm) during dynamic test: higher values indicate better balance ability

Study or subgroup	Exercise N	Mean(SD)	Control N	Mean(SD)	Mean Difference IV,Random,95% CI	Weight	Mean Difference IV,Random,95% CI
Lord 1995	48	20.2 (3.2)	39	18.3 (3.4)		45.8 %	1.90 [0.50, 3.30]
Lord 2003	259	16.1 (4.4)	249	16.3 (4.1)		54.2 %	-0.20 [-0.94, 0.54]
Total (95% CI)	**307**		**288**			**100.0 %**	**0.76 [-1.29, 2.81]**
Heterogeneity: Tau^2 = 1.88; Chi^2 = 6.76, df = 1 (P = 0.01); I^2 =85%							
Test for overall effect: Z = 0.73 (P = 0.47)							



Analysis 7.3. Comparison 7 Multiple exercise types versus control, Outcome 3 Total distance travelled by COP during quiet stance (mm): lower values indicate better balance ability.

Review: Exercise for improving balance in older people

Comparison: 7 Multiple exercise types versus control

Outcome: 3 Total distance travelled by COP during quiet stance (mm): lower values indicate better balance ability

Study or subgroup	Exercise N	Exercise Mean(SD)	Control N	Control Mean(SD)	Mean Difference IV,Fixed,95% CI	Weight	Mean Difference IV,Fixed,95% CI
1 Eyes open							
Sauvage 1992	8	948.46 (73.54)	6	851.31 (74.73)		100.0 %	97.15 [18.59, 175.71]
Subtotal (95% CI)	**8**		**6**			**100.0 %**	**97.15 [18.59, 175.71]**
Heterogeneity: not applicable							
Test for overall effect: Z = 2.42 (P = 0.015)							
2 Eyes closed							
Sauvage 1992	8	1076.45 (123)	6	863.93 (59.76)		100.0 %	212.52 [114.79, 310.25]
Subtotal (95% CI)	**8**		**6**			**100.0 %**	**212.52 [114.79, 310.25]**
Heterogeneity: not applicable							
Test for overall effect: Z = 4.26 (P = 0.000020)							
Test for subgroup differences: Chi^2 = 3.25, df = 1 (P = 0.07), I^2 =69%							

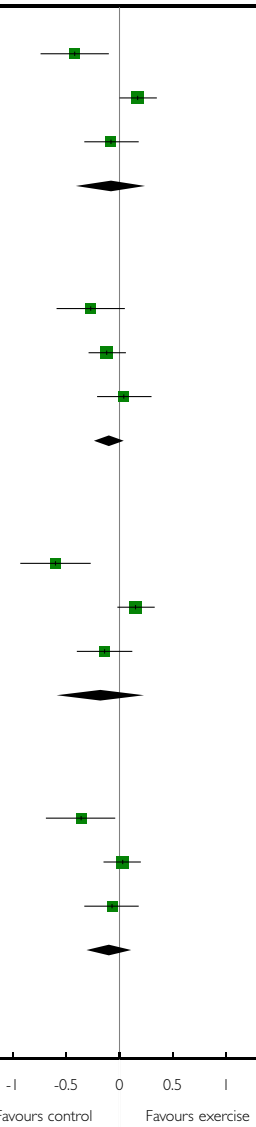
Analysis 7.4. Comparison 7 Multiple exercise types versus control, Outcome 4 Sway (mm) during dynamic test: higher values indicate better balance ability.

Review: Exercise for improving balance in older people

Comparison: 7 Multiple exercise types versus control

Outcome: 4 Sway (mm) during dynamic test: higher values indicate better balance ability

Study or subgroup	Exercise N	Mean(SD)	Control N	Mean(SD)	Std. Mean Difference IV,Random,95% CI	Weight	Std. Mean Difference IV,Random,95% CI
1 Floor, eyes open (immediately post intervention)							
Lord 1995	75	53 (29)	76	65 (28)		27.0 %	-0.42 [-0.74, -0.10]
Lord 2003	259	126 (73)	249	113 (76)		40.4 %	0.17 [0.00, 0.35]
Lord 2005	118	475 (481)	116	516 (595)		32.6 %	-0.08 [-0.33, 0.18]
Subtotal (95% CI)	**452**		**441**			**100.0 %**	**-0.08 [-0.41, 0.24]**
Heterogeneity: Tau² = 0.07; Chi² = 10.63, df = 2 (P = 0.005); I² =81%							
Test for overall effect: Z = 0.50 (P = 0.61)							
2 Floor, eyes closed (immediately post intervention)							
Lord 1995	75	70 (37)	76	80 (37)		27.1 %	-0.27 [-0.59, 0.05]
Lord 2003	259	156 (97)	249	169 (127)		40.3 %	-0.12 [-0.29, 0.06]
Lord 2005	118	690 (716)	116	653 (1020)		32.6 %	0.04 [-0.21, 0.30]
Subtotal (95% CI)	**452**		**441**			**100.0 %**	**-0.10 [-0.24, 0.04]**
Heterogeneity: Tau² = 0.00; Chi² = 2.27, df = 2 (P = 0.32); I² =12%							
Test for overall effect: Z = 1.36 (P = 0.17)							
3 Foam, eyes open (immediately post intervention)							
Lord 1995	75	86 (29)	76	110 (48)		26.8 %	-0.60 [-0.93, -0.27]
Lord 2003	259	187 (123)	249	168 (127)		40.5 %	0.15 [-0.02, 0.33]
Lord 2005	118	1495 (1019)	116	1661 (1313)		32.7 %	-0.14 [-0.40, 0.12]
Subtotal (95% CI)	**452**		**441**			**100.0 %**	**-0.18 [-0.59, 0.23]**
Heterogeneity: Tau² = 0.11; Chi² = 16.60, df = 2 (P = 0.00025); I² =88%							
Test for overall effect: Z = 0.85 (P = 0.40)							
4 Foam, eyes closed (immediately post intervention)							
Lord 1995	75	148 (64)	76	176 (87)		27.0 %	-0.36 [-0.69, -0.04]
Lord 2003	259	266 (169)	249	261 (181)		40.4 %	0.03 [-0.15, 0.20]
Lord 2005	118	3374 (2319)	116	3539 (2180)		32.6 %	-0.07 [-0.33, 0.18]
Subtotal (95% CI)	**452**		**441**			**100.0 %**	**-0.10 [-0.31, 0.11]**
Heterogeneity: Tau² = 0.02; Chi² = 4.44, df = 2 (P = 0.11); I² =55%							
Test for overall effect: Z = 0.96 (P = 0.34)							



Analysis 7.5. Comparison 7 Multiple exercise types versus control, Outcome 5 Body sway (cm): lower values indicate better balance ability.

Review: Exercise for improving balance in older people

Comparison: 7 Multiple exercise types versus control

Outcome: 5 Body sway (cm): lower values indicate better balance ability

Study or subgroup	Exercise N	Mean(SD)	Control N	Mean(SD)	Std. Mean Difference IV,Fixed,95% CI	Weight	Std. Mean Difference IV,Fixed,95% CI
Jessup 2003	9	1.83 (0.26)	9	2.31 (0.34)		46.3 %	-1.51 [-2.59, -0.43]
Ramsbottom 2004	11	166 (90)	6	201 (132)		53.7 %	-0.31 [-1.32, 0.69]
Total (95% CI)	**20**		**15**			**100.0 %**	**-0.87 [-1.60, -0.13]**

Heterogeneity: Chi^2 = 2.54, df = 1 (P = 0.11); I^2 =61%

Test for overall effect: Z = 2.32 (P = 0.021)

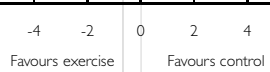
Analysis 7.6. Comparison 7 Multiple exercise types versus control, Outcome 6 Loss of balance during sensory organisation test (errors): less errors indicate better balance ability.

Review: Exercise for improving balance in older people

Comparison: 7 Multiple exercise types versus control

Outcome: 6 Loss of balance during sensory organisation test (errors): less errors indicate better balance ability

Study or subgroup	Exercise N	Mean(SD)	Control N	Mean(SD)	Mean Difference IV,Fixed,95% CI	Weight	Mean Difference IV,Fixed,95% CI
1 Immediately post intervention							
Wolfson 1996	27	1.9 (2.08)	26	2.5 (2.55)		100.0 %	-0.60 [-1.86, 0.66]
Subtotal (95% CI)	**27**		**26**			**100.0 %**	**-0.60 [-1.86, 0.66]**
Heterogeneity: not applicable							
Test for overall effect: Z = 0.94 (P = 0.35)							
2 Follow-up @ 6 months post intervention							
Wolfson 1996	20	1.9 (2.24)	23	2.1 (2.4)		100.0 %	-0.20 [-1.59, 1.19]
Subtotal (95% CI)	**20**		**23**			**100.0 %**	**-0.20 [-1.59, 1.19]**
Heterogeneity: not applicable							
Test for overall effect: Z = 0.28 (P = 0.78)							
Test for subgroup differences: Chi^2 = 0.18, df = 1 (P = 0.68), I^2 =0.0%							



Analysis 7.7. Comparison 7 Multiple exercise types versus control, Outcome 7 Co-ordinated stability (errors): less errors indicate better balance ability.

Review: Exercise for improving balance in older people

Comparison: 7 Multiple exercise types versus control

Outcome: 7 Co-ordinated stability (errors): less errors indicate better balance ability

Study or subgroup	Exercise N	Mean(SD)	Control N	Mean(SD)	Mean Difference IV,Fixed,95% CI	Weight	Mean Difference IV,Fixed,95% CI
Lord 1995	48	5.5 (6.6)	39	8.5 (8.4)		13.8 %	-3.00 [-6.23, 0.23]
Lord 2003	259	13.6 (9.4)	249	13.3 (9.1)		55.8 %	0.30 [-1.31, 1.91]
Lord 2005	118	8.6 (8)	116	10.3 (9)		30.3 %	-1.70 [-3.88, 0.48]
Total (95% CI)	**425**		**404**			**100.0 %**	**-0.76 [-1.97, 0.44]**

Heterogeneity: Chi^2 = 4.23, df = 2 (P = 0.12); I^2 =53%

Test for overall effect: Z = 1.24 (P = 0.21)

Analysis 7.8. Comparison 7 Multiple exercise types versus control, Outcome 8 Single leg stance time eyes open (s): higher values indicate better balance ability.

Review: Exercise for improving balance in older people

Comparison: 7 Multiple exercise types versus control

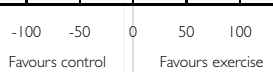
Outcome: 8 Single leg stance time eyes open (s): higher values indicate better balance ability

Study or subgroup	Exercise N	Mean(SD)	Control N	Mean(SD)	Mean Difference IV,Fixed,95% CI	Weight	Mean Difference IV,Fixed,95% CI
1 Immediately post intervention							
Nelson 2004	32	15.7 (11.1)	38	12.1 (10.2)		18.2 %	3.60 [-1.43, 8.63]
Rubenstein 2000	28	6.1 (4.4)	27	6.5 (5.4)		67.8 %	-0.40 [-3.01, 2.21]
Suzuki 2004	21	36.86 (25.28)	18	26.11 (20.11)		2.3 %	10.75 [-3.51, 25.01]
Wolfson 1996	19	15.1 (10.9)	19	9.4 (8.72)		11.7 %	5.70 [-0.58, 11.98]
Subtotal (95% CI)	**100**		**102**			**100.0 %**	**1.30 [-0.85, 3.44]**

Heterogeneity: Chi^2 = 6.01, df = 3 (P = 0.11); I^2 =50%

Test for overall effect: Z = 1.18 (P = 0.24)

2 Follow up @ 6 months post intervention



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Study or subgroup	Exercise N	Mean(SD)	Control N	Mean(SD)	Mean Difference IV,Fixed,95% CI	Weight	Mean Difference IV,Fixed,95% CI
Wolfson 1996	15	13 (11.62)	18	10.2 (10.18)		100.0 %	2.80 [-4.73, 10.33]
Subtotal (95% CI)	**15**		**18**			**100.0 %**	**2.80 [-4.73, 10.33]**

Heterogeneity: not applicable

Test for overall effect: Z = 0.73 (P = 0.47)

Test for subgroup differences: Chi^2 = 0.14, df = 1 (P = 0.71), I^2 =0.0%

Analysis 7.9. Comparison 7 Multiple exercise types versus control, Outcome 9 Single leg stance time eyes closed (s): higher values indicate better balance ability.

Review: Exercise for improving balance in older people

Comparison: 7 Multiple exercise types versus control

Outcome: 9 Single leg stance time eyes closed (s): higher values indicate better balance ability

Study or subgroup	Exercise N	Mean(SD)	Control N	Mean(SD)	Mean Difference IV,Fixed,95% CI	Weight	Mean Difference IV,Fixed,95% CI
Suzuki 2004	21	4.81 (5.01)	18	2.78 (1.93)		100.0 %	2.03 [-0.29, 4.35]
Total (95% CI)	**21**		**18**			**100.0 %**	**2.03 [-0.29, 4.35]**

Heterogeneity: not applicable

Test for overall effect: Z = 1.71 (P = 0.086)

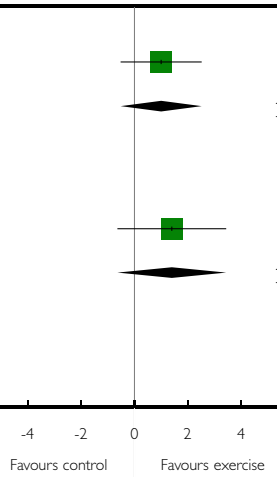
Analysis 7.10. Comparison 7 Multiple exercise types versus control, Outcome 10 Semitandem stance time (s): higher values indicate better balance ability.

Review: Exercise for improving balance in older people

Comparison: 7 Multiple exercise types versus control

Outcome: 10 Semitandem stance time (s): higher values indicate better balance ability

Study or subgroup	Exercise N	Mean(SD)	Control N	Mean(SD)	Mean Difference IV,Fixed,95% CI	Weight	Mean Difference IV,Fixed,95% CI
1 Immediately post intervention							
Schoenfelder 2004	33	9 (2.7)	34	8 (3.6)		100.0 %	1.00 [-0.52, 2.52]
Subtotal (95% CI)	**33**		**34**			**100.0 %**	**1.00 [-0.52, 2.52]**
Heterogeneity: not applicable							
Test for overall effect: Z = 1.29 (P = 0.20)							
2 Follow-up @ 3 months post intervention							
Schoenfelder 2004	30	8.2 (3.5)	28	6.8 (4.3)		100.0 %	1.40 [-0.63, 3.43]
Subtotal (95% CI)	**30**		**28**			**100.0 %**	**1.40 [-0.63, 3.43]**
Heterogeneity: not applicable							
Test for overall effect: Z = 1.35 (P = 0.18)							
Test for subgroup differences: Chi^2 = 0.10, df = 1 (P = 0.76), I^2 =0.0%							



Analysis 7.11. Comparison 7 Multiple exercise types versus control, Outcome 11 Parallel stance time (s): higher values indicate better balance ability.

Review: Exercise for improving balance in older people

Comparison: 7 Multiple exercise types versus control

Outcome: 11 Parallel stance time (s): higher values indicate better balance ability

Study or subgroup	Exercise N	Mean(SD)	Control N	Mean(SD)	Mean Difference IV,Fixed,95% CI	Weight	Mean Difference IV,Fixed,95% CI
1 Immediately post intervention							
Schoenfelder 2004	33	9.6 (1.8)	34	8.8 (3.3)		100.0 %	0.80 [-0.47, 2.07]
Subtotal (95% CI)	**33**		**34**			**100.0 %**	**0.80 [-0.47, 2.07]**
Heterogeneity: not applicable							
Test for overall effect: Z = 1.24 (P = 0.22)							
2 Follow-up @ 3 months post intervention							
Schoenfelder 2004	30	9 (2.7)	28	9.3 (2.6)		100.0 %	-0.30 [-1.66, 1.06]
Subtotal (95% CI)	**30**		**28**			**100.0 %**	**-0.30 [-1.66, 1.06]**
Heterogeneity: not applicable							
Test for overall effect: Z = 0.43 (P = 0.67)							
Test for subgroup differences: Chi^2 = 1.34, df = 1 (P = 0.25), I^2 =25%							

Analysis 7.12. Comparison 7 Multiple exercise types versus control, Outcome 12 Tandem stance time (s): higher values indicate better balance ability.

Review: Exercise for improving balance in older people

Comparison: 7 Multiple exercise types versus control

Outcome: 12 Tandem stance time (s): higher values indicate better balance ability

Study or subgroup	Exercise N	Mean(SD)	Control N	Mean(SD)	Mean Difference IV,Fixed,95% CI	Weight	Mean Difference IV,Fixed,95% CI
1 Immediately post intervention							
Schoenfelder 2004	33	4.6 (3.9)	34	2.7 (3.8)		100.0 %	1.90 [0.06, 3.74]
Subtotal (95% CI)	**33**		**34**			**100.0 %**	**1.90 [0.06, 3.74]**
Heterogeneity: not applicable							
Test for overall effect: Z = 2.02 (P = 0.043)							
2 Follow-up @ 3 months post intervention							
Schoenfelder 2004	30	3.6 (4.1)	28	2.4 (3)		100.0 %	1.20 [-0.64, 3.04]
Subtotal (95% CI)	**30**		**28**			**100.0 %**	**1.20 [-0.64, 3.04]**
Heterogeneity: not applicable							
Test for overall effect: Z = 1.28 (P = 0.20)							
Test for subgroup differences: Chi^2 = 0.28, df = 1 (P = 0.60), I^2 =0.0%							

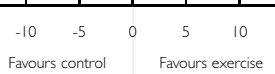
Analysis 7.13. Comparison 7 Multiple exercise types versus control, Outcome 13 Tandem walk (number of steps): higher values indicate better balance ability.

Review: Exercise for improving balance in older people

Comparison: 7 Multiple exercise types versus control

Outcome: 13 Tandem walk (number of steps): higher values indicate better balance ability

Study or subgroup	Exercise N	Mean(SD)	Control N	Mean(SD)	Mean Difference IV,Fixed,95% CI	Weight	Mean Difference IV,Fixed,95% CI
Suzuki 2004	21	10.67 (0.86)	18	7.28 (3.46)		100.0 %	3.39 [1.75, 5.03]
Total (95% CI)	**21**		**18**			**100.0 %**	**3.39 [1.75, 5.03]**
Heterogeneity: not applicable							
Test for overall effect: Z = 4.05 (P = 0.000051)							



Analysis 7.14. Comparison 7 Multiple exercise types versus control, Outcome 14 Tandem walk (s): lower values indicate better balance ability.

Review: Exercise for improving balance in older people

Comparison: 7 Multiple exercise types versus control

Outcome: 14 Tandem walk (s): lower values indicate better balance ability

Study or subgroup	Exercise N	Mean(SD)	Control N	Mean(SD)	Mean Difference IV,Fixed,95% CI	Weight	Mean Difference IV,Fixed,95% CI
Nelson 2004	32	30.9 (7)	38	39 (15.9)		100.0 %	-8.10 [-13.71, -2.49]
Total (95% CI)	**32**		**38**			**100.0 %**	**-8.10 [-13.71, -2.49]**

Heterogeneity: not applicable

Test for overall effect: Z = 2.83 (P = 0.0046)

Analysis 7.15. Comparison 7 Multiple exercise types versus control, Outcome 15 Functional Reach Test (cm): higher values indicate better balance ability.

Review: Exercise for improving balance in older people

Comparison: 7 Multiple exercise types versus control

Outcome: 15 Functional Reach Test (cm): higher values indicate better balance ability

Study or subgroup	Exercise N	Mean(SD)	Control N	Mean(SD)	Mean Difference IV,Fixed,95% CI	Weight	Mean Difference IV,Fixed,95% CI
Ramsbottom 2004	11	33.6 (6)	10	27.2 (4.1)		31.1 %	6.40 [2.04, 10.76]
Suzuki 2004	21	33.52 (4.7)	18	27.99 (4.61)		68.9 %	5.53 [2.60, 8.46]
Total (95% CI)	**32**		**28**			**100.0 %**	**5.80 [3.37, 8.23]**

Heterogeneity: Chi^2 = 0.11, df = 1 (P = 0.75); I^2 =0.0%

Test for overall effect: Z = 4.68 (P < 0.00001)

Analysis 7.16. Comparison 7 Multiple exercise types versus control, Outcome 16 Gait speed: higher values indicate better balance ability.

Review: Exercise for improving balance in older people

Comparison: 7 Multiple exercise types versus control

Outcome: 16 Gait speed: higher values indicate better balance ability

Study or subgroup	Exercise N	Mean(SD)	Control N	Mean(SD)	Std. Mean Difference IV,Fixed,95% CI	Weight	Std. Mean Difference IV,Fixed,95% CI
1 Immediately post intervention							
Nelson 2004	32	1.5 (0.5)	38	1.6 (0.4)		26.8 %	-0.22 [-0.69, 0.25]
Ramsbottom 2004	11	-6.5 (1.3)	10	-7.8 (2)		7.5 %	0.75 [-0.14, 1.64]
Sauvage 1992	8	50.39 (5.44)	6	46.68 (6.1)		5.0 %	0.61 [-0.48, 1.70]
Schoenfelder 2004	33	-20.6 (19.1)	34	-18.7 (16.3)		26.0 %	-0.11 [-0.59, 0.37]
Suzuki 2004	21	0.83 (0.15)	18	0.93 (0.19)		14.4 %	-0.58 [-1.22, 0.07]
Wolfson 1996	27	1.09 (0.21)	26	1.14 (0.15)		20.4 %	-0.27 [-0.81, 0.27]
Subtotal (95% CI)	**132**		**132**			**100.0 %**	**-0.14 [-0.38, 0.11]**
Heterogeneity: Chi^2 = 7.73, df = 5 (P = 0.17); I^2 =35%							
Test for overall effect: Z = 1.11 (P = 0.27)							
2 Follow-up @ 6 months post intervention							
Wolfson 1996	27	1.19 (0.18)	23	1.12 (0.19)		100.0 %	0.37 [-0.19, 0.93]
Subtotal (95% CI)	**27**		**23**			**100.0 %**	**0.37 [-0.19, 0.93]**
Heterogeneity: not applicable							
Test for overall effect: Z = 1.30 (P = 0.19)							
3 Follow-up @ 3 months post intervention							
Schoenfelder 2004	30	-20.5 (19.4)	28	-18.5 (15.7)		100.0 %	-0.11 [-0.63, 0.40]
Subtotal (95% CI)	**30**		**28**			**100.0 %**	**-0.11 [-0.63, 0.40]**
Heterogeneity: not applicable							
Test for overall effect: Z = 0.42 (P = 0.67)							
Test for subgroup differences: Chi^2 = 2.72, df = 2 (P = 0.26), I^2 =26%							

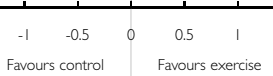
Analysis 8.1. Comparison 8 Sensitivity analyses for effect of clustering, Outcome 1 (01.10) Single leg stance time eyes open (s): higher values indicate better balance ability.

Review: Exercise for improving balance in older people

Comparison: 8 Sensitivity analyses for effect of clustering

Outcome: 1 (01.10) Single leg stance time eyes open (s): higher values indicate better balance ability

Study or subgroup	Exercise N	Mean(SD)	Control N	Mean(SD)	Std. Mean Difference IV,Fixed,95% CI	Weight	Std. Mean Difference IV,Fixed,95% CI
1 Immediately post intervention							
Johansson 1991	18	20.7 (10.2)	15	19.5 (10.9)		20.5 %	0.11 [-0.57, 0.80]
MacRae 1994	28	14.7 (12.17)	31	14 (11.14)		37.0 %	0.06 [-0.45, 0.57]
Reinsch 1992	17	17.01 (10.6)	16	10.4 (10.5)		19.7 %	0.61 [-0.09, 1.31]
Wolfson 1996	20	16.6 (10.73)	19	9.4 (8.72)		22.8 %	0.72 [0.07, 1.37]



Analysis 8.2. Comparison 8 Sensitivity analyses for effect of clustering, Outcome 2 (01.14) Self paced gait speed: higher values indicate better balance ability.

Review: Exercise for improving balance in older people

Comparison: 8 Sensitivity analyses for effect of clustering

Outcome: 2 (01.14) Self paced gait speed: higher values indicate better balance ability

Study or subgroup	Exercise N	Mean(SD)	Control N	Mean(SD)	Std. Mean Difference IV,Fixed,95% CI	Weight	Std. Mean Difference IV,Fixed,95% CI
1 Immediately post intervention							
Brouwer 2003	17	1.21 (0.19)	17	1.11 (0.26)		19.4 %	0.43 [-0.25, 1.11]
Johansson 1991	18	-15.7 (1.8)	15	-17.8 (3)		17.4 %	0.85 [0.13, 1.57]
MacRae 1994	28	1.1 (0.32)	31	1.16 (0.33)		34.3 %	-0.18 [-0.69, 0.33]
Wolfson 1996	24	1.18 (0.2)	26	1.14 (0.15)		29.0 %	0.22 [-0.33, 0.78]

APPENDICES

Appendix 1. Search strategy for MEDLINE

MEDLINE levels 1 & 2	MEDLINE level 3
1 exp Aged/ not Adolescent/ 2 (parkinson$ or stroke$1 or multiple sclerosis or amput$ or meniere$ or Alzheimer$ or dementia).ti. 3 Exercise Movement Techniques/or Dance Therapy/ or Exercise/ or Exercise Therapy/ or Tai Ji/ or Walking/ or Yoga/ or "Biofeedback (Psychology)"/ 4 (exercis$ or training or biofeedback or Tai Chi).tw. 5 (balance adj3 (retraining or re-training or reeducation or re-education)).tw. 6 or/3-5 7 Musculoskeletal Equilibrium/or Posture/ 8 (balance or functional reach or sway).tw. 9 (postur$ adj3 (stability or instability)).tw. 10 posturograph$.tw. 11 (cent$3 adj (pressure or mass)).tw. 12 or/7-11 13 and/1,6,12 14 13 not 2 15 randomized controlled trial.pt. 16 controlled clinical trial.pt. 17 Randomized Controlled Trials/ 18 Random Allocation/ 19 Double-Blind Method/ 20 Single-Blind Method/ 21 or/15-20 22 Animals/ not Human/ 23 21 not 22 24 clinical trial.pt. 25 exp Clinical Trials/ 26 (clinic$ adj25 trial$).tw. 27 ((singl$ or doubl$ or trebl$ or tripl$) adj (mask$ or blind$)).tw. 28 Placebos/ 29 placebo$.tw. 30 random$.tw. 31 Research Design/ 32 (latin adj square).tw. 33 or/24-32 34 33 not 22 35 34 not 23 36 and/14,23 37 and/14,35 38 or/36,37	1. *Aged/ or *"Aged, 80 and over"/ or *Frail elderly/ 2. (elderly or seniors or geriatric or frail).ti. 3. (older adj (adult or people or person$1)).ti. 4. or/1-3 5. Exercise Movement Techniques/or Dance Therapy/ or Exercise/ or Exercise Therapy/ or Tai Ji/ or Walking/ or Yoga/ or "Biofeedback (Psychology)"/ 6. (exercis$ or training or biofeedback or Tai Chi).tw. 7. (balance adj3 (retraining or re-training or reeducation or re-education)).tw. 8. or/5-7 9. Musculoskeletal Equilibrium/or Posture/ 10. (balance or functional reach or sway).tw. 11. (postur$ adj3 (stability or instability)).tw. 12. posturograph$.tw. 13. (cent$3 adj (pressure or mass)).tw. 14. or/9-13 15. and/4,8,14 16 Comparative Study/ 17 exp Evaluation Studies/ 18 Follow-Up Studies/ 19 Prospective Studies/ 20 (control$ or prospectiv$ or volunteer$).tw. 21 Cross-Over Studies/ 22 Animals/ not Humans/ 23 or/16-21 24 23 not 22 25 and/9,24

Appendix 2. Search strategy for *The Cochrane Library*

The Cochrane Library
#1. AGED explode tree 1 (MeSH)
#2. ADOLESCENT single term (MeSH)
#3. (#1 and (not #2))
#4. (parkinson* or stroke* or (multiple next sclerosis)or amput* or meniere* or alzheimer* or dementia):ti
#5. EXERCISE MOVEMENT TECHNIQUES single term (MeSH)
#6. DANCE THERAPY single term (MeSH)
#7. EXERCISE single term (MeSH)
#8. EXERCISE THERAPY single term (MeSH)
#9. TAI JI single term (MeSH)
#10. YOGA single term (MeSH)
#11. BIOFEEDBACK (PSYCHOLOGY)single term (MeSH)
#12. (exercis* or training or biofeedback or (tai next chi))
#13. ((balance near retraining)or (balance near (re next training)) or (balance near reeducation)or (balance near (re next education)))
#14. (#5 or #6 or #7 or #8 or #9 or #10 or #11 or #12 or #13)
#15. POSTURE single term (MeSH)
#16. (balance or (functional next reach) or sway)
#17. ((postur* near stability)or (postur* near instability))
#18. posturograph*
#19. ((cent* next pressure) or (cent* next mass))
#20. (#15 or #16 or #17 or #18 or #19)
#21. (#3 and #14 and #20)
#22. (#21 and not #4)

Appendix 3. Search strategy for CINAHL

CINAHL (OVID WEB)
1. exp Aged/
2. Tai Chi/ or Yoga/
3. exp Exercise/
4. exp Therapeutic Exercise/
5. (exercis$ or training or Tai Chi).tw.
6. (balance adj3 (retrain$ or re-train$ or reeducation or re-education)).tw.
7. or/2-6
8. Balance, Postural/ or Posture/
9. (balance or functional reach or sway or posturog$).tw.
10. (postur$ adj3 (stability or instability)).tw.
11. (cent$ adj (pressure or mass)).tw.
12. or/8-11
13. and/1,7,12
14. exp Clinical Trials/
15. exp Evaluation Research/
16. exp Comparative Studies/
17. exp Crossover Design/
18. clinical trial.pt.
19. or/14-18
20. ((clinical or controlled or comparative or placebo or prospective or randomi#ed)adj3 (trial or study)).tw.
21. (random$ adj7 (allocat$ or allot$ or assign$ or basis$ or divid$ or order$)).tw.
22. ((singl$ or doubl$ or trebl$ or tripl$) adj7 (blind$ or mask$)).tw.
23. (cross?over$ or (cross adj1 over$)).tw.
24. ((allocat$ or allot$ or assign$ or divid$) adj3 (condition$ or experiment$ or intervention$ or treatment$ or therap$ or control$ or group$)).tw.
25. or/20-24
26. or/19,25
27. and/13,26

Appendix 4. Search strategy for EMBASE

EMBASE (OVID WEB)
1. Aged/ not Adolescent/
2. Parkinson Disease/
3. Stroke/
4. Multiple Sclerosis/
5. Meniere Disease/
6. Dementia/ or Senile Dementia/
7. exp Amputation/
8. or/2-7
9. 1 not 8
10. exp Exercise/
11. exp Kinesiotherapy/
12. Training/
13. Qigong/ or Qigong Therapy/
14. (exercis$ or training or Tai Chi).tw.
15. (balance adj3 (retrain$ or re-train$ or reeducat$ or re-educat$)).tw.
16. or/10-15
17. Body Equilibrium/or Body Posture/ or Body Position/
18. (balance or functional reach or sway or posturog$).tw.
19. (postur$ adj3 (stability or instability)).tw.
20. (cent$ adj (pressure or mass)).tw.
21. or/17-20
22. and/9,16,21
23. exp Randomized Controlled trial/
24. exp Double Blind Procedure/
25. exp Single Blind Procedure/
26. exp Crossover Procedure/
27. Controlled Study/
28. or/23-27
29. ((clinical or controlled or comparative or placebo or prospective$ or randomi#ed)adj3 (trial or study)).tw.
30. (random$ adj7 (allocat$ or allot$ or assign$ or basis$ or divid$ or order$)).tw.
31. ((singl$ or doubl$ or trebl$ or tripl$) adj7 (blind$ or mask$)).tw.
32. (cross?over$ or (cross adj1 over$)).tw.
33. ((allocat$ or allot$ or assign$ or divid$) adj3 (condition$ or experiment$ or intervention$ or treatment$ or therap$ or control$ or group$)).tw.
34. or/29-33
35. or/28,34
36. limit 35 to human
37. and/22,36

Appendix 5. Search strategy for AMED

AMED (Ovid web)
1. exp Aged/
2. exp Exercise/
3. exp Tai chi/
4. exp Yoga/
5. (exercis$ or training or Tai Chi).tw.
6. exp Exercise therapy/
7. (balance adj3 (retrain$ or re-train$ or reeducation or re-education)).tw.
8. (balance or functional reach or sway or posturog$).tw.
9. (postur$ adj3 (stability or instability)).tw.
10. (cent$ adj3 (pressure or mass)).tw.
11. exp Kinematics/
12. or/2-7
13. or/8-11
14. and/1,12-13
15. randomized controlled trial.pt.
16. controlled clinical trial.pt.
17. Randomized Controlled Trials/
18. Random Allocation/
19. Double-Blind Method/
20. or/15-19
21. Animals/ not Humans/
22. 20 not 21
23. clinical trial.pt.
24. exp Clinical Trials/
25. (clinic$ adj25 trial$).tw.
26. ((singl$ or doubl$ or trebl$ or tripl$) adj (mask$ or blind$)).tw.
27. Placebos/
28. placebo$.tw.
29. random$.tw.
30. Research Design/
31. (latin adj square).tw.
32. or/23-31
33. 32 not 21
34. and/14,22
35. and/14,33
36. or/34-35

Appendix 6. Search strategy for PEDro

PEDro
Abstract & Title: exercise and balance Therapy: no selection Body part: no selection Subdiscipline: gerontology Method: clinical trial When searching: match all search terms (AND)

Appendix 7. Search strategy for OT seeker

OT seeker
Keywords:balance Intervention:exercise/strength training Diagnosis/Subdiscipline:Gerontology - General Method:Clinical Trial Options:Do a “fuzzy logic” search if precise search finds nothing

WHAT'S NEW

Last assessed as up-to-date: 26 July 2007.

7 July 2008	Amended	Converted to new review format.

HISTORY

Protocol first published: Issue 4, 2004

Review first published: Issue 4, 2007

CONTRIBUTIONS OF AUTHORS

TEH - conceived the review, coordinated data collection, searching and retrieval of papers and additional information, screened all search results, appraised quality and extracted data from all papers, entered data into RevMan, analysed and interpreted data and wrote review. TEH is the guarantor for this review.

LR - conceived the review, screened search results, appraised quality, extracted data from papers, assisted in interpretation of data and critically commented on drafts.

AJ - screened search results, appraised quality and extracted data from papers and commented on drafts

PMHB & VAB - screened search results, appraised quality and extracted data from papers.

DECLARATIONS OF INTEREST

None known.

SOURCES OF SUPPORT

Internal sources

- Glasgow Caledonian University, UK.
- University of Northumbria, UK.
- Bell College, UK.

External sources

- Scottish Funding Council, UK.
- Scottish Executive Health Department, UK.
- NHS Education for Scotland, UK.
- Chief Scientist Office, UK.

INDEX TERMS

Medical Subject Headings (MeSH)

Breathing Exercises; Dancing; Exercise [*physiology]; Gait [physiology]; Muscle Strength [physiology]; Postural Balance [*physiology]; Randomized Controlled Trials as Topic; Tai Ji; Yoga

MeSH check words

Aged; Female; Humans; Male; Middle Aged