Physiotherapy versus placebo or no intervention in Parkinson's disease (Review)

Tomlinson CL, Patel S, Meek C, Clarke CE, Stowe R, Shah L, Sackley CM, Deane KHO, Herd CP, Wheatley K, Ives N

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TABLE OF CONTENTS

[Intervention Review]

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Claire L Tomlinson[1], Smitaa Patel[1], Charmaine Meek[2], Carl E Clarke[3], Rebecca Stowe[1], Laila Shah[1], Catherine M Sackley[4], Katherine HO Deane[5], Clare P Herd[3], Keith Wheatley[6], Natalie Ives[1]

[1]Birmingham Clinical Trials Unit, University of Birmingham, Birmingham, UK. [2]Primary Care Clinical Sciences, University of Birmingham, Birmingham, UK. [3]School of Clinical and Experimental Medicine, College of Medical and Dental Sciences, Birmingham, UK. [4]Faculty of Medicine and Health Sciences, University of East Anglia, Norwich, UK. [5]Edith Cavell Building, University of East Anglia, Norwich, UK. [6]Cancer Research UK Clinical Trials Unit, School of Cancer Sciences, University of Birmingham, Birmingham, UK

Contact address: Claire L Tomlinson, Birmingham Clinical Trials Unit, University of Birmingham, Robert Aitken Institute, Edgbaston, Birmingham, B15 2TT, UK. c.l.smith.1@bham.ac.uk.

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ABSTRACT

Background

Despite medical therapies and surgical interventions for Parkinson's disease (PD), patients develop progressive disability. The role of physiotherapy aims to maximise functional ability and minimise secondary complications through movement rehabilitation within a context of education and support for the whole person. The overall aim is to optimise independence, safety and well-being, thereby enhancing quality of life.

Objectives

To assess the effectiveness of physiotherapy intervention compared with no intervention in patients with PD.

Search methods

We identified relevant trials by electronic searches of numerous literature databases (e.g. MEDLINE, EMBASE) and trial registers, plus handsearching of major journals, abstract books, conference proceedings and reference lists of retrieved publications. The literature search included trials published up to end of December 2010.

Selection criteria

Randomised controlled trials of physiotherapy intervention versus no physiotherapy intervention in patients with PD.

Data collection and analysis

Two review authors independently extracted data from each article. We used standard meta-analysis methods to assess the effectiveness of physiotherapy intervention compared with no physiotherapy intervention. Trials were classified into the following intervention comparisons: general physiotherapy, exercise, treadmill training, cueing, dance and martial arts. We used tests for heterogeneity to assess for differences in treatment effect across these different physiotherapy interventions.

Main results

We identified 33 trials with 1518 participants. Compared with no-intervention, physiotherapy significantly improved the gait outcomes of velocity (mean difference 0.05 m/s, 95% confidence interval (CI): 0.02 to 0.07, P = 0.0002), two- or six-minute walk test (16.40 m, CI: 1.90 to 30.90, P = 0.03) and step length (0.03 m, CI: 0 to 0.06, P = 0.04); functional mobility and balance outcomes of Timed Up & Go test (-0.61 s, CI: -1.06 to -0.17, P = 0.006), Functional Reach Test (2.16 cm, CI: 0.89 to 3.43, P = 0.0008) and Berg Balance Scale (3.36 points, CI: 1.91 to 4.81, P < 0.00001); and clinician-rated disability using the Unified Parkinson's Disease Rating Scale (UPDRS) (total: -4.46 points, CI -7.16 to -1.75, P = 0.001; activities of daily living: -1.36, CI -2.41 to -0.30, P = 0.01; and motor: -4.09, CI: -5.59 to -2.59, P < 0.00001). There was no difference between arms in falls or patient-rated quality of life. Indirect comparisons of the different physiotherapy interventions found no evidence that the treatment effect differed across the physiotherapy interventions for any of the outcomes assessed.

Authors' conclusions

Benefit for physiotherapy was found in most outcomes over the short-term (i.e. < three months), but was only significant for velocity, two- or six-minute walk test, step length, Timed Up & Go, Functional Reach Test, Berg Balance Scale and clinician-rated UPDRS. Most of the observed differences between the treatments were small. However, for some outcomes (e.g. velocity, Berg Balance Scale and UPDRS), the differences observed were at, or approaching, what are considered minimally clinical important changes.

The review illustrates that a wide range of approaches are employed by physiotherapists to treat PD. However, there was no evidence of differences in treatment effect between the different types of physiotherapy interventions being used, though this was based on indirect comparisons. There is a need to develop a consensus menu of 'best-practice' physiotherapy, and to perform large well-designed randomised controlled trials to demonstrate the longer-term efficacy and cost-effectiveness of 'best practice' physiotherapy in PD.

PLAIN LANGUAGE SUMMARY

Physiotherapy for treatment of Parkinson's disease

In spite of various medical and surgical treatments for Parkinson's disease (PD), patients gradually develop significant physical problems. Physiotherapists aim to enable people with PD to maintain their maximum level of mobility, activity and independence through monitoring their condition and targeting the appropriate treatment. A range of approaches to movement rehabilitation are used, which aim to enhance quality of life by maximising physical ability and minimising secondary complications over the whole course of the disease.

Only randomised controlled trials were included in this review. These were studies where a group of participants were given physiotherapy intervention and compared with another group who did not receive physiotherapy. The participants were assigned to a group in a random fashion to reduce the potential for bias. Thirty-three randomised trials involving 1518 participants were identified as suitable for this review. The trials assessed various physiotherapy interventions, so the trials were grouped according to the type of intervention being used (general physiotherapy, exercise, treadmill training, cueing, dance or martial arts).

There was an improvement with physiotherapy intervention in all walking outcomes (except the 10- or 20-metre walk test). However, these improvements were only significant for walking speed, walking endurance and step length. Mobility and balance outcomes were also improved with physiotherapy intervention, with significant improvements in one test of mobility (the Timed Up & Go test which times how long it takes a person to get up from a chair, walk a certain distance, then walk back to the chair and sit down) and in two tests of balance (one assessing how far a person can reach before they lose balance (Functional Reach Test) and another which assesses multiple aspects of balance (Berg Balance Scale)). Clinician-rated disability, using the Unified Parkinson's Disease Rating Scale (UPDRS), was also improved with physiotherapy intervention. There was no difference between the two groups in data on falls or patient-rated quality of life. When comparing the different physiotherapy interventions, there was no evidence that the treatment effect differed across the physiotherapy interventions for any of the outcomes assessed.

This review provides evidence on the short-term benefit of physiotherapy for the treatment of PD. Although most of the observed differences were small, the improvements seen for walking speed, balance with the Berg Balance Scale and clinician-rated disability (using the UPDRS) were of a size that patients would consider an important improvement.

BACKGROUND

Parkinson's disease (PD) is a complex neurodegenerative disorder (Rubenis 2007) with wide-reaching implications for patients and their families. Whilst disability can occur at all stages of the disease (Deane 2001a), PD is progressive in nature and so patients face increased difficulties with activities of daily living (ADL) (Kwakkel 2007) and various aspects of mobility such as gait, transfers, balance and posture (Keus 2007b). Ultimately, this leads to decreased independence, inactivity and social isolation (Keus 2007b), resulting in reduced quality of life (Schrag 2000).

The management of PD has traditionally centred on drug therapy with levodopa viewed as the "gold standard" treatment (Rascol 2002). However, even with optimal medical management, patients with PD still experience a deterioration of body function, daily activities and participation (Nijkrake 2007). For this reason, there has been increasing support for the inclusion of rehabilitation therapies as an adjuvant to pharmacological and neurosurgical treatment (Gage 2004; Nijkrake 2007), and a call for the move towards multidisciplinary management of this multidimensional condition (Robertson 2003; Rubenis 2007).

The physiotherapist is a member within this multidisciplinary team (Robertson 2008; Rubenis 2007), with the purpose of maximising functional ability and minimising secondary complications through movement rehabilitation within a context of education and support for the whole person (Deane 2001a; Plant 2000). Physiotherapy for PD focuses on transfers, posture, upper limb function, balance (and falls), gait, and physical capacity and (in)activity, utilising cueing strategies, cognitive movement strategies and exercise to optimise the patient's independence, safety and well-being, thereby enhancing quality of life (Keus 2004; Keus 2007a).

Referral rates to physiotherapy for people with PD have historically been low (Mutch 1986; Yarrow 1999). However, in recent years, the number of referrals has increased, with a survey by Parkinson's UK in 2008 reporting that 54% of the 13,000 members surveyed had seen a physiotherapist compared with 27% in a survey undertaken in 1998 (PDS 2008; Yarrow 1999). This rise in referrals may be attributed to two factors. Firstly, guidelines published by the National Collaborating Centre for Chronic Conditions (Nat Collab Centre for Chronic Conditions 2006) recommended that physiotherapy be made available throughout all stages of the disease, raising the profile of the profession. This has been further supported by the publication of Dutch physiotherapy guidelines (Keus 2004), which provide specific information for physiotherapists involved in the management of PD. Secondly, there has been a substantial increase in the number of trials completed over the last decade (particularly in the last five years), offering supportive evidence for the inclusion of physiotherapy in the management of PD (Keus 2009).

This Cochrane review assessing the effectiveness of physiotherapy intervention versus no physiotherapy intervention in patients with PD was first published in 2001, and included only 11 randomised controlled trials with a total of 280 participants (Deane 2001a). Most of the trials in the review reported a positive effect in favour of physiotherapy, but few outcome measures were statistically significant. This, combined with the presence of methodological flaws, small sample sizes, and the possibility of publication bias, led Deane et al. to conclude that there was insufficient evidence to support or refute the efficacy of physiotherapy for PD (Deane 2001a). This review updates the previous Cochrane review. We appraised and synthesised relevant randomised controlled trials, and we conducted a meta-analysis of outcomes where possible.

OBJECTIVES

To compare the effectiveness of physiotherapy intervention versus no physiotherapy intervention in participants with PD.

To indirectly compare the different physiotherapy interventions used within the various trials.

METHODS

Criteria for considering studies for this review

Types of studies

We considered all randomised controlled trials (including the first phase of cross-over trials) comparing a physiotherapy intervention with no physiotherapy intervention (including placebo-control) for inclusion in the study. We included trials where the no-intervention arm used an active or credible placebo in the review, as long as no physiotherapy was delivered to this group. We only included trials that implemented random methods of treatment allocation.

Types of participants

Participants with a diagnosis of PD (as defined by the authors of the studies).

- Any duration of PD
- All ages
- Any drug therapy
- Any duration of physiotherapy treatment

Types of interventions

Physiotherapy interventions aim to maximise functional ability and minimise secondary complications through movement rehabilitation within a context of education and support for the whole person. Physiotherapy encompasses a wide range of techniques, so

we were inclusive in our definition of physiotherapy intervention (including those not delivered by a physiotherapist) with trials of general physiotherapy, exercise, treadmill training, cueing, dance and martial arts being included.

Types of outcome measures

1. Gait outcomes such as:

a. Two- or six-minute walk test (m) - measures the number of metres a person can walk in two or six minutes, thereby providing a measurement of walking endurance (Kersten 2004).

b. Walking speed:

i. 10- or 20-metre walk test (s) - measures the time in seconds that a person takes to walk 10 or 20 metres, thereby providing a measurement of gait speed (Kersten 2004).

ii. Velocity (m/s) - measures the rate of change of position, recorded in metres per second (Trew 2005).

c. Cadence (steps/min) - measures the number of steps taken in a given period of time, which is then converted into the number of steps taken per minute (Trew 2005).

d. Stride length (m) - measures the average distance (in metres) between two successive placements of the same foot (Whittle 1996).

e. Step length (m) - measures the average distance (in metres) between successive foot to floor contact with opposite feet (Trew 2005).

f. Freezing of Gait Questionnaire - validated questionnaire for the assessment of freezing of gait. The questionnaire consists of six items and scores range from 0 to 24, with higher scores corresponding to more severe freezing of gait (Giladi 2000).

2. Functional mobility and balance outcomes such as:

a. Timed Up & Go (s) - measures time taken in seconds for a person to get up from a chair, walk a certain distance (usually three metres), turn around and walk back to the chair and sit down (Podsiadlo 1991).

b. Functional Reach Test (cm) - "the maximal distance one can reach forward beyond arm's length, while maintaining a fixed base of support in the standing position" (Duncan 1990).

c. Berg Balance Scale - validated questionnaire designed to measure functional standing balance of the older adult. The measure consists of 14-items and score ranges from 0 to 56; with 0 to 20 = high fall risk; 21 to 40 = medium fall risk; and 41 to 56 = low fall risk (Berg 1992; Qutubuddin 2005).

d. Activity Specific Balance Confidence - 16-item self-report questionnaire that asks individuals to rate their confidence that they will maintain their balance in the course of daily activities. Each item is rated from 0% (no confidence) to 100% (complete confidence) (Powell 1995; Talley 2008).

3. Data on falls such as:

a. Number of patients falling - e.g. falls diary.

b. Falls Efficacy Scale - 10-item patient-reported questionnaire that measures how confident a person is at carrying out various activities of daily living (ADL). Items are rated from 1 to 10, with higher scores correlating with lower levels of confidence, and a total score of 70 or over indicating that a person has a fear of falling (Tinetti 1990).

c. Falls Efficacy Scale International - 16-item questionnaire that includes the 10 original items of the standard Falls Efficacy Scale as well as six items regarding higher functioning and social activities. Each item is rated on a scale of 1 to 4, with 1 being 'not connected at all' and 4 'very concerned' (maximum score out of 64) (Yardley 2005).

4. Clinician-rated impairment and disability measures such as:

a. Hoehn & Yahr - scale used to describe how symptoms of Parkinson's disease progress. Scale ranges from 0 to 5, with higher levels indicating greater disability (Hoehn 1967).

b. Unified Parkinson's Disease Rating Scale (UPDRS) - designed to assess motor impairment and disability in Parkinson's disease. Higher scores correspond to greater disability (Fahn 1987).

i. total - score ranges from 0 to 176.

ii. mental - score ranges from 0 to 16.

iii. ADL - score ranges from 0 to 52.

iv. motor - score ranges from 0 to 108.

c. Webster Rating Scale - Assessment of severity of disease and clinical impairment against 10 items using a scale of 0 = normal to 3 = maximum impairment: bradykinesia, rigidity, posture, upper extremity swing, gait, tremor at rest, facies, seborrhoea, speech, and self care. Score ranges from 0 to 30, with higher scores indicating greater disease severity and disability (Webster 1968).

d. Columbia University Rating Scale - Assessment of motor impairment and activities of daily living against 13 items, using a five-point scale for each to give a total score between 0 = normal to 65 = maximum disability (Yahr 1969).

5. Patient-rated quality of life such as:

a. Parkinson's Disease Questionnaire - 39 (PDQ-39) - PD specific health-related quality of life questionnaire containing 39 items divided between eight domains. Scores range from 0 to 100 with higher scores corresponding to poorer quality of life (Jenkinson 1997; Peto 1995).

b. PDQUALIF - PD specific health-related quality of life questionnaire containing 32 items in seven dimensions and one item of global health-related quality of life. Total score ranges from 0 to 128 with higher scores indicating poorer quality of life (Welsh 2003).

c. PDQL - PD specific health-related quality of life questionnaire containing 37 items grouped into four subscales. Item scores range from 1 to 5. The PDQL-Summary Index ranges from 37 to 185, with higher scores reflecting better quality of life (Deboer 1996).

d. Short Form-36 or 12 - Generic short form health survey consisting of 36 or 12 questions. The SF-36 consists of eight scaled scores assessing vitality, physical functioning, bodily pain, general health perceptions, physical role functioning, emotional role functioning, social role functioning and mental health. Scores range from 0 to 100 with higher scores corresponding to better quality of life (Ware 1992).

6. Adverse events e.g. fractures, pain.
7. Compliance e.g. participant adherence, treatment fidelity.
8. Economic analysis.

Search methods for identification of studies

The review is based on the Movement Disorders Group search strategy and also the following more general search strategy:
a. Physiotherapy OR physical therapy OR exercise OR rehabilitation.
b. Parkinson OR Parkinson's disease OR Parkinsonism.
c. #a AND #b.
Further details on this search strategy are available in the Group's module within *The Cochrane Library* (www.cochrane.org). This includes explanations of the acronyms, sources and websites.
We undertook a systematic search of the literature up to the end of December 2010 for publications or abstracts describing relevant trials. This included searching:
1. General biomedical and science electronic databases (without date limiters) including the Movement Disorders Review Group Specialized Register, *The Cochrane Library*, MEDLINE (1966-2010), EMBASE (1974-2010), CINAHL (1982-2010), ISI-SCI (1981-2010); rehabilitation databases: AMED (1985-2010), REHABDATA (1995-2010), REHADAT, GEROLIT (1979-2010); English language databases of foreign language research and third world publications: LILACS (1982-2010), MedCarib (17th Century-2010) and IMEMR (1984-2010).
2. The Cochrane Controlled Trials Register, the CentreWatch Clinical Trials listing service, the metaRegister of Controlled Trials, ClinicalTrials.gov, RePORT, PEDro, NIDRR and NRR.
3. Handsearching of general (*Lancet*, *BMJ*, *JAMA*) and specific journals (*Movement Disorders*, *Neurology*, *Archives of Physical Medicine and Rehabilitation*, *Clinical Rehabilitation*, *Physiotherapy*, *Physical Therapy*) from 2001 to the end of 2010.
4. The reference lists of retrieved papers and review articles.
5. Abstract books and conference proceedings. This included The XIII International Congress on Parkinson's disease (1999), The International Congress of Parkinson's Disease and Movement Disorders (1990, 92, 94, 96, 98, 2000, 02, 04, 05, 06, 07, 08, 09, 10), World Congress on Parkinson's Disease and Related Disorders (2009) and The American Academy of Neurology 51st annual meeting (1999).
6. Grey literature databases (including theses): Conference Proceedings Citation Index (1982-2010), DISSABS (1999-2010), Conference Papers Index (1982-2010), Index to Theses (1970-2010), Electronic Theses Online Service (EThOS) (16^{th} Century-2010) and ProQuest dissertations and theses databases (1861-2010).

Data collection and analysis

Selection of studies

Abstracts of potentially relevant studies from search results were each screened by two of the three review authors involved in study selection (CT, SP, LS). The full paper was obtained if the abstract did not provide sufficient information to determine eligibility for inclusion in the review. Disagreement was resolved by referral to an additional review author (RS). We contacted authors of potentially eligible studies for further information if details of their trial were unclear.

Data extraction and management

Three review authors (CT, SP or CM) independently assessed the identified papers and abstracts for trial details and outcome data, each eligible study was considered by two of these three authors. This was validated by discussion with any discrepancies resolved by consensus. We recorded trial details on a standard trial description form and included: trial name, trial group, authors, randomised comparison, treatment schedule (including duration, number of sessions, type of intervention), other therapy, eligibility criteria, method of randomisation, allocation concealment, blinding, accrual period, number of participants randomised, number of drop outs, duration of follow-up, outcomes reported, use of intention-to-treat analysis and publication date(s). Outcome data extracted included data on gait, functional mobility and balance, falls, clinician-rated disability scale and patient-rated quality of life, adverse events, compliance/withdrawals and health economics where available.
We contacted the authors of any eligible unpublished studies to ask if further details and data for their trial could be provided.

Assessment of risk of bias in included studies

We assessed the full papers for methodological quality by recording eligibility criteria, method of randomisation and blinding, concealment of allocation, similarity of participants in treatment groups at baseline, co-intervention(s) constant, use of active or credible placebo, whether an intention-to-treat analysis was performed and the number of participants lost to follow-up and missing values (see 'Risk of bias' tables under Characteristics of included studies).

Data synthesis

We combined the results of each trial using standard meta-analytic methods to estimate an overall effect for physiotherapy intervention versus no physiotherapy intervention.
All outcomes with data available for meta-analysis were continuous variables, so we calculated the mean difference between treatment arms using mean difference methods (Fleiss 1993). In summary, this involved for each trial, calculating the mean change (and standard deviation) from baseline to the post-intervention time point for both the intervention and no-intervention groups.

From these, the mean difference and its variance between arms for each trial could be calculated. In some studies, the standard deviation for the mean change was not reported, in these cases we imputed this standard deviation using the standard deviations for the baseline and final scores. To do this we used the following formula to estimate the variance of the change in score:

$$\text{var}_{diff} = \text{var}_{pre} + \text{var}_{post} - 2r\sqrt{(\text{var}_{pre}\ \text{var}_{post})}$$

where var_{diff} is the variance of the change score; var_{pre} is the variance of the baseline score; var_{post} is the variance of the final score and r is the correlation between the pre- and post-treatment scores. We assumed a correlation co-efficient of 0.5, which is a conservative estimate, to reduce the chance of false positive results (Higgins 2011).

These values were then combined using weighted mean difference methods to give the overall pooled estimate of the mean difference, with 95% confidence interval, for physiotherapy intervention versus no physiotherapy intervention (control).

If any trials with three or more intervention arms were identified, then we made the following assumptions for the analysis:

1. If the trial was comparing two or more physiotherapy interventions within the same classification (see subgroup analysis below) versus no intervention, then we combined the data for these physiotherapy interventions to give one comparison of physiotherapy intervention versus no intervention.
2. If the trial was comparing two or more physiotherapy interventions in different classifications versus no intervention, then we included the trial in each relevant physiotherapy intervention classification. This meant that some trials were included multiple times in the analysis, and the control arms from these trials were counted more than once in the analysis.

The primary analysis was a comparison of physiotherapy intervention versus no physiotherapy intervention (control) using change from baseline to the first assessment after the treatment period (which in most cases was immediately post intervention). This was chosen as the primary analysis for this review, as in most trials this was the main data analysis, and few trials reported data at longer-term assessment points (i.e. after six months). Also, some trials allowed participants in the no-intervention arm to receive physiotherapy intervention after this point. So this allowed a clean comparison of physiotherapy intervention versus no physiotherapy intervention.

Subgroup analysis and investigation of heterogeneity

The different trials implemented various types of physiotherapy intervention. Therefore trials were divided according to the type of intervention administered:

1. general physiotherapy versus control;
2. exercise versus control;
3. treadmill versus control;
4. cueing versus control;
5. dance versus control;
6. martial arts versus control.

To assess for differences between the different types of interventions involved, we used indirect comparisons using tests of heterogeneity and I^2 values to investigate whether the treatment effect differed across the different interventions (Deeks 2001; Higgins 2003). The I^2 value describes the percentage of the variability in effect estimates that is due to heterogeneity rather than sampling error (chance) (Higgins 2003). These tests may suggest the possible superiority of one type of intervention over another, and may provide clinicians and patients with more reliable information upon which to base decisions about therapy. However, as with all subgroup comparisons, these analyses should be interpreted with caution and should be considered hypothesis generating (Assmann 2000; Clarke 2001).

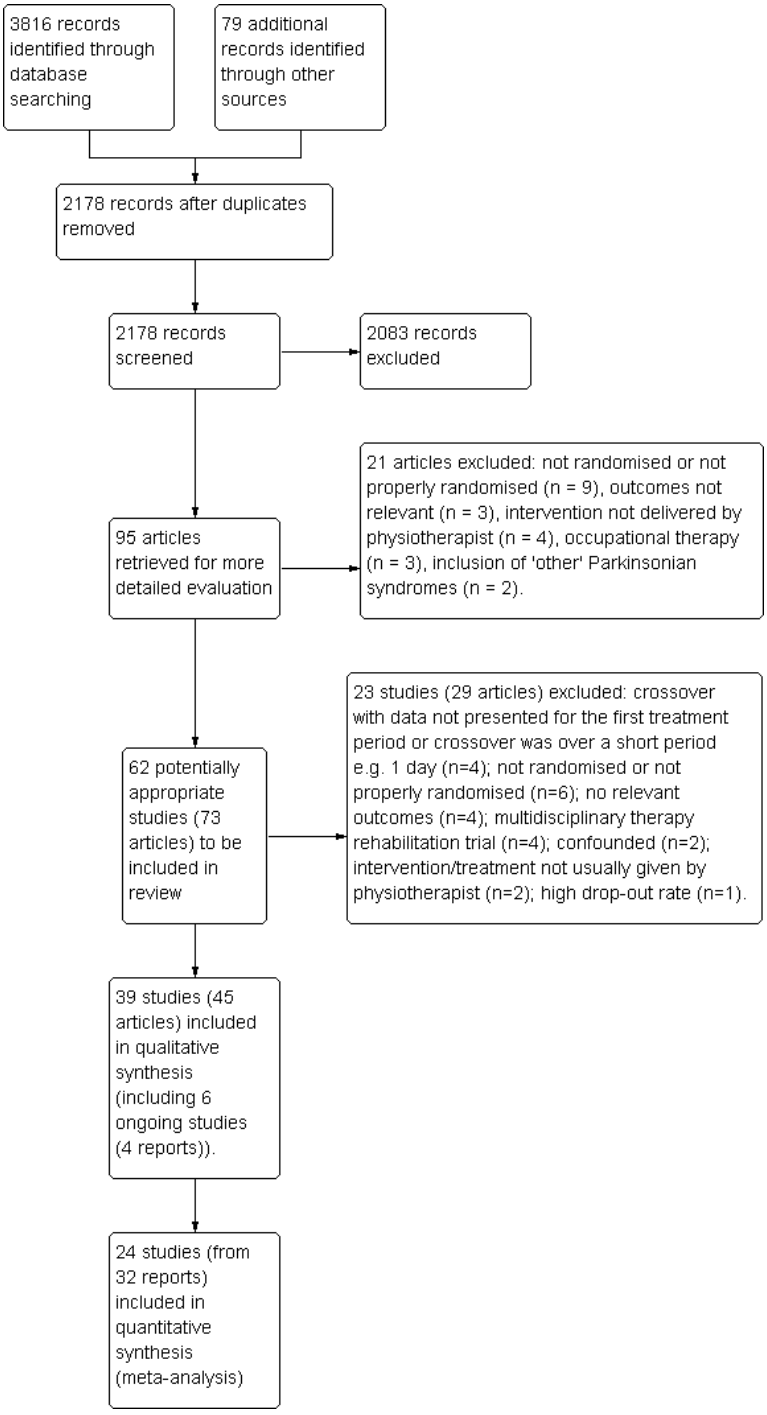
RESULTS

Description of studies

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

We identified 61 randomised trials of physiotherapy intervention in PD patients. We excluded 22 studies (see Characteristics of excluded studies). The reasons for excluding these trials were cross-over study with data not presented for the first treatment period or cross-over was over a short period e.g. one day (n = 4); not randomised or not properly randomised (n = 6); no outcome measures relevant to our review (n = 4); multidisciplinary therapy rehabilitation trial (n = 4); study was confounded (n = 2); and treatment given in trial not usually used by physiotherapists (n = 2). There were also six ongoing trials for which data were not yet available (see Characteristics of ongoing studies). Therefore, there were 33 trials available for inclusion in the review compared with 11 in the 2001 review (Figure 1).

Figure 1. Study PRISMA flow diagram.



The number of participants randomised into the 33 trials ranged from six to 153 participants, with 1518 participants randomised in total (giving an average trial size of nearly 50 participants) (Characteristics of included studies). The assessment period ranged from three weeks to 12 months. The mean age of participants in the trials was 67 years, 64% were male, the mean Hoehn & Yahr stage was 2.4, and they had had PD for approximately six years (Table 1).

There was one trial comparing walking on treadmill listening to music versus walking on treadmill without music versus listening to music alone (Shankar 2009). We excluded the treadmill without music arm of this trial from the analysis as this was a confounded comparison.

There were two three-arm trials comparing two exercise interventions with control. One compared exercise versus exercise and education versus control (Klassen 2007), and the other compared exercise versus PD SAFEx versus control (Sage 2009a). The exercise interventions being compared in these studies were considered suitably similar, so we combined the data from the two exercise arms within each trial to give one comparison of exercise versus control. There was also one four-arm trial comparing two types of dance (waltz/foxtrot and tango) and martial arts with control. We combined the two dance arms to give one comparison of dance versus control, as well as a martial arts versus control comparison (Hackney 2009).

There were three other three-arm trials that contributed data to two of the different physiotherapy intervention comparisons. Two of these were trials of cueing versus exercise versus control, which contributed to both the cueing versus control and exercise versus control comparisons (Mak 2008; Thaut 1996). The other trial was of treadmill versus general physiotherapy versus control, which contributed to both the treadmill versus control and general physiotherapy versus control comparisons (Fisher 2008). The 33 trials therefore contributed data to 37 comparisons within the six different types of physiotherapy interventions - general physiotherapy versus control (n = 5), exercise versus control (n = 12), treadmill versus control (n = 7), cueing versus control (n = 7), dance versus control (n = 2) and martial arts versus control (n = 4).

General physiotherapy versus control

The five trials of general physiotherapy versus control involved 197 participants (Chandler 1999; Ellis 2005; Fisher 2008; Homann 1998; Keus 2007b). The mean participant age was 65 years, 70% were male, the mean Hoehn & Yahr stage was 2.3 and mean duration of PD was four years. All the trials were parallel-group design, except one which was a cross-over design (Ellis 2005). Treatment sessions took place over a period of five weeks to 12 months; duration of sessions was only described by one trial (Ellis 2005). One trial used Bobath training for gait and posture (Homann 1998). The remaining trials provided multifaceted interventions encompassing movement strategies, exercise, hands-on techniques, education and advice, targeting a wide range of areas including gait, balance, transfers, posture and physical fitness. Thus, general physiotherapy is a holistic intervention and on the whole uses a combination of techniques which does not routinely include complementary and/or alternative medicine such as acupuncture or hypnotherapy.

Exercise versus control

The 12 trials of exercise versus control involved 635 participants (Allen 2010; Ashburn 2007; Cerri 1994; Goodwin 2009; Klassen 2007; Mak 2008; Meek 2010; Sage 2009a; Schenkman 1998; Schilling 2008; Stozek 2003; Thaut 1996). The mean participant age was 67 years, 63% were male, the mean Hoehn & Yahr stage was 2.4 and mean duration of PD was six years. All the trials were parallel-group design. Treatment sessions lasted from 30 minutes to two hours, and took place over a period of three to 24 weeks. Exercise involved a variety of different activities including strengthening and balance training, walking, falls prevention, neuromuscular facilitation, resistance exercise and aerobic training as well as education and relaxation techniques. Although sometimes multifaceted, the primary focus of these interventions was exercise delivery, and treatment was frequently categorised by the trial authors as this.

Treadmill versus control

The seven trials of treadmill versus control involved 179 participants (Cakit 2007; Canning 2008; Fisher 2008; Ganesan 2010; Kurtais 2008; Protas 2005; Shankar 2009). The mean participant age was 67 years, 68% were male, the mean Hoehn & Yahr stage was 2.4 and mean duration of PD was five years. All the trials were parallel-group design. Treatment sessions lasted from 30 to 60 minutes, and took place over a period of four to eight weeks. Treadmill training mainly involved participants walking on a treadmill with speed and/or incline adjustments. Two trials used body weight supported treadmill training (Fisher 2008; Ganesan 2010) and two other trials provided gait and step training (Kurtais 2008; Protas 2005).

Cueing versus control

The seven trials of cueing versus control involved 303 participants (de Bruin 2010a; de Bruin 2010b; Lehman 2005; Mak 2008; Nieuwboer 2007; Shankar 2008; Thaut 1996). The mean participant age was 68 years, 60% were male, the mean Hoehn & Yahr stage was 2.5 and mean duration of PD was seven years. Six of the trials were parallel-group design and one was a cross-over design (Nieuwboer 2007). Treatment sessions lasted from 20 to 30

minutes and took place over a period of two to 13 weeks. There were three types of cueing used in the trials - audio (music, spoken instructions), visual (computer images) and sensory (vibration). Six trials applied external cues during gait or gait-related activity, whilst Mak (Mak 2008) utilised cues for the rehabilitation of sit-to-stand transfers.

Dance versus control

The two trials of dance versus control involved 120 participants (Earhart 2010; Hackney 2009). The mean participant age was 69 years, 64% were male, the mean Hoehn & Yahr stage was 2.3 and mean duration of PD was seven years. Both trials had a parallel-group design. Dance classes lasted one hour over 12 to 13 weeks, with a trained instructor teaching participants the tango, waltz or foxtrot.

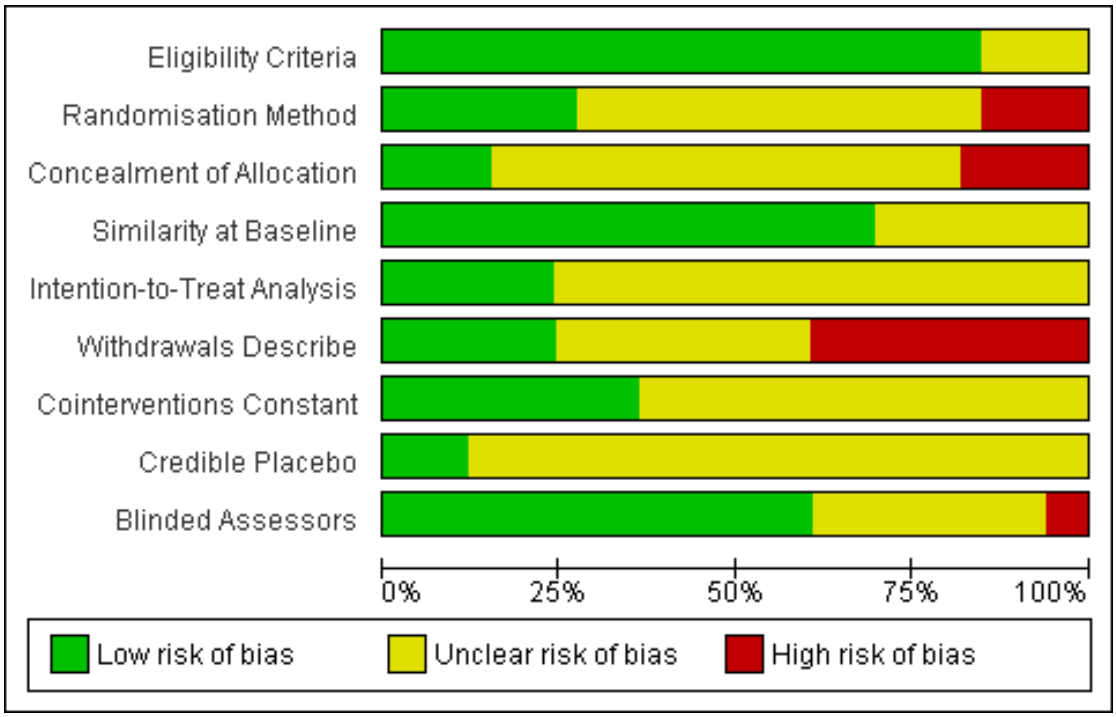
Martial arts versus control

The four trials of martial arts versus control involved 143 participants (Hackney 2009; Marjama-Lyons 2002; Purchas 2007; Schmitz-Hubsch 2006). The mean participant age was 66 years, 72% were male, the mean Hoehn & Yahr stage was 2.1 and mean duration of PD was seven years. All the trials were parallel-group design, except one which was a cross-over design (Purchas 2007). Treatment lasted one hour and took place over a period of 12 to 24 weeks. Participants took classes on Tai Chi (three trials; Hackney 2009; Marjama-Lyons 2002; Purchas 2007) or Qigong (one trial; Schmitz-Hubsch 2006).

Risk of bias in included studies

See Characteristics of included studies, risk of bias in included studies tables, risk of bias graph (Figure 2).

Figure 2. Risk of bias graph: review authors' judgements about each risk of bias item presented as percentages across all included studies.



Trial design

Thirty trials had a parallel design and three had a cross-over design (Ellis 2005; Nieuwboer 2007; Purchas 2007). The cross-over trials had no washout period, with participants assessed at baseline, after the first treatment period, and then after the second treatment period. Most trials looked at the short-term effect of therapy by

assessing the participants at baseline and immediately or shortly after the physiotherapy intervention period (which ranged from two to 52 weeks). Eight of the parallel design trials (Ashburn 2007; Goodwin 2009; Klassen 2007; Lehman 2005; Mak 2008; Meek 2010; Schmitz-Hubsch 2006; Stozek 2003) reported additional data at assessment points after the treatment period had finished; this may have been at only one week or up to 12 months after the end of the treatment period.

Sample size

Only four studies (12%; Allen 2010; Ashburn 2007; Ellis 2005; Nieuwboer 2007) reported a sample size calculation in the trial report, which was achieved by all but one study (Ashburn 2007).

Eligibility criteria

The eligibility criteria for the trials were broad and varied considerably across the trials. The level of detail provided on the eligibility criteria was also variable, with some studies providing a detailed description of the entry criteria, and others just stating "patients with Parkinson's disease". Only seven trials (Cakit 2007; de Bruin 2010a; Homann 1998; Keus 2007b; Nieuwboer 2007; Schmitz-Hubsch 2006; Shankar 2008) stated that a diagnosis of PD by the United Kingdom Brain Bank Criteria (Gibb 1988) was required. It is vital that eligibility criteria are well-defined, so that the trial participant population can be determined.

Randomisation method and concealment of allocation

Only fourteen trials (42%) described the randomisation method used, of which nine trials used low risk methods (e.g. block randomisation or computer random number generators). No details on the randomisation method used were provided for the remaining nineteen trials. Further, only 11 trials (33%) either stated or gave adequate information that allowed the assessment of whether an adequate concealment of treatment allocation procedure had been used. Five trials were considered to be low risk by virtue of having used a central randomisation service with the other six considered high risk (i.e. concealment of treatment allocation was potentially compromised - sealed envelopes, picking card or picking from a hat).

Blinding of assessors

It would be impossible to blind participants and therapists to randomised treatment allocation in trials of physiotherapy. Therefore, such trials are open label by nature, and are consequently liable to the possibility of both performance and attrition bias. However, blinding of assessors could be employed to try and reduce the possibility of bias. Twenty-one (64%) of the 33 studies used blinded assessors (though in one study the assessors correctly guessed the treatment allocation in nearly 30% of patients (unclear risk; Ashburn 2007), two used un-blinded assessors so were classed as high risk, and in the other 10 studies this information was not provided (classed as unclear risk).

Description of the no-intervention (control) group

In most trials (n = 29), the control group did not receive any physiotherapy treatment or intervention, however in four trials (Allen 2010; Ashburn 2007; Fisher 2008; Shankar 2009) an active or credible placebo that attempted to control for the time and attention involved in receiving physiotherapy intervention compared with no treatment was used. This included contact with a PD nurse, education classes, advice on falls prevention or listening to music. The control groups were followed up and assessed in the same manner as the intervention groups.

Co-interventions

Information on co-interventions was provided in 19 trials (58%), with participants continuing with their standard PD medication. In 12 trials, this drug therapy was kept stable (low risk) throughout the duration of the trial, whereas seven trials allowed variation (unclear risk). The remaining 14 trials did not describe drug therapy (unclear risk).

Similarity of treatment groups at baseline

A description of the baseline characteristics of the trial participants is important to determine whether the trial results are generalisable and to compare characteristics of the two arms to ensure that the randomisation methods were successful.

Four trials (de Bruin 2010b; Ganesan 2010; Homann 1998; Marjama-Lyons 2002) did not provide any information on the baseline characteristics of the participants entered into the trial. Twenty-three (of the 29) trials that reported baseline data gave this information split by treatment group and showed participants to be similar at baseline. In nine trials, the baseline characteristics of the withdrawn participants were not given (Cakit 2007; de Bruin 2010a; Hackney 2009; Klassen 2007; Kurtais 2008; Mak 2008; Purchas 2007; Sage 2009a; Schenkman 1998). This, along with the four studies that did not supply baseline data, meant that 151 (10%) of the 1518 randomised participants were not characterised.

Data analysis

Eight trials stated intention-to-treat as the primary method of analysis, although it was not always clear if patients who withdrew from the trial were included in the analysis. The number of patient withdrawals was classed as low risk ($\leq$ 10% of trial participants withdrew) in six of the eight trials. In the other 25 trials, the method of analysis was not described (unclear risk). Of these trials,

11 were considered high risk in terms of the proportion of patients that withdrew (i.e. > 10%), and in 12 trials the number of patient withdrawals (if any) was not described (unclear risk).

Data available for analysis

Thirteen trials were reported in abstract form. We requested further information from authors with seven (Canning 2008; Earhart 2010; Goodwin 2009; Klassen 2007; Meek 2010; Purchas 2007; Shankar 2008) providing additional information and six (Cerri 1994; de Bruin 2010b; Ganesan 2010; Homann 1998; Marjama-Lyons 2002; Shankar 2009) requests being unsuccessful. However, sufficient data were available for meta-analysis for five of the 13 studies (Earhart 2010; Goodwin 2009; Klassen 2007; Meek 2010; Shankar 2009). Further, one trial had relevant data which could not be extracted as they were only available in graph form (Lehman 2005). Therefore data were not available for meta-analysis for nine trials, meaning that of the 33 trials, data available for analysis were provided by 24 trials.

Effects of interventions

Primary analysis

Gait outcomes

Two-or six-minute walk test (m)

Data on the two- or six-minute walk test were available from four trials for five comparisons within three physiotherapy interventions (exercise, dance and martial arts). (Note: Hackney 2009 contributed data to both the dance and martial arts comparisons). One hundred and seventy-two participants were included in this analysis. There was a benefit of borderline significance, with a greater increase in the distance walked in two or six minutes with physiotherapy intervention compared with no intervention (mean difference 16.40 m, 95% confidence interval (CI) 1.90 to 30.90; P = 0.03). There was no evidence of heterogeneity between the individual trials (P = 0.37, I^2 = 7%), nor was there evidence that the treatment effect differed across the three physiotherapy interventions (P = 0.14, I^2 = 49%).

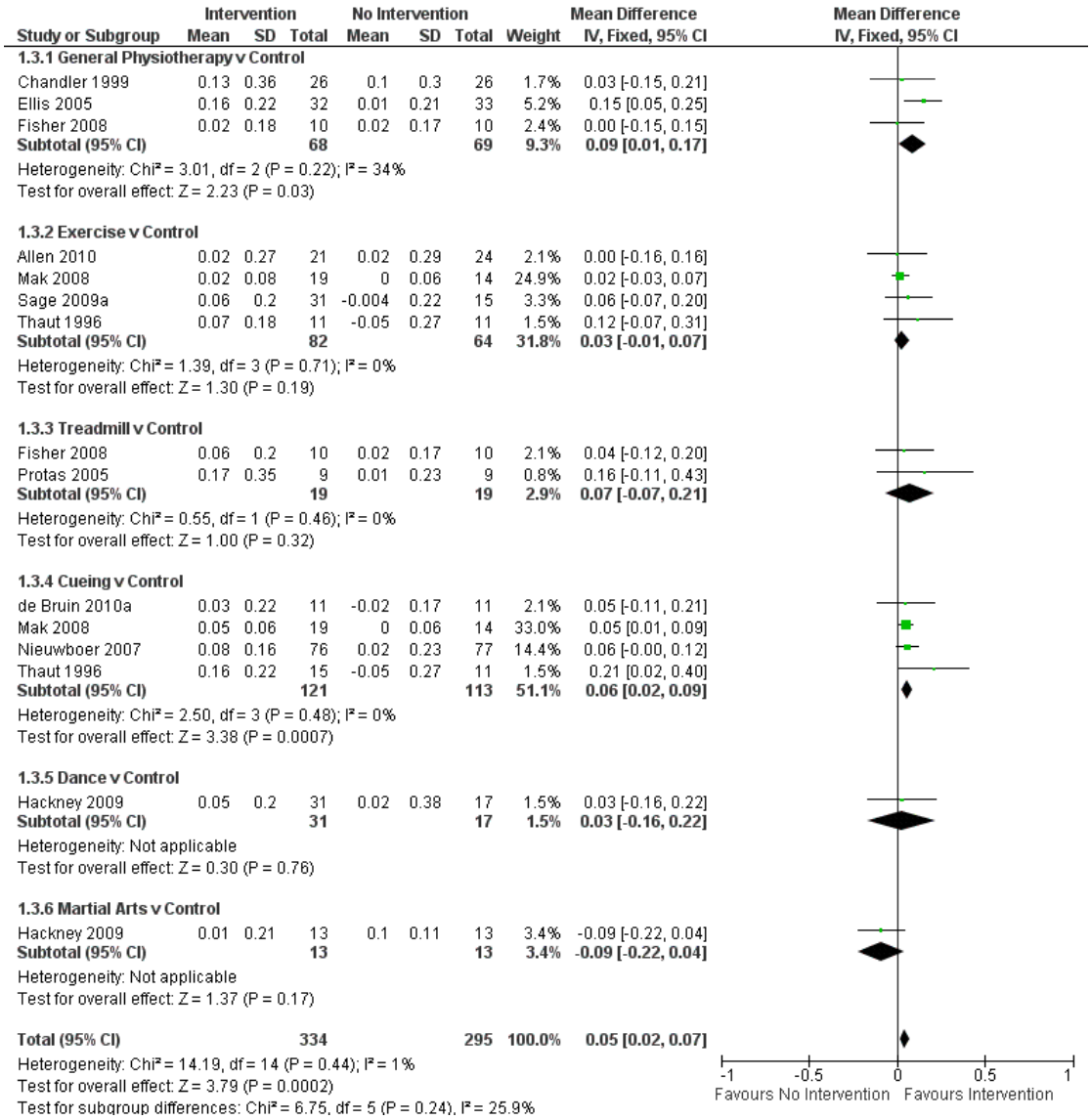
Ten- or 20-metre walk test (s)

Data on the 10- or 20-metre walk test were available from four trials for two physiotherapy interventions (exercise and treadmill). One hundred and sixty-nine participants were included in the analysis. There was borderline significance in favour of no intervention for the time taken to walk 10 or 20 metres (0.40 s, CI 0.00 to 0.80; P = 0.05). There was no evidence of heterogeneity between the individual trials (P = 0.19, I^2 = 38%), nor was there evidence that the treatment effect differed across the two physiotherapy interventions (P = 0.51, I^2 = 0%).

Velocity (m/s)

Data on velocity were available from 11 trials for 15 comparisons within all six physiotherapy interventions. (Note: Fisher 2008; Hackney 2009; Mak 2008; and Thaut 1996 all contributed data to two physiotherapy comparisons). Six hundred and twenty-nine participants were included in this analysis. There was a significant benefit for physiotherapy, with velocity increased by 5 cm/second with physiotherapy intervention compared with no intervention (0.05 m/s, CI 0.02 to 0.07; P = 0.0002, see Figure 3). There was no evidence of heterogeneity between the individual trials (P = 0.44, I^2 = 1%), nor was there any evidence of heterogeneity between the different types of physiotherapy intervention (P = 0.24, I^2 = 25.9%).

Figure 3. Velocity (m/s).



Cadence (steps/min)

Data on cadence were available from six trials for eight comparisons within four physiotherapy interventions (general physiotherapy, exercise, treadmill and cueing). (Note: Fisher 2008 and Thaut 1996 contributed data to two physiotherapy comparisons). Three hundred and twenty-seven participants were included in this analysis. There was no significant difference in cadence between the two treatment arms (-1.72 steps/min, CI -4.01 to 0.58; P = 0.14).

Stride length (m)

Data on stride length were available from five trials for eight comparisons within all six physiotherapy interventions. (Note: Fisher 2008, Hackney 2009 and Thaut 1996 contributed data to two physiotherapy comparisons). Two hundred and two participants were included in this analysis. There was no difference in stride length between the two treatment arms (0.03 m, CI -0.02, 0.09; P = 0.26).

Step length (m)

Data on step length were available from three trials for four comparisons within four physiotherapy interventions (general physiotherapy, exercise, treadmill and cueing). (Note: Fisher 2008 contributed data to both the general physiotherapy and treadmill comparisons). Two hundred and thirty-nine participants were included in this analysis. There was a borderline significant benefit, with step length increased by 3 cm with physiotherapy intervention compared with no intervention (0.03 m, CI 0.00 to 0.06; P = 0.04). There was no evidence of heterogeneity between the individual trials (P = 0.60, I^2 = 0%), nor was there evidence that the treatment effect differed across the four physiotherapy interventions (P = 0.60, I^2 = 0%).

Freezing of Gait Questionnaire

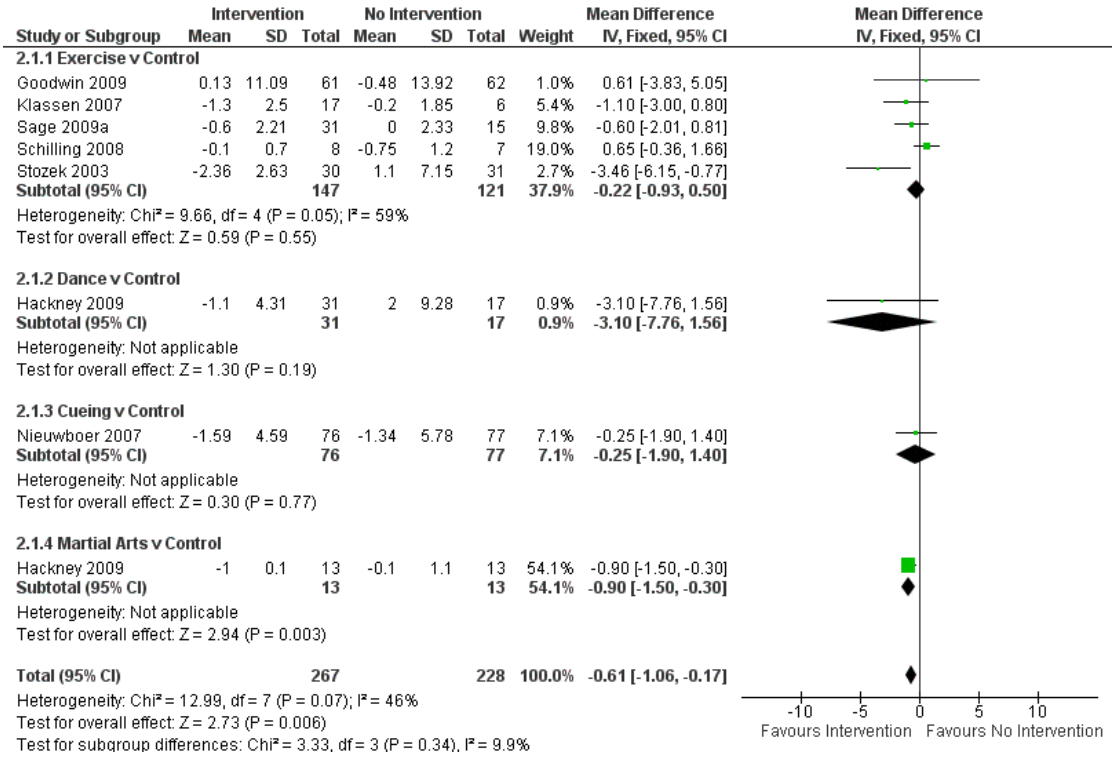
Data from the Freezing of Gait Questionnaire were available from just three trials for three physiotherapy interventions (exercise, cueing and dance). Two hundred and forty-six participants were included in this analysis. There was no significant difference between the two treatment arms (-1.19, CI -2.54 to 0.16; P = 0.08).

Functional Mobility and Balance Outcomes

Timed Up & Go (s)

Data on the Timed Up & Go test were available from seven trials for eight comparisons within four physiotherapy interventions (exercise, cueing, dance and martial arts). (Note: Hackney 2009 contributed data to both the dance and martial arts comparisons). Four hundred and ninety-five participants were included in this analysis. Overall, the time taken to complete the Timed Up & Go test was significantly improved (i.e. reduced) with physiotherapy intervention compared with no intervention (-0.61 s, CI -1.06 to -0.17; P = 0.006, see Figure 4). There was no heterogeneity between the individual trials (P = 0.07, I^2 = 46%), nor between the four physiotherapy interventions (P = 0.34, I^2 = 9.9%).

Figure 4. Timed Up & Go (s).



The results for the Hackney et al. martial arts comparison were heavily weighted in the analysis (54.1%), due to very small standard deviations (Hackney 2009) compared with the other studies. It was also noted that in the trial publication, a non-significant (P = 0.093) effect of martial arts intervention was reported, which was in contrast to our data analysis which reported a significant improvement (P = 0.003). We contacted the author to check whether the data reported in the paper were in fact standard errors, but they were confirmed as standard deviations. We therefore performed a sensitivity analysis removing this study and found that the overall result became non-significant (-0.28 s, CI -0.93 to 0.37; P = 0.40), so this data perhaps need to be interpreted with caution.

Functional Reach Test (cm)

Data on the Functional Reach Test were available from four trials for two physiotherapy interventions (exercise and cueing). Three hundred and ninety-three participants were included in this analysis. Functional reach was significantly improved with physiotherapy intervention compared with no intervention (2.16 cm, CI 0.89 to 3.43; P = 0.0008). There was no evidence of heterogeneity between the individual trials (P = 0.15, I^2 = 44%), nor was there evidence that the treatment effect differed across the two physiotherapy interventions (P = 0.48, I^2 = 0%).

Berg Balance Scale

Data on the Berg Balance Scale were available from four trials for five comparisons within four physiotherapy interventions (exercise, treadmill, dance and martial arts). (Note: Hackney 2009 contributed data to both the dance and martial arts comparisons). Three hundred and sixty-one participants were included in this analysis. The Berg Balance Scale was significantly better following physiotherapy intervention (3.36 points, CI 1.91 to 4.81; P < 0.00001). There was no evidence of heterogeneity between the individual trials (P = 0.16, I^2 = 40%), nor was there evidence that the treatment effect differed across the four physiotherapy interventions (P = 0.21, I^2 = 33%).

Activity Specific Balance Confidence

Data on Activity Specific Balance Confidence were available from three trials for two physiotherapy interventions (exercise and cueing). Sixty-six participants were included in this analysis. There was no difference between the two treatment arms (2.40 points, CI -2.78 to 7.57; P = 0.36).

Falls

Number of falls

Seven trials (Ashburn 2007; Goodwin 2009; Marjama-Lyons 2002; Meek 2010; Nieuwboer 2007; Protas 2005; Purchas 2007) attempted to record the number of falls during the trial period. This was usually by means of a falls diary, which can be difficult to analyse and subject to bias. Nevertheless, most of the individual trials reported a general trend for a reduction in the number of falls with intervention. However, when this was compared with the no-intervention arm this was not significant, except in one trial. Marjama-Lyons 2002 reported a significant decrease in the chance of fall frequency with Tai Chi intervention when compared with no intervention.

Falls Efficacy Scale

Data on the Falls Efficacy Scale were available from four trials for four comparisons within two physiotherapy interventions (exercise and cueing). Three hundred and fifty-three participants were included in this analysis. There was no difference in the Falls Efficacy Scale between the two treatment arms (-1.91 points, CI -4.76 to 0.94; P = 0.19).

Clinician-rated disability

Only data on the Unified Parkinson's Disease Rating Scale were available for meta-analysis.

Unified Parkinson's Disease Rating Scale (UPDRS)

Total

Data on total UPDRS score were available from two trials for three comparisons within two physiotherapy interventions (general physiotherapy and treadmill). (Note: Fisher 2008 contributed data to both the general physiotherapy and treadmill comparisons). One hundred and five participants were included in this analysis. Overall, the UPDRS total score was significantly improved with physiotherapy intervention compared with no intervention (-4.46 points, CI -7.16 to -1.75; P = 0.001). There was no evidence of heterogeneity between the individual trials (P = 0.45, I^2 = 0%), nor was there evidence of heterogeneity between the different types of physiotherapy intervention (P = 0.29, I^2 = 9.6%).

Mental

Data on the mental sub-scale of the UPDRS were available from two trials for three comparisons within two physiotherapy interventions (general physiotherapy and treadmill). (Note: Fisher 2008 contributed data to both the general physiotherapy and treadmill comparisons). One hundred and five participants were included in this analysis. There was no difference in UPDRS mental score between the two treatment arms (-0.44, CI -0.98 to 0.09; P = 0.10).

Activities of daily living (ADL)

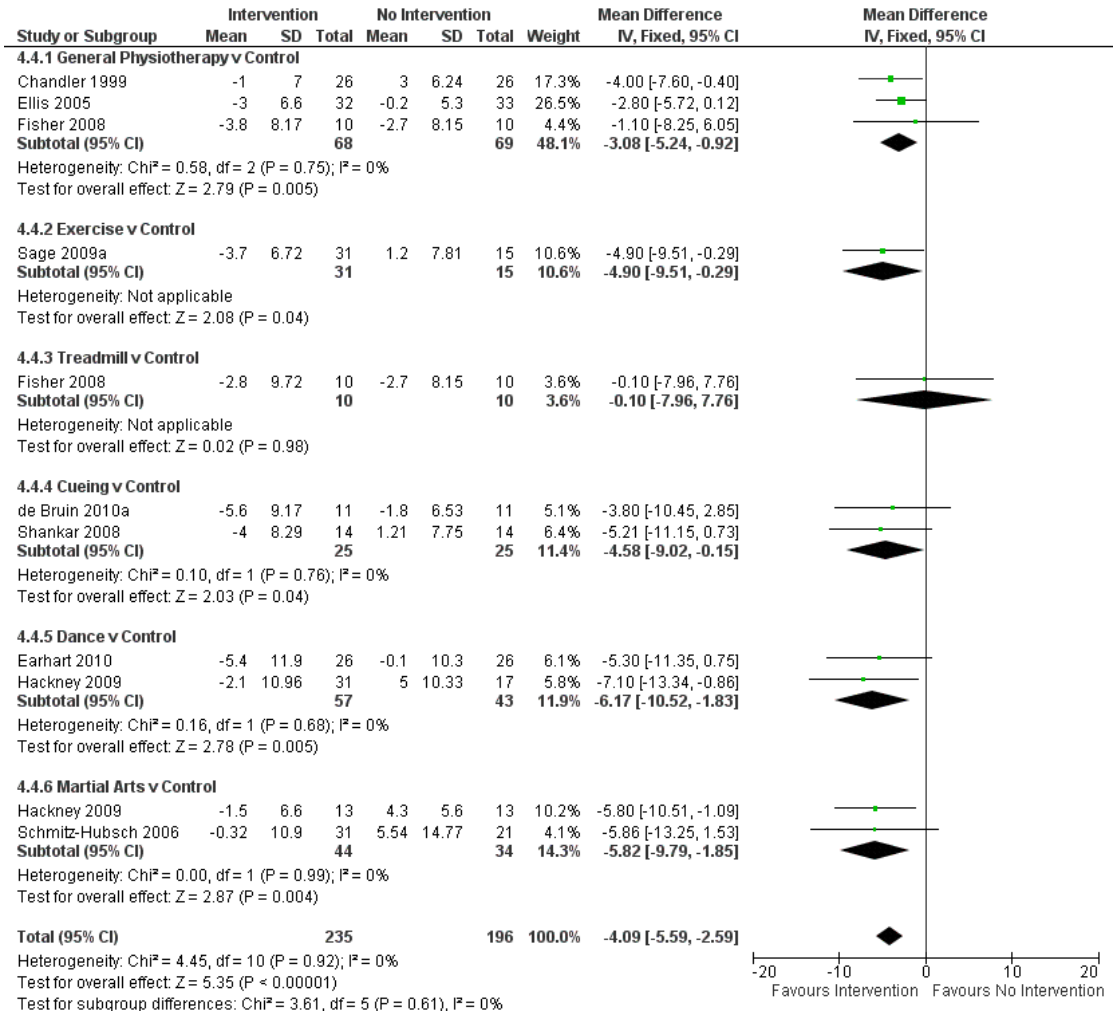
Data on the ADL sub-scale of the UPDRS were available from three trials for four comparisons within three physiotherapy interventions (general physiotherapy, treadmill and dance). (Note:

Fisher 2008 contributed data to both the general physiotherapy and treadmill comparisons). One hundred and fifty-seven participants were included in this analysis. Overall, the UPDRS ADL score was significantly improved with physiotherapy intervention compared with no intervention (-1.36 points, CI -2.41 to -0.30; P = 0.01). There was no evidence of heterogeneity between the individual trials (P = 0.28, I^2 = 22%), nor was there any evidence of heterogeneity between the different types of physiotherapy intervention (P = 0.19, I^2 = 40.1%).

Motor

Data on the motor sub-scale of the UPDRS were available from nine trials for eleven comparisons within all six physiotherapy interventions. (Note: Fisher 2008 and Hackney 2009 both contributed data to two physiotherapy interventions). Four hundred and thirty-one participants were included in this analysis. Overall, the UPDRS motor score was significantly improved with physiotherapy intervention compared with no intervention (-4.09 points, CI -5.59 to -2.59; P < 0.00001, see Figure 5). There was no evidence of heterogeneity between the individual trials (P = 0.92, I^2 = 0%), nor was there evidence that the treatment effect differed across the six physiotherapy interventions (P = 0.61, I^2 = 0%).

Figure 5. UPDRS - Motor.Earhart 2010, MDS-UPDRS



Patient-rated quality of life

Only data on the Parkinson's Disease Questionnaire - 39 (PDQ-39) for the mobility domain and summary index were available for meta-analysis.

Parkinson's Disease Questionnaire - 39 (PDQ-39)

Summary Index

Data on the Summary Index of the PDQ-39 were available from six trials for seven comparisons within five physiotherapy interventions (general physiotherapy, exercise, cueing, dance and martial arts). (Note: Hackney 2009 contributed data to both the dance and martial arts comparisons). Three hundred and eighty-seven participants were included in this analysis. There was no difference between treatment arms in patient-rated quality of life following physiotherapy intervention (-0.35 points, CI -2.66 to 1.96; P = 0.77).

Mobility

Data on the mobility domain of the PDQ-39 were available from two trials for three comparisons within three physiotherapy interventions (general physiotherapy, dance and martial arts). (Note: Hackney 2009 contributed data to both the dance and martial arts comparisons). One hundred and five participants were included in this analysis. There was no difference in the PDQ-39 mobility score between the two treatment arms (-1.43, CI -8.03 to 5.18; P = 0.67).

Adverse Events

No trials reported data on adverse events.

Compliance

Only eleven trials of the 33 discussed patient compliance with eight (Allen 2010; Ellis 2005; Keus 2007b; Klassen 2007; Kurtais 2008; Meek 2010; Sage 2009a; Schenkman 1998) quantifying it in some form, however, this was difficult to analyse.

Health economic

No trials reported data on health economic outcomes.

Subgroup analysis

There was no evidence of any differences in the treatment effect between the different physiotherapy interventions used in the various trials for any of the outcomes assessed.

DISCUSSION

Summary of main results

This review updates the previous Cochrane review published in 2001 (Deane 2001a) comparing physiotherapy intervention versus no physiotherapy intervention for the treatment of PD. The review now includes 33 randomised trials with 1518 participants (compared with 11 trials and 280 participants in the 2001 review). It also reports the comparison of the different types of physiotherapy interventions used in the treatment of PD, and thus provides a comprehensive assessment of physiotherapy treatment. Many recent systematic reviews have focused on specific areas of physiotherapy such as exercise and cueing (Crizzle 2006; Goodwin 2008; Lim 2005; Nieuwboer 2008). Nowadays, physiotherapy for PD encompasses a wide range of methods and techniques ranging from standard NHS physiotherapy to exercise regimens and martial arts. Therefore, it is important that all forms of physiotherapy intervention are included, so that the true benefit (if any) of physiotherapy can be assessed. The review also includes a more comprehensive range of outcome measures compared with previous reviews (18 outcomes assessing gait, functional mobility and balance, falls, clinician-rated Unified Parkinson's Disease Rating Scale (UPDRS) and patient-rated quality of life), and thus provides the most reliable summary available of the current published evidence.

Physiotherapy intervention versus no-physiotherapy intervention

This review provides evidence on the short-term (< three months) benefit of physiotherapy in the treatment of PD. All outcomes showed an improvement with physiotherapy intervention compared with no intervention (except the 10- or 20-metre walk test). However, significant benefit following physiotherapy intervention was only observed for the gait outcomes of velocity, the two- or six-minute walk test and step length; the functional and mobility outcomes of the Timed Up & Go test, Functional Reach Test and Berg Balance Scale, and clinician-rated UPDRS. It is of interest that the direction of the treatment effect favoured physiotherapy intervention in all, except one, outcome measure. The absence of evidence in these outcomes is not necessarily evidence of absence of a benefit for physiotherapy. One possible reason for this may be the lack of data. Over 1500 participants were randomised into the 33 trials included in this review, with 24 trials and 1234 participants (81% of total) providing data for analysis. However, the most data were provided for analysis of the outcome velocity, and this included just 11 trials and 629 participants (51% of participants providing data).

Gait

People with PD frequently have problems with gait, and treatment is usually targeted, maximising exercise tolerance, improving gait pattern, maintaining or increasing independence regarding mo-

bility and reducing the risk of falls. The most significant improvement among the outcomes assessing gait was in velocity. In light of previous experimental evidence, it may be hypothesised that the improvement in velocity is linked to an increase in step or stride length, or both, and that this in turn leads to a compensatory decrease in cadence (Morris 1994; Morris 1996). In this review, although a significant improvement in velocity was observed, we found only a borderline improvement in step length, and no difference in stride length or cadence. This could again be due to a lack of data, as a smaller number of studies reported step and stride length and cadence (up to six studies) compared with velocity (11 studies). Thus, further data on the possible link between velocity, cadence, step and stride length are required.

Freezing of gait is a prevalent motor disturbance within PD, and is known to have a detrimental impact on quality of life, as well as gait and mobility (Moore 2007). We found no difference in scores derived from the Freezing of Gait Questionnaire, but this was only measured in three trials (246 participants), again highlighting the need for further data on this important area.

The observed differences in the three significant gait outcomes (velocity, the two- or six-minute walk test and step length) were relatively small. Therefore, their relevance and benefit to PD patients must be put into context in terms of what is considered a minimally clinically important change (MCIC). Velocity was significantly improved with physiotherapy intervention by 0.05 metres/second. Data on what is considered a MCIC are lacking for PD patients, but some data have been reported in stroke patients. In one study, it was reported that an increase in velocity of just 0.03 and 0.13 metres/second could translate into a change from a limited household to an unlimited household walker and an unlimited household to a most-limited community walker respectively (Perry 1995). Our data fit in with the findings reported by Perry (Perry 1995). For the two- or six-minute walk test and step length, those participants who received physiotherapy intervention were able to walk further over two or six minutes (by 16 m) and step length was increased by 3 cm. There is a lack of data on the MCIC for these outcomes, but whilst a 16 m increase in distance walked would probably be considered clinically important, the importance of a 3 cm increase in step length is less clear.

Functional Mobility and Balance

The changes in functional mobility and balance within PD have been well-documented (Bloem 2001). Of the functional mobility and balance outcomes assessed within this review, significant improvements were observed in the Timed Up & Go test, Functional Reach Test and Berg Balance Scale. The time taken to complete the Timed Up & Go test was significantly improved by 0.61 seconds with physiotherapy. Despite this significant change, the MCIC in PD patients is thought to be 11 seconds (Steffen 2008). Therefore, the small change observed within this review may not translate into a noticeable improvement within a person's functional mobility.

A five-point change is the MCIC on the Berg Balance Scale (Steffen 2008). In this review, there was a significant three-point improvement in the Berg Balance Scale after physiotherapy intervention. Although this is less than the five-point MCIC, the results are approaching the level of clinical importance (upper confidence interval: 4.81). A significant improvement of 2 cm was also noted in the Functional Reach Test, but this is somewhat lower than the MCIC of 9 cm and 7 cm for forward and backward Functional Reach Test (Steffen 2008).

Falls

Falls are a common and disabling problem within PD (Bloem 2001), with a high clinical impact and serious cost implications to society. They are also a recurrent problem, with up to 51% of those falling reporting two or more falls per year (Wood 2002). Fear of falling has been recognised as a contributing factor to recurrent falls (Mak 2009). Within this review, fear of falling has been captured through the Falls Efficacy Scale (standard and international). No difference between treatment arms was observed for this outcome. This might be attributed to the small number of trials (and therefore participants) included within these analyses, but could also indicate that an improvement in balance does not automatically result in increased confidence in an individual's ability not to fall. In turn, it could be hypothesised that an improvement in balance does not directly equate to improved levels of mobility and independence. Although fear of falling was not reduced with physiotherapy within this review, it would be of interest to assess whether the number of falls was reduced, as this may be more relevant to patients. Unfortunately data on this were poorly reported and measured too variably within the trials, and could not be meta-analysed. However, in the seven trials where data on the number of falls were reported, there was a general trend for a reduction in the number of falls with physiotherapy intervention, but there was no difference between the two treatment arms.

Clinician-Rated Disability

Significant improvements following physiotherapy intervention were also observed for the clinician-rated UPDRS (total, ADL and motor scores). The UPDRS total score was improved by 4.5 points, the ADL score by 1.4 points and motor score by 4.1 points. The MCIC for the UPDRS was reported in two studies. One analysed data from two independent randomised controlled trials and concluded the MCIC to be eight points for the UPDRS total score, between two and three points for the ADL score and five points for the motor score (Schrag 2006). The second study performed a cross-sectional analysis on the 653 participants with PD, and reported MCIC of 2.3 to 2.7 points for motor and 4.1 to 4.5 points for total UPDRS (Shulman 2010). Taking into account the recommendations of both Schrag (Schrag 2006) and Shulman

et al (Shulman 2010), it can be concluded that the significant improvements observed within this review are approaching or are MCICs (the MCICs for the UPDRS total, ADL and motor scores lie within the confidence interval). This suggests that physiotherapy intervention is beneficial in improving motor symptoms and may positively impact on ADL.

Patient-Rated Quality of Life

There was no significant benefit of physiotherapy intervention on overall patient-rated quality of life (measured using the Parkinson's Disease Questionnaire (PDQ)-39 Summary Index) or the mobility domain of the PDQ-39, which is surprising considering the significant improvements seen in the UPDRS scores. Another study (Chandler 1999) assessed patient quality of life using the generic Short Form-36 and also showed no effect of physiotherapy intervention.

Comparison of Different Physiotherapy Interventions

Whilst, we found short-term benefit for physiotherapy intervention in the treatment of PD, what is less clear is whether there is a certain type of physiotherapy intervention which may provide greater benefit. This would be of interest to both clinicians and patients, so that appropriate physiotherapy interventions which provide greater benefit can be delivered to patients with PD. To assess this, we categorised the various physiotherapy interventions used in the trials included in this review according to the type of treatment administered and then compared using tests for heterogeneity. We found no evidence of any differences in the treatment effect between the different physiotherapy interventions used for any of the outcomes assessed. However, these were based on indirect comparisons (with limited data within each physiotherapy intervention) so should be interpreted with caution, and would be better assessed in trials directly comparing different types of physiotherapy interventions.

This lack of difference between the different types of physiotherapy intervention is perhaps not surprising. The content and delivery of the interventions used in the trials included within this review are diverse in nature and, although attempts were made to compare trials "like for like" through the creation of different categories, the interventions delivered varied substantially within these categories. The variety in the therapy delivered is perhaps unsurprising. By nature physiotherapists are autonomous professionals with differing sets of skills who work within their own scope of practice (Chartered Society of Physiotherapy), and so this variation in the interventions delivered within clinical trials may actually reflect clinical practice. Secondly, and perhaps more importantly, PD is recognised as a complex condition with an individualised presentation (Van der Marck 2009). For this reason, Morris et al (Morris 2010) recognises the importance of the physiotherapist understanding the specific experience of PD in each patient, and advocates that treatment is tailored to fit the individual's complaints, their lifestyle and personal interests, as opposed to a "one size fits all" approach. Over the past decade, steps have been taken to try and provide best practice consensus in the form of the Dutch *KNGF guidelines for physical therapy in patients with Parkinson's disease* (Keus 2004). However, this publication provides a guidance framework rather than a "recipe" for treatment. It is therefore important that physiotherapy interventions are compared against each other within rigorous trial designs to determine which are most effective. This will provide therapists with a menu of treatment strategies, which are known to be effective, from which they can devise individualised interventions.

Quality of the evidence

There has been an improvement in the trial methodological quality and reporting since the last Cochrane review (Deane 2001a) The use of more robust randomisation methods, blinding and intention-to-treat analyses had increased since the previous review, although are still inadequate. Of the 33 trials, only 14 trials provided information on the randomisation method (of which nine were considered low risk) and only five used a central randomisation procedure to ensure concealment of treatment allocation. Twenty-one used blinded assessors and eight used intention-to-treat analysis. The lack of information on this in many trial reports may not necessarily indicate lack of implementation within the trial, but without this information the level of bias within the individual trials is difficult to assess. The need for further improvement in the methodological quality of trials in physiotherapy for PD was noted in another recent systematic review (Kwakkel 2007). Future trials need to ensure that their designs fulfil the requirements of a methodologically sound, large randomised controlled trial, and that the reporting follows the CONSORT guidelines (Schulz 2010).

The trials included in the review were relatively small, with the majority assessing the effect of physiotherapy intervention versus no physiotherapy intervention over a short period of time with limited follow-up. The overall size of trials has increased (with an average of 50 participants per trial in this review compared to 25 in the previous review), but the number of small and underpowered trials remains a problem. Small trials may be subject to 'random error' (Doll 1980), and consequently may give rise to false negative or positive results. To highlight this point, this review illustrates that any differences observed in the various outcome measures showing benefit for physiotherapy were quite small. So trials need to be large enough to detect these small but possibly clinically important differences.

Further, it must be noted that only 11 of the 33 trials discussed participant compliance. This is surprising as compliance can be an important determinant of the outcomes measured in trials. Therefore, it would be beneficial if the level of compliance is measured

in future trials.

Another limitation is that the follow-up period in the trials included in this review was relatively short. Outcome measures were assessed by all trials at baseline and immediately or shortly after intervention had ceased (one or two weeks with one trial (Goodwin 2009) assessing at 10 weeks post intervention). Thus, this review is only able to provide conclusions on the short-term benefits of physiotherapy. It is also important to consider results alongside the possibility of a so-called honeymoon effect (Goetz 2008) in the period during or just after physiotherapy, which may inflate the treatment effect in favour of physiotherapy. Parkinson's disease is a long-term neurodegenerative disease, so it is important that the long-term effect of treatment be assessed. Only eight of the 33 trials followed up participants and reported further data during the post-treatment period (but this could have been only one week or up to six months after the treatment period). The previous review's recommendations were for participants to be followed up for at least six months; but only one trial (Schmitz-Hubsch 2006) reported follow-up data at six months post treatment completion. Long-term data will provide valuable information about the duration of any improvement following therapy.

The outcome measures included in this review were standard physiotherapy and PD outcomes. However, PD is a multidimensional disease, and many important outcomes were either poorly or not reported, this includes data on the number of the falls, depression and anxiety, adverse events and the health of the carer supporting the person with PD. Further, no health economics analysis of physiotherapy intervention was reported, therefore, little is known about the cost-effectiveness and economic value of this therapy. Future trials should include these outcomes.

In summary, this review provides evidence on the short-term (< three months) benefit of physiotherapy intervention for the treatment of PD. Importantly, although most of the observed differences between the two treatments were small, the improvements seen for velocity, Berg Balance Scale, and UPDRS scores were at levels considered to be of clinical importance. To clarify the long-term (if any) benefit of physiotherapy, further large, well-designed randomised trials with a follow-up of at least 12 months which assess the impact of this treatment on all aspects of a patients PD, alongside a health economics assessment, are needed.

AUTHORS' CONCLUSIONS

Implications for practice

Physiotherapy provides short-term benefit in the treatment of PD. There were significant benefits with physiotherapy intervention for the following outcomes: two- or six-minute walk test, velocity, step length, Timed Up & Go test, Functional Reach Test, Berg Balance Scale, UPDRS total, ADL and motor scores. Although most of the observed differences between the two treatment arms were small, the improvements seen for velocity, Berg Balance Scale and UPDRS scores were at levels considered to be of clinical importance.

The long-term, if any, benefit of physiotherapy remains unanswered, as does which type of physiotherapy intervention to deliver. Therefore, although this review has provided evidence that physiotherapy intervention may be of benefit to patients with PD, it has also highlighted that further evidence is needed before firm conclusions can be made on the long-term benefit and which physiotherapy intervention to use.

Implications for research

The majority of the studies in this review were small and had a short follow-up period. It is clear that larger randomised controlled trials are required, particularly focusing on improving trial methodology and reporting. Rigorous methods of randomisation should be used and the allocation adequately concealed. Data should be analysed according to intention-to-treat principles and trials should be reported according to the guidelines set out in the CONSORT statement (Schulz 2010).

There were also a large variety of outcome measures assessed in the trials, but there were only enough data for meta-analysis to be performed for eighteen outcomes. This review illustrates the need for the universal employment of relevant, reliable and sensitive outcome measures. Additionally, only one trial looked at the longer-term benefit of physiotherapy intervention. In order to assess whether, or how long, any improvements due to physiotherapy intervention may last, it is important that long-term follow-up is performed.

There was no evidence to indicate the best form of physiotherapy intervention. The comparisons of the different physiotherapy interventions in this review were based on indirect comparisons between the individual trials. A more reliable comparison would be obtained in large randomised trials that directly compare different physiotherapy interventions.

This review highlights the variety of physiotherapy interventions being used in the treatment of PD. There is a need for more specific trials with improved treatment strategies to underpin the most appropriate choice of physiotherapy intervention and the outcomes measured.

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REFERENCES

References to studies included in this review

Allen 2010 *{published data only}*
Allen NE, Canning CG, Sherrington C, Lord SR, Latt MD, Close JCT, et al.The effects of an exercise program on fall risk factors in people with Parkinson's disease: a randomized controlled trial. *Movement Disorders* 2010;**25**(9):1217–25.

Ashburn 2007 *{published data only}*
* Ashburn A, Fazakarley L, Ballinger C, Pickering R, McLellan LD, Fitton C. A randomised controlled trial of a home based exercise programme to reduce the risk of falling among people with Parkinson's disease. *Journal of Neurology, Neurosurgery and Psychiatry* 2007;**78**(7):678–84.

Cakit 2007 *{published data only}*
* Cakit BD, Saracoglu M, Genc H, Erdem HR, Inan L. The effects of incremental speed-dependent treadmill training on postural instability and fear of falling in Parkinson's disease. *Clinical Rehabilitation* 2007;**21**(8):698–705.

Canning 2008 *{published data only (unpublished sought but not used)}*
* Canning CG, Allen NE, Fung VSC, Morris JGL, Dean CM. Home-based treadmill walking for individuals with Parkinson's disease: A pilot randomized controlled trial. *Movement Disorders* 2008;**23**(Suppl 1):637.

Cerri 1994 *{published data only}*
* Cerri C, Arosio A, Biella AM, Premoselli S, Piccini L. Physical exercise therapy of Parkinson. *Movement Disorders* 1994;**9**(Suppl 1):68.

Chandler 1999 *{published data only}*
* Chandler C, Plant R. A targeted physiotherapy service for people with Parkinson's disease from diagnosis to end stage: a pilot study. In: R. Percival, P. Hobson editor(s). *Parkinson's disease: Studies in psychological and social care*. Leicester: BPS Books, 1999:256–69.
Chandler CS, Maher S, Harrison S, Plant R. A targeted physiotherapy service for people with Parkinson's disease from diagnosis to end stage - a pilot study. Parkinson's Disease Society Welfare Research Conference. London: Parkinson's Disease Society, 1997.

de Bruin 2010a *{published data only}*
de Bruin N, Bonfield S, Hu B, Suchowersky O, Doan J, Brown L. Walking while listening to music improves gait performance in Parkinson's disease. *Movement Disorders* 2008;**23**(Suppl 1):667.
de Bruin N, Doan JB, Turnbull G, Suchowersky O, Bonfield S, Hu B, et al.Walking with music is a safe and viable tool for gait training in Parkinson's disease: The effect of a 13-week feasibility study on single and dual task walking. *Parkinson's Disease* 2010;**Article ID 483530**:9 pages.

de Bruin 2010b *{published data only}*
de Bruin N, Doan J, Turnbull G, Bonfield S, Suchowersky O, Hu B, et al.The effects of a music accompanied walking rogram on obstacle crossing behaviours in people with Parkinson's disease. Movement Disorders 2010; Vol. 25, issue Suppl 3:S697.

Earhart 2010 *{published and unpublished data}*
Earhart GM, Rotello JMM, Duncan RP. Short-term effects of a community-based tango program on motor and non-motor symptoms, activities of daily living, and motor complications in PD. Movement Disorders 2010; Vol. 25, issue Suppl 3:S697–8.

Ellis 2005 *{published data only}*
De Goede CJT, Ellis T, Wagenaar RC, Feldman RCH, Wolters E, Kwakkel G. Effects of group physiotherapy for patients with Parkinson's disease: a cross-over trial. *Nederlands Tijdschrift Fysiotherapie* 2004;**114**(3):78–82.
* Ellis T, De Goede CJ, Feldman RG, Wolters EC, Kwakkel G, Wagenaar RC. Efficacy of a physical therapy program in patients with Parkinson's disease: a randomized controlled trial. *Archives of Physical Medicine and Rehabilitation* 2005; **86**(4):626–32.

Fisher 2008 *{published data only}*
* Fisher BE, Wu AD, Salem GJ, Song J, Lin CH, Yip J, et al.The effect of exercise training in improving motor performance and corticomotor excitability in people with early Parkinson's disease. *Archives of Physical Medicine and Rehabilitation* 2008;**89**(7):1221–9.

Ganesan 2010 *{published data only}*
Ganesan M, Pal PK, Gupta A, Talakad S. Effect of partial weight supported treadmill gait training on balance in patients of Parkinson's disease. Parkinsonism & Related Disorders 2010; Vol. 16, issue Suppl 1:S66.

Goodwin 2009 *{published and unpublished data}*
* Goodwin V, Richards S, Ewings P, Taylor A, Campbell J. Preventing falls in Parkinson's disease: the GETuP trial. *Parkinsonism & Related Disorders* 2009;**15**(Suppl 2):S83.
Goodwin VA, Richards SH, Ewings P, Taylor AH, Campbell JL. Preventing falls in Parkison's disease: the GETuP trial. Parkinsonism & Related Disorders 2009; Vol. 15, issue Suppl 2:S49.

Hackney 2009 *{published data only}*
Hackney ME, Earhart GM. Effects of dance on movement control in Parkinson's disease: a comparison of Argentine

tango and American ballroom. *Journal of Rehabilitation Medicine* 2009;**41**(6):475–81.

* Hackney ME, Earhart GM. Health-related quality of life and alternative forms of exercise in Parkinson disease. *Parkinsonism & Related Disorders* 2009;**15**:644–8.

Hackney ME, Earhart GM. Tai Chi improves balance and mobility in people with Parkinson disease. *Gait & Posture* 2008;**28**(3):456–60.

Homann 1998 ***{published and unpublished data}***

* Homann CN, Crevenna R, Kojnig H, Kurzl B, Reinprecht S, Wenzel K, et al.Can physiotherapy improve axial symptoms in parkinsonian patients? A pilot study with the computerized movement analysis battery Zebris. *Movement Disorders* 1998;**13**(Suppl 2):234.

Keus 2007b ***{published data only}***

* Keus SH, Bloem BR, Van Hilten JJ, Ashburn A, Munneke M. Effectiveness of physiotherapy in Parkinson's disease: the feasibility of a randomised controlled trial. *Parkinsonism & Related Disorders* 2007;**13**(2):115–21.

Klassen 2007 ***{published and unpublished data}***

* Klassen L, Dal Bello-Haas V, Sheppard M, Metcalfe A. Evaluating the benefits of group exercise and group exercise and education programs for individuals with Parkinson's disease. *Physiotherapy* 2007;**93**(Suppl 1):S91.

Kurtais 2008 ***{published data only}***

* Kurtais Y, Kutlay S, Tur BS, Gok H, Akbostanci C. Does treadmill training improve lower-extremity tasks in Parkinson disease? A randomized controlled trial. *Clinical Journal of Sport Medicine* 2008;**18**(3):289–91.

Lehman 2005 ***{published data only}***

* Lehman DA, Toole T, Lofald D, Hirsch MA. Training with verbal instructional cues results in near-term improvement of gait in people with Parkinson disease. *Journal of Neurologic Physical Therapy* 2005;**29**(1):2–8.

Mak 2008 ***{published data only}***

* Mak MK, Hui-Chan CW. Cued task-specific training is better than exercise in improving sit-to-stand in patients with Parkinson's disease: A randomized controlled trial. *Movement Disorders* 2008;**23**(4):501–9.

Mak MK, Hui-Chan CW. Effect of 4-week training with audio-visual cues on sit-to-stand in Parkinsonian patients. *Movement Disorders* 2005;**20**(Suppl 10):388.

Marjama-Lyons 2002 ***{published data only}***

* Marjama-Lyons J, Smith L, Mylar B, Nelson J, Holliday G, Seracino D. Tai Chi and reduced rate of falling in Parkinson's disease: A single-blinded pilot study. *Movement Disorders* 2002;**17**(Suppl 5):190.

Meek 2010 ***{published and unpublished data}***

Meek C, Sackley CM, Clarke CE, Soundy AA, Winward C, Esser P, et al.Long-term individual fitness enablement (LIFE) for Parkinson's disease: a feasibility study. Movement Disorders 2010; Vol. 25, issue Suppl 3:S713.

Nieuwboer 2007 ***{published data only}***

Nieuwboer A, Kwakkel G, Rochester L, Jones D, Van Wegen E, Willems AM. The effects of cueing therapy on gait and gait related mobility in people with Parkinson's disease: The RESCUE project. *Movement Disorders* 2006; **21**:S126.

* Nieuwboer A, Kwakkel G, Rochester L, Jones D, Van Wegen E, Willems AM, et al.Cueing training in the home improves gait-related mobility in Parkinson's disease: the RESCUE trial. *Journal of Neurology, Neurosurgery and Psychiatry* 2007;**78**(2):134–40.

Protas 2005 ***{published data only}***

* Protas EJ, Mitchell K, Williams A, Qureshy H, Caroline K, Lai EC. Gait and step training to reduce falls in Parkinson's disease. *NeuroRehabilitation* 2005;**20**(3):183–90.

Purchas 2007 ***{published and unpublished data}***

* Purchas MA, MacMahon DG. The effects of Tai Chi training on general wellbeing and motor performance in patients with Parkinson's disease (PD): A pilot study. *Movement Disorders* 2007;**22**(Suppl 16):260.

Sage 2009a ***{published data only}***

* Sage MD, Almeida QJ. Symptom and gait changes after sensory attention focused exercise vs aerobic training in Parkinson's disease. *Movement Disorders* 2009;**24**(8): 1132–8.

Schenkman 1998 ***{published data only}***

* Schenkman M, Cutson TM, Kuchibhatla M, Chandler J, Pieper CF, Ray L, et al.Exercise to improve spinal flexibility and function for people with Parkinson's disease: a randomised, controlled trial. *Journal of the American Geriatrics Society* 1998;**46**:1207–16.

Schilling 2008 ***{published data only}***

* Schilling BK, Ledoux MS, Pfeiffer RF, Karlage RE, Weiss LW, Falvo MJ. Effects of lower-body resistance training in persons with Parkinson's disease. *Movement Disorders* 2008; **23**(Suppl 1):639.

Schmitz-Hubsch 2006 ***{published data only}***

* Schmitz-Hubsch T, Pyfer D, Kielwein K, Fimmers R, Klockgether T, Wullner U. Qigong exercise for the symptoms of Parkinson's disease: a randomized, controlled pilot study. *Movement Disorders* 2006;**21**(4):543–8.

Shankar 2008 ***{published and unpublished data}***

* Shankar A, de Bruin N, Bonfield S, Derwent L, Eliasziw M, Hu B, et al.Benefit of music therapy in patients with Parkinson's disease: a randomized controlled trial. *Movement Disorders* 2008;**23**(Suppl 1):608.

Shankar 2009 ***{published data only}***

* Shankar A, Labelle N, Derwent L, Bonfield S, Eliasziw M, Hu B, et al.Treadmill-walking with music shows a synergistic improvement in gait and balance in patients with Parkinson's disease: a randomized controlled trial. *Movement Disorders* 2009;**24**(Suppl 1):S281–2.

Stozek 2003 ***{published data only}***

* Stozek J, Rudzinska M, Longawa K, Szczudlik A. The effect of the complex rehabilitation on posture and gait in Parkinson disease. *Neurologia i Neurochirurgia Polska* 2003; **37**(Suppl 5):67–81.

Thaut 1996 *{published data only}*

* Thaut MH, McIntosh GC, Rice RR, Miller RA, Rathbun J, Brault JM. Rhythmic auditory stimulation in gait training for Parkinson's disease patients. *Movement Disorders* 1996; **11**(2):193–200.

References to studies excluded from this review

Bergen 2002 *{published data only}*

* Bergen JL, Toole T, Elliott RG, Wallace B, Robinson K, Maitland CG. Aerobic exercise intervention improves aerobic capacity and movement initiation in Parkinson's disease patients. *NeuroRehabilitation* 2002;**17**(2):161–8.

Blackington 2002 *{published data only}*

Blackinton MT, Summerall L, Waguespack K. Tertiary prevention in Parkinson disease: Results from a preliminary study.. *Neurology Report* 2002;**26**(3):160–165.

Bridgewater 1997 *{published data only}*

Bridgewater KJ, Sharpe MH. Aerobic exercise and early Parkinson's disease. *Journal of Neurologic Rehabilitation* 1996;**10**:233–41.

* Bridgewater KJ, Sharpe MH. Trunk muscle training and early Parkinson's disease. *Physiotherapy Theory and Practise* 1997;**13**(2):139–53.

Byl 2009 *{published data only}*

Byl N. Enhancing safe mobility in patients with Parkinson's disease: effect of dual task training during aerobic and moderate exercise. *Parkinsonism & Related Disorders* 2009; **15**(Suppl 2):S122.

Christofoletti 2010 *{published data only}*

Christofoletti G, Beinotti F, Borges G, Damasceno BP. Physical therapy improves the balance of patients with Parkinson's disease: a randomised controlled trial. Parkinsonism & Related Disorders 2010; Vol. 16, issue Suppl 1:S58.

Christofoletti G, Freitas RT, Candido ER, Cardoso CS. Effectiveness of a physical therapy treatment on static and dynamic balance of subjects with Parkinson's disease. *Fisioterapia e Pesquisa* 2010;**17**(3):259–63.

Cianci 2010 *{published data only}*

Cianci H, Robinson K, Bunting-Perry L, Sollenberger J, Nooregian J, Duda J. Are wheeled walkers with visual cues efficacious to treat freezing of gait in Parkinson's disease?. Parkinsonism & Related Disorders 2010; Vol. 16, issue Suppl 1:S64.

Comella 1994 *{published data only}*

* Comella CL, Stebbins GT, Brown-Toms N, Goetz CG. Physical therapy and Parkinson's disease: a controlled clinical trial. *Neurology* 1994;**44**:376–8.

Forkink 1996 *{published data only}*

* Forkink A, Toole T, Hirsch MA, Lehman DA, Maitland CG. The effects of a balance and strengthening program on equilibrium in Parkinsonism. *Working Paper Series: Pepper Institute on Ageing and Public Policy*. Vol. **PI-96-33**, Tallahassee, Florida: Florida State University, 1996.

Toole T, Hirsch MA, Forkink A, Lehman DA, Maitland CG. The effects of a balance and strength training program on equilibrium in Parkinsonism: A preliminary study. *NeuroRehabilitation* 2000;**14**(3):Accepted for publication, page numbers unknown.

Formisano 1992 *{published data only}*

* Formisano R, Pratesi L, Modarelli FT, Bonifati V, Meco G. Rehabilitation and Parkinson's disease. *Scandinavian Journal of Rehabilitation Medicine* 1992;**24**(3):157–60.

Gibberd 1981 *{published data only}*

* Gibberd FB, Page NG, Spencer KM, Kinnear E, Hawksworth JB. Controlled trial of physiotherapy and occupational therapy for Parkinson's disease. *British Medical Journal* 1981;**282**(6271):1196.

Gibberd FB, Page NG, Spencer KM, Kinnear E, Williams JB. A controlled trial of physiotherapy for Parkinson's disease. In: F.C. Rose, R. Capildeo editor(s). *Recent Progress in Parkinson's Disease*. Tunbridge Wells: Pitman Medical, 1981:401–3.

Guo 2009 *{published data only}*

* Guo LP, Jiang YP, Yatsuya H, Yoshida Y, Sakamoto J. Group education with personal rehabilitation for idiopathic Parkinson's disease. *Canadian Journal of Neurological Sciences* 2009;**36**(1):51–9.

Haas 2006 *{published data only}*

* Haas CT, Turbanski S, Kessler K, Schmidtbleicher D. The effects of random whole-body-vibration on motor symptoms in Parkinson's disease. *NeuroRehabilitation* 2006; **21**(1):29–36.

Hurwitz 1989 *{published data only}*

* Hurwitz A. The benefit of a home exercise regimen for ambulatory Parkinson's disease patients. *Journal of Neuroscience Nursing* 1989;**21**(3):180–4.

Katsikitis 1996 *{published data only}*

* Katsikitis M, Pilowsky I. A controlled study of facial mobility treatment in Parkinson's disease. *Journal of Psychosomatic Research* 1996;**40**(4):387–96.

King 2009 *{published data only}*

King LK, Almeida QJ, Ahonen H. Short-term effects of vibration therapy on motor impairments in Parkinson's disease. *Neurorehabilitation* 2009;**25**(4):297–306.

Patti 1996 *{published data only}*

* Patti F, Reggio A, Nicoletti F, Sellaroli T, Deinite G, Nicoletti F. Effects of rehabilitation therapy on parkinsonians' disability and functional independence. *Journal of Neurologic Rehabilitation* 1996;**10**(4):223–31.

Pohl 2003 *{published data only}*

* Pohl M, Rockstroh G, Ruckriem S, Mrass G, Mehrholz J. Immediate effects of speed-dependent treadmill training on gait parameters in early Parkinson's disease. *Archives of Physical Medicine and Rehabilitation* 2003;**84**(12):1760–6.

Sage 2009b *{published and unpublished data}*

* Sage MD, Almeida QJ. A Canadian approach to exercise rehabilitation: a systematic evaluation of strategies to reduce the symptoms of Parkinson's disease. *Movement Disorders* 2009;**24**(Suppl 1):S276–7.

Stallibrass 2002 *{published data only}*

* Stallibrass C, Sissons P, Chalmers C. Randomized controlled trial of the Alexander Technique for idiopathic Parkinson's disease. *Clinical Rehabilitation* 2002;**16**(7): 695–708.

Tickle-Degnen 2010 *{published data only}*

Tickle-Degnen L, Ellis T, Saint-Hilaire M, Thomas CA, Wagenaar RC. Efficacy of self-management rehabilitation on quality of life outcomes in Parkinson's disease. *Movement Disorders* 2009;**24**(Suppl 1):S377–8.

* Tickle-Degnen L, Ellis T, Saint-Hilaire M, Thomas CA, Wagenaar RC. Self-management rehabilitation and health-related quality of life in Parkinson's disease: a randomized controlled trial. *Movement Disorders* 2010;**25**(2):194–204. White DK, Wagenaar RC, Ellis TD, Tickle-Degnen L. Changes in walking activity and endurance following rehabilitation for people with Parkinson disease. *Archives of Physical Medicine and Rehabilitation* 2009;**90**(1):43–50.

Van Gerpen 2010 *{published data only}*

Van Gerpen J, Saucier M, Matthews M. Attentuating gain freezing and stride reduction in Pakinsonian patients with an attachable, adjustable laser (the Mobilaser):a pilot trial. Parkinsonism & Related Disorders 2010; Vol. 16, issue Suppl 1:S85.

Wade 2003 *{published data only}*

* Wade DT, Gage H, Owen C, Trend P, Grossmith C, Kaye J. Multidisciplinary rehabilitation for people with Parkinson's disease: a randomised controlled study. *Journal of Neurology, Neurosurgery and Psychiatry* 2003;**74**(2): 158–62.

Wells 1999 *{published data only}*

* Wells MR, Giantinoto S, D'Agate D, Areman RD, Fazzini EA, Dowling D, et al.Standard osteopathic manipulative treatment acutely improves gait performance in patients with Parkinson's disease. *Journal of the American Osteopathic Association* 1999;**99**(2):92–8.

References to ongoing studies

Canning 2009 *{published data only}*

Canning CG, Sherrington C, Lord SR, Fung VS, Close JC, Latt MD, et al.Exercise therapy for prevention of falls in people with Parkinson's disease: a protocol for a randomised controlled trial and economic evaluation. *BMC Neurology* 2009;**9**:4.

Ledger 2008 *{published data only}*

Ledger S, Galvin R, Lynch D, Stokes EK. A randomised controlled trial evaluating the effect of an individual auditory cueing device on freezing and gait speed in people with Parkinson's disease. *BMC Neurology* 2008;**8**:46.

Martin 2009 *{published data only}*

Martin CL, Morris ME, Menz HB, Taylor NF, Watts JJ. Home-based rehabilitation to reduce falls and disability in Parkinson's disease: protocol for a randomised controlled trial. *Movement Disorders* 2009;**24**(Suppl 1):S268.

Schenkman 2009 *{published data only}*

Schenkman M, Shinowara N. Exercise, physical function and Parkinson's disease. Report Database 2009.

Watts 2008 *{published data only}*

Watts JJ, McGinley JL, Huxham F, Menz HB, Iansek R, Murphy AT, et al.Cost effectiveness of preventing falls and improving mobility in people with Parkinson disease: protocol for an economic evaluation alongside a clinical trial. *BMC Geriatrics* 2008;**8**:23.

Woo 2010 *{published data only}*

Woo CW. The effectiveness of physiotherapy interventions in patients with Parkinson's disease, a randomized controlled trial. clinicaltrials.gov March 2010.

Additional references

Assmann 2000

Assmann SF, Pocock SJ, Enos LE, Kasten LE. Subgroup analysis and other (mis)uses of baseline data in clinical trials. *Lancet* 2000;**355**(9209):1064–9.

Berg 1992

Berg KO, Wooddauphinee SL, Williams JI. Measuring balance in the elderly: validation of an instrument. *Canadian Journal of Public Health-Revue Canadienne de Sante Publique* 1992;**83**:S7–S11.

Bloem 2001

Bloem BR, Grimbergen YAM, Cramer M, Willemsen M, Zwinderman AH. Prospective assessment of falls in Parkinson's disease. *Journal of Neurology* 2001;**248**(11): 950–8.

Chartered Society of Physiotherapy

The Chartered Society of Physiotherapy. In: The Chartered Society of Physiotherapy, editor(s). *Rules of professional conduct*. 2nd Edition. London: The Chartered Society of Physiotherapy, 2002.

Clarke 2001

Clarke M, Halsey J. DICE 2: A further investigation of the effect of chance in life, death and subgroup analyses. *International Journal of Clinical Practice* 2001;**55**(4):240–2.

Crizzle 2006

Crizzle AM, Newhouse IJ. Is physical exercise beneficial for persons with Parkinson's disease?. *Clinical Journal of Sports Medicine* 2006;**16**(5):422–5.

Deboer 1996

Deboer AGEM, Wijker W, Speelman JD, Dehaes JCJM. Quality of life in patients with Parkinson's disease: Development of a questionnaire. *Journal of Neurology Neurosurgery and Psychiatry* 1996;**61**(1):70–4.

Deeks 2001

Deeks JJ, Altman DG, Bradburn MJ. Statistical methods for examining heterogeneity and combining results from several studies in meta-analysis. In: Egger M, Davey Smith G, Altman DG editor(s). *Systematic Reviews in Health Care: Meta-analysis in Context*. 2nd Edition. London: BMJ Publication Group, 2001.

Doll 1980
Doll R, Peto R. Randomised controlled trials and retrospective controls. *British Medical Journal* 1980;**280** (6206):44.

Duncan 1990
Duncan PW, Weiner DK, Chandler J, Studenski S. Functional reach: a new clinical measure of balance. *Journals of Gerontology* 1990;**45**(6):M192–7.

Fahn 1987
Fahn S, Elton RL. UPDRS Development Committee. Unified Parkinson's Disease Rating Scale. In: Fahn S, Marsden CD, Calne DB, Goldestein M editor(s). *Recent developments in Parkinson's disease*. Florham Park, NJ: Macmillan Health Care Information, 1987:153–63.

Fleiss 1993
Fleiss JL. The statistical basis of meta-analysis. *Statistical Methods in Medical Research* 1993;**2**(2):121–45.

Gage 2004
Gage H, Storey L. Rehabilitation for Parkinson's disease: a systematic review of available evidence. *Clinical Rehabilitation* 2004;**18**(5):463–82.

Gibb 1988
Gibb WRG, Lees AJ. The relevance of the Lewy body to the pathogenesis of idiopathic Parkinson's disease. *Journal of Neurology Neurosurgery and Psychiatry* 1988;**51**(6):745–52.

Giladi 2000
Giladi N, Shabtai H, Simon ES, Biran S, Tal J, Korczyn AD. Construction of freezing of gait questionnaire for patients with Parkinsonism. *Parkinsonism & Related Disorders* 2000; **6**(3):165–70.

Goetz 2008
Goetz CG, Wuu J, McDermott MP, Adler CH, Fahn S, Freed CR, et al.Placebo response in Parkinson's disease: Comparisons among 11 trials covering medical and surgical interventions. *Movement Disorders* 2008;**23**(5):690–9.

Goodwin 2008
Goodwin VA, Richards SH, Taylor RS, Taylor AH, Campbell JL. The effectiveness of exercise interventions for people with Parkinson's disease: a systematic review and meta-analysis. *Movement Disorders* 2008;**23**(5):631–40.

Higgins 2003
Higgins JPT, Thompson SG, Deeks JJ, Altman DG. Measuring inconsistency in meta-analyses. *BMJ* 2003;**327** (7414):557–60.

Higgins 2011
Higgins JPT, Green S. *Cochrane handbook for systematic reviews of interventions*. Version 5.1.0. The Cochrane Collaboration 2011, 2011.

Hoehn 1967
Hoehn MM, Yahr MD. Parkinsonism: onset, progression and mortality. *Neurology* 1967;**17**(5):427–42.

Jenkinson 1997
Jenkinson C, Fitzpatrick R, Peto V, Greenhall R, Hyman N. The Parkinson's Disease Questionnaire (PDQ-39): development and validation of a Parkinson's disease summary index score. *Age and Ageing* 1997;**26**(5):353–7.

Kersten 2004
Kersten P. Principles of physiotherapy assessment and outcome measures. In: Stokes M editor(s). *Physical management in neurological rehabilitation*. 2nd Edition. London: Elsevier Mosby, 2004:29–46.

Keus 2004
Keus S, Hendriks HJ, Bloem BR, Bredero-Cohen AB, De Goede CJ, Van Haaren M, et al.Clinical practice guidelines for physical therapy in patients with Parkinsons disease. *Dutch Journal of Physiotherapy* 2004;**114**(Suppl 3):1–94.

Keus 2007a
Keus SH, Bloem BR, Hendriks EJ, Bredero-Cohen AB, Munneke M, Practice Recommendations Development Group. Evidence-based analysis of physical therapy in Parkinson's disease with recommendations for practice and research. *Movement Disorders* 2007;**22**(4):451–60.

Keus 2009
Keus SH, Munneke M, Nijkrake MJ, Kwakkel G, Bloem BR. Physical therapy in Parkinson's disease: evolution and future challenges. *Movement Disorders* 2009;**24**(1):1–14.

Kwakkel 2007
Kwakkel G, De Goede CJT, Van Wegen EEH. Impact of physical therapy for Parkinson's disease: a critical review of the literature. *Parkinsonism & Related Disorders* 2007;**13** (Suppl 3):S478–87.

Lim 2005
Lim I, Van Wegen E, De Goede C, Deutekom M, Nieuwboer A, Willems A, et al.Effects of external rhythmical cueing on gait in patients with Parkinson's disease: a systematic review. *Clinical Rehabilitation* 2005;**19**(7): 695–713.

Mak 2009
Mak MKY, Pang MYC. Fear of falling is independently associated with recurrent falls in patients with Parkinson's disease: a 1-year prospective study. *Journal of Neurology* 2009;**256**(10):1689–95.

Moore 2007
Moore O, Peretz C, Giladi N. Freezing of gait affects quality of life of peoples with Parkinson's disease beyond its relationships with mobility and gait. *Movement Disorders* 2007;**22**(15):2192–5.

Morris 1994
Morris ME, Iansek R, Matyas TA, Summers JJ. The pathogenesis of gait hypokinesia in Parkinson's disease. *Brain* 1994;**117**:1169–81.

Morris 1996
Morris ME, Iansek R, Matyas TA, Summers JJ. Stride length regulation in Parkinson's disease normalization strategies and underlying mechanisms. *Brain* 1996;**119**:551–68.

Morris 2010
Morris ME, Martin CL, Schenkman ML. Striding out with Parkinson disease: evidence-based physical therapy for gait disorders. *Physical Therapy* 2010;**90**(2):280–8.

Mutch 1986
Mutch WJ, Strudwick A, Roy SK, Downie AW. Parkinson's disease: disability, review, and management. *British Medical Journal* 1986;**293**(6548):675–7.

Nat Collab Centre for Chronic Conditions 2006
National Collaborating Centre For Chronic Conditions. Parkinson's Disease: National clinical guideline for diagnosis and management in primary and secondary care. Royal College of Physicians, London 2006.

Nieuwboer 2008
Nieuwboer A. Cueing for freezing of gait in patients with Parkinson's disease: a rehabilitation perspective. *Movement Disorders* 2008;**23**(Suppl 2):S475–81.

Nijkrake 2007
Nijkrake MJ, Keus SH, Kalf JG, Sturkenboom IH, Munneke M, Kappelle AC, et al.Allied health care interventions and complementary therapies in Parkinson's disease. *Parkinsonism & Related Disorders* 2007;**13**(Suppl 3):S488–94.

PDS 2008
PDS. Life with Parkinson's today - room for improvement. Parkinson's Disease Society, London 2008.

Perry 1995
Perry J, Garrett M, Gronley JK, Mulroy SJ. Classification of walking handicap in the stroke population. *Stroke* 1995;**26**(6):982–9.

Peto 1995
Peto V, Jenkinson C, Fitzpatrick R, Greenhall R. The development and validation of a short measure of functioning and well being for individuals with Parkinson's disease. *Quality of Life Research* 1995;**4**(3):241–8.

Plant 2000
Plant R, Jones D, Walton G, Ashburn A, Lovgreen B, Handford F, et al.Physiotherapy for people with Parkinson's disease: UK best practice short report. Institution of Rehabilitation, University of Northumbria 2000.

Podsiadlo 1991
Podsiadlo D, Richardson S. The timed "Up & Go": a test of basic functional mobility for frail elderly persons. *Journal of the American Geriatrics Society* 1991;**39**(2):142–8.

Powell 1995
Powell LE, Myers AM. The Activities-specific Balance Confidence (ABC) Scale. *Journals of Gerontology Series A-Biological Sciences and Medical Sciences* 1995;**50**(1):M28–34.

Qutubuddin 2005
Qutubuddin AA, Pegg PO, Cifu DX, Brown R, McNamee S, Carne W. Validating the Berg Balance Scale for patients with Parkinson's disease: A key to rehabilitation evaluation. *Archives of Physical Medicine and Rehabilitation* 2005;**86**(4):789–92.

Rascol 2002
Rascol O, Payoux P, Ferreira J, Brefel-Courbon C. The management of patients with early Parkinson's disease. *Parkinsonism & Related Disorders* 2002;**9**(1):61–7.

Robertson 2003
Robertson D. Developing and delivering services. In: Playford D, Thompson AJ editor(s). *Neurological Rehabilitation of Parkinson's Disease*. London: Martin Dunitz, 2003.

Robertson 2008
Robertson D, Aragon A, Moore G, Whelan L. Rehabilitation and the interdisciplinary team. In: Playfer J, Hindle J editor (s). *Parkinson's Disease in the Older Patient*. 2nd Edition. Oxford: Radcliffe Publishing Ltd, 2008.

Rubenis 2007
Rubenis J. A rehabilitational approach to the management of Parkinson's disease. *Parkinsonism & Related Disorders* 2007;**13**(Suppl 3):S495–7.

Schrag 2000
Schrag A, Jahanshahi M, Quinn N. How does Parkinson's disease affect quality of life? A comparison with quality of life in the general population. *Movement Disorders* 2000;**15**(6):1112–8.

Schrag 2006
Schrag A, Sampaio C, Counsell N, Poewe W. Minimal clinically important change on the Unified Parkinson's Disease Rating Scale. *Movement Disorders* 2006;**21**(8):1200–7.

Schulz 2010
Schulz KF, Altman DG, Moher D. CONSORT 2010 Statement: updated guidelines for reporting parallel group randomised trials. *BMJ* 2010;**340**:c332.

Shulman 2010
Shulman LM, Gruber-Baldini AL, Anderson KE, Fishman PS, Reich SG, Weiner WJ. The clinically important difference on the unified Parkinson's disease rating scale. *Archives of Neurology* 2010;**67**(1):64–70.

Steffen 2008
Steffen T, Seney M. Test-retest reliability and minimal detectable change on balance and ambulation tests, the 36-Item Short-Form Health Survey, and the unified Parkinson disease rating scale in people with parkinsonism. *Physical Therapy* 2008;**88**(6):733–46.

Talley 2008
Talley KMC, Wyman JF, Gross CR. Psychometric properties of the activities-specific balance confidence scale and the survey of activities and fear of falling in older women. *Journal of the American Geriatrics Society* 2008;**56**(2):328–33.

Tinetti 1990
Tinetti ME, Richman D, Powell L. Falls efficacy as a measure of fear of falling. *Journals of Gerontology* 1990;**45**(6):239–43.

Trew 2005
Trew M, Everett T. *Human movement: an introductory text*. 5th Edition. Edinburgh: Churchill Livingstone, 2005.

Van der Marck 2009
Van der Marck MA, Kalf JG, Sturkenboom IH, Nijkrake MJ, Munneke M, Bloem BR. Multidisciplinary care for

patients with Parkinson's disease. *Parkinsonism & Related Disorders* 2009;**15**(Suppl 3):S219–23.

Ware 1992
Ware JE, Sherbourne CD. The Mos 36-Item Short-Form Health Survey (SF-36) .1. Conceptual-Framework and Item Selection. *Medical Care* 1992;**30**(6):473–83.

Webster 1968
Webster DD. Critical analysis of the disability in Parkinson's disease. *Modern Treatment* 1968;**5**(2):257–&.

Welsh 2003
Welsh M, McDermott MP, Holloway RG, Plumb S, Pfeiffer R, Hubble J, et al.Development and testing of the Parkinson's disease quality of life scale. *Movement Disorders* 2003;**18**(6):637–45.

Whittle 1996
Whittle M. *Gait analysis: an introduction*. 2nd Edition. Oxford: Butterworth-Heinemann, 1996.

Wood 2002
Wood BH, Bilclough JA, Bowron A, Walker RW. Incidence and prediction of falls in Parkinson's disease: a prospective multidisciplinary study. *Journal of Neurology Neurosurgery and Psychiatry* 2002;**72**(6):721–5.

Yahr 1969
Yahr MD, Duvoisin RC, Schear MJ, Barrett RE, Hoehn MM. Treatment of Parkinsonism with Levodopa. *Archives of Neurology* 1969;**21**(4):343–54.

Yardley 2005
Yardley L, Beyer N, Hauer K, Kempen G, Piot-Ziegler C, Todd C. Development and initial validation of the Falls Efficacy Scale-International (FES-I). *Age and Ageing* 2005; **34**(6):614–9.

Yarrow 1999
Yarrow S. Members' 1998 survey of the Parkinson's Disease Scoiety of the United Kingdom. In: Percival R, Hobson P editor(s). *Parkinson's disease: Studies in psychological and social care*. Leicester: BPS Books, 1999:79–92.

References to other published versions of this review

Deane 2001a
Deane K, Jones DE, Playford ED, Ben-Shlomo Y, Clarke CE. Physiotherapy versus placebo or no intervention in Parkinson's disease. *Cochrane Database of Systematic Reviews* 2001, Issue 3. [DOI: 10.1002/14651858.CD002817; :]

* *Indicates the major publication for the study*

CHARACTERISTICS OF STUDIES

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

Allen 2010

Methods	Parallel-group design. Randomised using a randomisation schedule with randomly permuted block sizes, developed by an investigator not involved in participant recruitment or assessment Data analysed on an intention-to-treat basis. Treated as outpatients and at home for 48-72 hours over 6 months Assessed at baseline and post-intervention. Assessors were blinded.
Participants	24 participants in the exercise group and 24 in the control group. 3 drop-outs in the exercise group Participants' mean age 66 years (exercise), 68 years (control); male/female 13/11 (exercise), 13/11 (control); duration of PD 7 years (exercise), 9 years (control). Hoehn and Yahr stage not reported Inclusion criteria: Diagnosis of idiopathic PD, able to walk independently (with or without an aid), fallen in the last year or deemed to be at risk of falling, 30-80 years in age, on the same PD medication for the last 2 weeks. Exclusion criteria: significant cognitive impairment (MMSE < 24), had another neurological/ musculoskeletal/cardiopulmonary/metabolic condition that would interfere with safe conduct of the training or testing protocol
Interventions	Exercise: 40-60 min program of progressive lower limb strengthening and balance exercises (targeted leg muscle strength, balance and freezing). Once monthly exercise classes with the remaining exercise sessions at home Control: Usual care with advice on fall prevention and falls diary recording any fall Drug therapy was allowed to vary.
Outcomes	PD falls risk score. Knee extensor strength. Co-ordinated stability. Sway. Maximum balance range in standing. Alternate step test. Freezing of Gait Questionnaire. Sit to stand time. Fast walking speed. Comfortable walking speed. Short physical performance battery. Falls Efficacy Scale - International. PDQ-39. Participants were assessed in their home about 1 hour after taking their usual PD medication, the order of measurements was standardised
Notes	Participants in the exercise group who experienced freezing of gait were also instructed in cueing strategies to reduce freezing as part of their exercise program Exercise group completed a mean of 70% of total prescribed exercise sessions
Risk of bias	

Allen 2010 (*Continued*)

Bias	Authors' judgement	Support for judgement
Eligibility Criteria	Low risk	
Randomisation Method	Low risk	Randomly permuted block size.
Concealment of Allocation	Unclear risk	No information provided.
Similarity at Baseline	Low risk	
Intention-to-Treat Analysis	Low risk	An intention-to-treat approach was used for all analyses.
Withdrawals Describe	Low risk	6% overall, but all from exercise group.
Cointerventions Constant	Unclear risk	Allowed variation in levodopa therapy.
Credible Placebo	Low risk	Falls prevention advice given in both arms.
Blinded Assessors	Low risk	Assessors were blinded to group allocation.

Ashburn 2007

Methods	Parallel-group design. Stratified by NHS using blocks of size four. Random allocation by telephoning the medical statistics group at University of Southampton. Participants were informed of their allocation by telephone Data analysed on an intention-to-treat basis. Treated as outpatients 7 times a week for a 6-week period, for a total period of 42 hours Assessed at baseline, 8 weeks and 6 months.
Participants	70 participants in the exercise group and 72 in the control group. 6 drop-outs in the exercise group and 8 in the control group Participants' mean age 72.7 years (exercise), 71.6 years (control); male/female 38/32 (exercise), 48/24 (control); Hoehn and Yahr stage 3.14 (exercise), 3.11 (control); duration of PD 7.7 years (exercise), 9 years (control) Inclusion criteria: confirmed diagnosis of PD, independently mobile, living at home in the community, experienced more than one fall in the previous 12 months, passed a screening for gross cognitive impairment (Mini Mental State). Exclusion criteria: unable to participate in assessments because of pain, acute medical condition, in receipt of or soon to receive treatment
Interventions	Exercise: personalised home-based exercise and strategy programme. Following assessment, treatment goals were established with participants and exercises from the exercise menu were taught. Participants were visited weekly at home by physiotherapist for approximately 1 hour. 6 levels of exercise progression which comprised of muscle strengthening, range of movement, balance training and walking. Strategies of falls prevention and movement initiation and compensation taught by physiotherapist. Participants were asked to complete the exercises daily for max of 1 hour and to keep record. Phoned monthly to encourage exercises

Ashburn 2007 (*Continued*)

	Control: Usual care, contact with local PD nurse. Drug therapy was not described.
Outcomes	Self-reported falls diary. Functional reach. Timed up and go test. Chair stand test. Berg balance test. Euroqol-5d, QoL thermometer. Self-assessment Parkinson's disease disability scale. Tests were carried out mid-way between drug doses.
Notes	At 6 months 34% in the control group were participating in extra rehabilitation compared with 25% in the exercise group

Risk of bias

Bias	**Authors' judgement**	**Support for judgement**
Eligibility Criteria	Low risk	
Randomisation Method	Low risk	Block randomisation (block size 4)
Concealment of Allocation	Low risk	Telephone call to central office
Similarity at Baseline	Low risk	
Intention-to-Treat Analysis	Low risk	Analysis was on an intention-to-treat basis.
Withdrawals Describe	Low risk	6% at 8 weeks and 8% at 6 months.
Cointerventions Constant	Unclear risk	Drug therapy was not described.
Credible Placebo	Low risk	Controls had contact with PD nurse.
Blinded Assessors	Unclear risk	Assessor remained blinded to group allocation but reported being aware of the allocation of 18 exercise and 11 control participants at 8 weeks and 25 exercise and 14 control participants at 6 months

Cakit 2007

Methods	Parallel-group design. Method of randomisation not stated. Method of analysis not described. Treated as outpatients for an unspecified time over 8 weeks (30 minute sessions) Assessed at baseline and immediately after treatment. Assessors were blinded.
Participants	27 participants in the treadmill group and 27 in the control group. 6 drop-outs in the treadmill group, 17 drop-outs in the control group No baseline characteristics given for drop-outs. Participants' mean age 71.8 years; male/female 16/15. The Hoehn and Yahr scores were not given. The mean duration of PD was 5.6 years Inclusion criteria: Patients with PD who fulfilled the UK Parkinson's Disease Society Brain Bank Criteria, medically stable, able to walk 10 metre distance at least 3 times with or without assistive device, able to provide informed consent. Exclusion criteria: participants who had neurological conditions other than idiopathic PD, scored greater than 3 in Hoehn and Yahr, scored less that 20 in MMSE, postural hypotension, cardiovascular disorders, class C or D exercise risk by the American College of Sports Medicine (ACSM) criteria, musculoskeletal disorders, visual disturbance or vestibular dysfunction limiting locomotion or balance
Interventions	Treadmill: 8 week exercise program using incremental speed-dependent treadmill training. Programme comprised of stretching, range of motion exercise and treadmill training. The treadmill session lasted for 30 min and participants were observed during treadmill training by a physiatrist, who gave no assistance in the actual performance of the movements. Maximum tolerated walking speed was determined before the training session. This speed was then halved and used for a 5 min warm-up period. After the warm-up period the belt speed was increased by increments of 0.6 km/h every 5 min. When the belt speed was increased to the highest speed at which the participant could walk safely and without stumbling, this maximum-achieved belt speed was maintained for 5 min and then followed by 0.6 km/h decrements. The participant maintained the rest of the treadmill session with this speed for 15 min Control: no intervention. Drug therapy was constant during the trial.
Outcomes	Berg Balance Test. Dynamic Gait Index. Falls Efficacy Scale. Walking distance on treadmill. Tolerated maximum speed on treadmill (km/h). Examinations took place when participants were in the 'on' phase of medication
Notes	

Risk of bias

Bias	Authors' judgement	Support for judgement
Eligibility Criteria	Low risk	
Randomisation Method	Unclear risk	Method of randomisation not stated.
Concealment of Allocation	Unclear risk	Method of randomisation not stated.

Cakit 2007 (*Continued*)

Similarity at Baseline	Unclear risk	Baseline data given overall, not split by treatment group.
Intention-to-Treat Analysis	Unclear risk	Method of analysis not described.
Withdrawals Describe	High risk	43% withdrawals.
Cointerventions Constant	Low risk	Drug therapy was constant during the trial.
Blinded Assessors	Low risk	Assessors were blinded to group allocation.

Canning 2008

Methods	Parallel-group design. Randomisation method not stated. Method of analysis not described. Treated at home 3 times a week for 6 weeks, for a total of 9-12 hours Assessed at baseline, 7 and 13 weeks. Assessors were blinded.
Participants	10 participants in the treadmill group and 10 participants in the control group. Drop-outs 2 (treadmill) , not stated (control) Mean age of all the participants, 61 years. Inclusion criteria: clinical diagnosis of idiopathic PD, aged 30-80 years, subjective disturbance of gait and/or a UPDRS gait sub score of 1, sedentary, defined as performing less than 2 hours / week of leisure-time physical activity over the prior 3 months, have adapted to their current anti-Parkinsonian medication for at least 2 weeks, be cognitively-intact, have no freezing 'on' medication, Hoehn and Yahr stage 1 or 2. Exclusion criteria: motor fluctuations or dyskinesias which are disabling, require the use of a walking aid, more than one fall in the last 12 months, MMSE score of < 24, exhibit other neurological or musculoskeletal conditions affecting walking, chest pain at rest or during exercise in the last 3 months, or heart attack, angioplasty or heart surgery in the last 6 months
Interventions	Treadmill: Walked on the treadmill holding onto the handle bars for 30-40 minutes Control: Advised to maintain current activity levels. Drug therapy was not described.
Outcomes	6-minute walk test to assess walking capacity. UPDRS - motor examination. PDQ-39 to assess quality of life. Walking automaticity, velocity of walking 10m while performing a concurrent (cognitive or cognitive + physical) task as expressed as a percentage of the walking velocity of walking 10 m without performing the concurrent task Walking consistency determined as the co-efficients of variation for stride time and stride length recorded during the 6-minute walk test 7-pt Likert scale to assess fatigue. Examinations took place during 'on' periods.

Canning 2008 (*Continued*)

Notes	Seven of the 24 exercise sessions were supervised by a physiotherapist Abstract only, extra data from ClinicalTrials.gov No means and SDs available.

Risk of bias

Bias	Authors' judgement	Support for judgement
Eligibility Criteria	Low risk	
Randomisation Method	Unclear risk	Method of randomisation not stated.
Concealment of Allocation	Unclear risk	Concealed allocation stated in abstract.
Similarity at Baseline	Unclear risk	Only information given was mean age of all participants was 61 years
Intention-to-Treat Analysis	Unclear risk	Method of analysis not described.
Withdrawals Describe	High risk	20% drop-out/withdrawal.
Cointerventions Constant	Unclear risk	Drug therapy was not described.
Blinded Assessors	Low risk	Assessors were blinded to group allocation.

Cerri 1994

Methods	Parallel-group design. Randomisation method was not stated. Method of analysis not described. Treated as outpatients for 15 hours over 3 weeks followed by a home exercise program for 2 months then the cycle was repeated. (Total of 30 hours therapy) Assessed at baseline and immediately after treatment. Not stated whether assessors were blinded.
Participants	3 participants in the exercise group and 3 in the control group. Drop-outs not described Participants' were all aged between 58-68 years and Hoehn and Yahr stage 3 and 4. No data were given for the sex of the participants Inclusion criteria: PD, stage 3 and 4 of Hoehn and Yahr scale, treated with L-dopa for more than 4 years with incomplete control of rigidity and tremor. No exclusion criteria stated
Interventions	Exercise: Individual. Physical exercise program with neuromuscular facilitation techniques to improve posture, inhibit rigidity and 'conscientize' movements Control: Untreated. Drug therapy was allowed to vary during trial.

Cerri 1994 (*Continued*)

Outcomes	Webster disability Scale. Activity of daily living. L-dopa reduction. Not stated when examinations took place.
Notes	Abstract only. No means and SDs available.

Risk of bias

Bias	**Authors' judgement**	**Support for judgement**
Eligibility Criteria	Low risk	
Randomisation Method	Unclear risk	Randomisation method was not stated.
Concealment of Allocation	Unclear risk	Randomisation method was not stated.
Similarity at Baseline	Unclear risk	Only information given was that all participants were aged between 58-68 years and Hoehn and Yahr stage 3 and 4
Withdrawals Describe	Unclear risk	Drop-outs not described.
Cointerventions Constant	Unclear risk	2 participants in the intervention group reduced dose of L-dopa to avoid side-effects. Allowed variation in medication
Blinded Assessors	Unclear risk	Not stated whether assessors were blinded.

Chandler 1999

Methods	Parallel-group design. Randomisation method was not stated. Method of analysis not described. Treated at home where they were assessed by a physiotherapist 5 times over a 12 month period. The amount of physiotherapy was variable and depended upon the participant's needs Assessed at baseline and during the duration of the trial (at 3, 6, 9 and 12 months) (see Outcomes) Assessors were not blinded.
Participants	32 participants in the physiotherapy group and 35 in the control group. Drop-outs 6 (physiotherapy), 9 (control) Participants' mean age 65 years (physiotherapy), 66 years (control). 31 males and 21 females completed the study; Hoehn and Yahr for 47 of the participants, 2.6 Inclusion criteria: Idiopathic PD, not receiving physiotherapy, no access (including self-referral) to a physiotherapy review system. No exclusion criteria stated

Chandler 1999 (*Continued*)

Interventions	Physiotherapy: Individualised, based on holistic approach in which empowerment of participants and carers was a strong element. Aimed to enhance the performance of activities. Gait and balance exercises using verbal, auditory and visual cues. Exercises to reduce stiffness, improve muscle tone and increase trunk rotation. Advice on transfers. Education in use of walking aids, reorganisation of environment to reduce hazards and facilitate movement. Leisure pursuits and social contacts encouraged after strategies were adopted to facilitate these. Relaxation techniques (audio tapes and aromatherapy) to improve sleep patterns. Aimed to reduce pain with education in postural awareness, exercise, TENS and acupuncture. Referral to other health professionals and social services for aids and appliances. Control: Untreated. Drug therapy could vary.
Outcomes	Functional Independence Measure*. Nottingham extended Activities Daily Living*. UPDRS - motor subsection*. Timed walk*. 9 hole peg test*. SF-36 +. PDQ-39 +. * Baseline, 3, 6, 9, 12 months. + Baseline, 6, 12 months. Not stated when during day examinations took place.
Notes	Participants referred to other health professionals and social services during trial Occupational therapy component to the physiotherapy.

Risk of bias

Bias	**Authors' judgement**	**Support for judgement**
Eligibility Criteria	Low risk	
Randomisation Method	Unclear risk	Randomisation method was not stated.
Concealment of Allocation	Unclear risk	Randomisation method was not stated.
Similarity at Baseline	Unclear risk	Only gave information for age split by treatment group.
Intention-to-Treat Analysis	Unclear risk	Method of analysis not described.
Withdrawals Describe	High risk	22% withdrawals.
Cointerventions Constant	Unclear risk	Drug therapy could vary.
Blinded Assessors	High risk	Assessors were not blinded.

de Bruin 2010a

Methods	Parallel-group design. Method of randomisation not stated. Method of analysis not described. Treated as outpatients 3 times per week for a 13 week period Assessed at baseline and immediately after treatment. Assessors were blinded.
Participants	16 participants in the cueing group and 17 participants in the control group. Drop-outs 4 (cueing), 3 (control) Participants' mean age 64.1 years (cueing), 67.0 years (control); male/female 6/5 (cueing), 5/6 (control); Hoehn and Yahr 2.3 (cueing), 2.1 (control); mean duration of PD 6.4 years (cueing), 4.5 years (control) . No baseline characteristics were given for the drop-out Inclusion criteria: Diagnosis of PD (United Kingdom Brain Bank Criteria), Hoehn and Yahr stage II-III, stable medication regimen, independently mobile without the use of a walking aid, and intact hearing. Exclusion criteria: diagnosis of less than 1 year, undergone deep brain stimulation surgery, experience regular freezing episodes, unable to ambulate independently in the community, presence of neurological disorders or co morbidities likely to affect gait, scoring 24 or less on the MMSE and/or already listening to music
Interventions	Cueing: Walking at a self-selected pace for 30 min, 3 times per week whilst listening to a preloaded music battery on an MP3 player. The music battery was individualised for each participant matching music preferences and the cadence of their preferred walking speed Control: Continued with their regular activities. Drug therapy was not described.
Outcomes	Velocity. Stride time. Stride length. Cadence. Stride time variability. UPDRS (III) score. Examined on medications at the same time of day.
Notes	Compliance in the intervention group was good. 2 participants in the music group took a 1 week break

Risk of bias

Bias	**Authors' judgement**	**Support for judgement**
Eligibility Criteria	Low risk	
Randomisation Method	Unclear risk	Randomisation method was not stated.
Concealment of Allocation	Unclear risk	Randomisation method was not stated.
Similarity at Baseline	Low risk	
Intention-to-Treat Analysis	Unclear risk	Method of analysis not described.

de Bruin 2010a (*Continued*)

Withdrawals Describe	High risk	21% withdrawals.
Cointerventions Constant	Unclear risk	Drug therapy was not described.
Blinded Assessors	Low risk	UPDRS evaluator was blinded to participant group assignment.

de Bruin 2010b

Methods	Parallel-group design. Method of randomisation was not stated. Method of analysis not described. Treated as outpatient 3 times per week for 13 weeks. Assessed at baseline and post-intervention. Not stated whether assessors were blinded.
Participants	8 participants in the cueing group and 5 participants in the control group. No drop-outs described No baseline characteristics reported. Inclusion criteria: PD. No exclusion criteria.
Interventions	Cueing: Walking 3 times per week whilst listening to an individual music playlist. Playlists closely matched each individual's music preferences and preferred cadence Control: Continued with their regular activities. Drug therapy was not described.
Outcomes	Spatiotemporal parameters approach, crossing and recovery steps of obstacle crossing were evaluated using a GAITRite mat Step velocity. Step length. Not stated when during the day examinations took place.
Notes	Abstract, only P values reported.

Risk of bias

Bias	**Authors' judgement**	**Support for judgement**
Randomisation Method	Unclear risk	Randomisation method was not stated.
Concealment of Allocation	Unclear risk	Randomisation method was not stated.
Similarity at Baseline	Unclear risk	No baseline characteristics reported.
Intention-to-Treat Analysis	Unclear risk	Method of analysis not described.
Withdrawals Describe	Unclear risk	No drop-outs described.

de Bruin 2010b (*Continued*)

Cointerventions Constant	Unclear risk	Drug therapy was not described.
Blinded Assessors	Unclear risk	Not stated whether assessors were blinded.

Earhart 2010

Methods	Parallel-group design. Method of randomisation was not stated. Method of analysis not described. Treated as outpatients for 24 hours over 3 months. Assessed at baseline and post-intervention. Assessor was blinded.
Participants	Total of 62 participants randomised. 26 participants in the dance group and 26 participants in the control group were analysed. 10 drop-outs Total participants mean age 70.3 years, mean Hoehn and Yahr stage 2.5, male/female ratio 35/27 Inclusion criteria: Idiopathic PD. No exclusion criteria.
Interventions	Dance: Tango class for 1 hour, twice weekly. Control: No exercise. Drug therapy was not described.
Outcomes	MDS-UPDRS. Participants were assessed while off medication (12-hr withdrawal)
Notes	Abstract - limited data. Author contacted who provided n numbers and drop-out data

Risk of bias

Bias	**Authors' judgement**	**Support for judgement**
Randomisation Method	Unclear risk	Randomisation method was not stated.
Concealment of Allocation	Unclear risk	Randomisation method was not stated.
Similarity at Baseline	Unclear risk	Baseline data not split by treatment group.
Intention-to-Treat Analysis	Unclear risk	Method of analysis not described.
Withdrawals Describe	High risk	16% withdrawals.
Cointerventions Constant	Unclear risk	Drug therapy was not described.
Blinded Assessors	Low risk	Assessor was blinded to group allocation.

Ellis 2005

Methods	Cross-over design. Block randomisation procedure was used in which each sealed envelope contained four Group A assignments and four Group B assignments. This process continued until a total of 68 participants were randomly allocated Method of analysis not described. Treated as outpatients 2 times a week for 6 weeks for a total of 18 hours (1.5 hour sessions) Assessed at baseline, immediately after 1st treatment. Immediately before 2nd treatment and 3 months after 2nd treatment Assessors were blinded.
Participants	35 participants in the physiotherapy group and 33 in the control group. 11 drop-outs Participants' mean age 64 years (physiotherapy), 63 years (control), male/female ratio, 25/10 (physiotherapy), 26/7 (placebo). Mean Hoehn and Yahr 2.5 (physiotherapy), 2.4 (control) Inclusion criteria: Stable medication usage, Hoehn and Yahr stage 2 or 3, at least 1 score of 2 or more for at least 1 limb for either the tremor, rigidity or bradykinesia item of the UPDRS, ability to walk independently, age 35-75 years, no severe cognitive impairment (MMSE $\geq$ 24), no other severe neurologic, cardiopulmonary or orthopaedic disorders, not having participated in a physical therapy or rehabilitation program in the previous 2 months. No exclusion criteria stated
Interventions	Physiotherapy: 1.5 hour long physical therapy session consisting of stretching, functional training, gait training, auditory cueing, balance, recreational, relaxation Control: Medical therapy only. It was not stated whether drug therapy was kept constant during the trial
Outcomes	Sickness Impact Profile (SIP-68). UPDRS (Sections I, II, III). Comfortable walking speed. Assessments were performed at the same time of day and in the same order. Assessments were performed in the 'on' state for participants who experience motor fluctuations
Notes	Of the 68 participants, 50 attended all treatment sessions.

Risk of bias

Bias	Authors' judgement	Support for judgement
Eligibility Criteria	Low risk	
Randomisation Method	Low risk	Blocked randomisation (block size 8) with sealed envelopes.
Concealment of Allocation	High risk	Sealed envelopes which contained 8 group allocations (4 per group)
Similarity at Baseline	Low risk	
Intention-to-Treat Analysis	Unclear risk	Method of analysis not described.
Withdrawals Describe	High risk	16% at the end of the trial.

Ellis 2005 (*Continued*)

Cointerventions Constant	Unclear risk	It was not stated whether drug therapy was kept constant during the trial
Blinded Assessors	Low risk	Assessors were blinded to group allocation.

Fisher 2008

Methods	Parallel-group design. Randomisation was done by the participants with their eyes closed; they selected a card corresponding to one of the 3 groups Method of analysis not described. Treated as outpatients for 24 sessions over 8 weeks for both treatment arms, 6 sessions over 8 weeks for control group Assessed at baseline and immediately post treatment. Assessors were blinded.
Participants	10 participants in the Treadmill group, 10 participants in the physiotherapy group and 10 participants in the control arm. No drop-outs described Participants' mean age, 64.1 years (treadmill), 61.5 years (physiotherapy), 63.1 years (control). Male/female ratio, 6/4 (treadmill), 5/5 (physiotherapy), 8/2 (control). Mean Hoehn and Yahr 1.9 in all 3 groups. Mean duration of PD 1.2 years (treadmill), 0.7 years (physiotherapy), 1.5 years (control) Inclusion criteria: Early stage PD, diagnosis of PD within 3 years of study participation, Hoehn and Yahr stage 1 or 2, 18 years or older, medical clearance from primary care physician to participate in exercise programme, ability to walk. Exclusion criteria: Medical or physical screening examination showed a score of less than 24 on the MMSE, there were physician determined major medical problems such as cardiac dysfunction that would interfere with participation, they had musculoskeletal impairments or excessive pain in any joint that could limit participation in an exercise programme, had insufficient endurance and stamina to participate in exercise 3 times per week for a 1 hour session
Interventions	Treadmill: Level of intensity was defined by MET. High intensity exercise greater than 3 METs. Body weight supported (BWS) treadmill training. Goal of each session was to reach and maintain a MET > 3. Exercise progressed by decreasing BWS (initially 10% of participants' bodyweight) and physical assistance, increasing the treadmill speed and time on the treadmill, with the end goal for each participant to walk on the treadmill continuously for 45 min within the MET range Physiotherapy: Less than 3 METs. This group was representative of general or traditional physical therapy. Each 45 min session was individualised and consisted of activities from 6 categories 1) passive range of motion and stretching 2) active range of motion 3) balance activities 4) gait 5) resistance training 6) practice of functional activities and transitional movements Control: Zero intensity group. Six 1 hour education classes taken over an 8 week period Drug therapy was constant during the trial.
Outcomes	UPDRS (Total, I, II and III subscores). Hoehn and Yahr. Functional assessments. Walking test. Sit-to-stand test. Transcranial magnetic stimulation. All participants took their customary medications at the same time relative to each assessment

Fisher 2008 (*Continued*)

Notes	Participants were allowed to continue their customary exercise routines and filled out a daily exercise diary

Risk of bias

Bias	Authors' judgement	Support for judgement
Eligibility Criteria	Low risk	
Randomisation Method	High risk	Participants self-selected a card with eyes closed.
Concealment of Allocation	High risk	Participants self-selected a card with eyes closed.
Similarity at Baseline	Low risk	
Intention-to-Treat Analysis	Unclear risk	Method of analysis not described.
Withdrawals Describe	Unclear risk	No drop-outs described.
Cointerventions Constant	Low risk	All medication kept stable during course of study.
Credible Placebo	Low risk	Education classes attended by controls.
Blinded Assessors	Low risk	Assessors were blinded to group allocation.

Ganesan 2010

Methods	Parallel-group design. Method of randomisation not stated. Method of analysis not described. Treated as outpatients for 8 hours over 4 weeks. Assessed at baseline, at 2 and 4 weeks. Not stated if assessors were blinded.
Participants	Total of 20 participants. No baseline characteristics were reported. Inclusion criteria: idiopathic PD, stable doses of dopaminomimetic drugs. No exclusion criteria
Interventions	Treadmill: Partial weight supported treadmill gait training with 20% unweighted for 30 min per day, 4 times per week Control: Did not receive any specific intervention. Drugs were stable at time of randomisation.
Outcomes	UPDRS. Dynamic Posturography. Berg Balance Scale. Tinetti performance orientated mobility assessment.

Ganesan 2010 (*Continued*)

	Tinetti balance score. Gait score. Participants were assessed in best 'ON' state.
Notes	Abstract - only P values reported.

Risk of bias

Bias	Authors' judgement	Support for judgement
Randomisation Method	Unclear risk	Randomisation method was not stated.
Concealment of Allocation	Unclear risk	Randomisation method was not stated.
Similarity at Baseline	Unclear risk	No baseline characteristics were reported.
Intention-to-Treat Analysis	Unclear risk	Method of analysis not described.
Withdrawals Describe	Unclear risk	No information provided (abstract only).
Cointerventions Constant	Unclear risk	Only information provided was that drugs were stable at time of randomisation
Blinded Assessors	Unclear risk	Not stated if assessors were blinded.

Goodwin 2009

Methods	Parallel-group design. Telephone randomisation external to the research team with 1:1 allocation in geographical cohorts Data were analysed on an intention-to-treat basis. Treated as outpatients for an unspecified time over 10 weeks Assessed at baseline and at 20 and 30 weeks. Assessors were not blinded.
Participants	64 participants in the exercise group and 66 in the control group. 7 drop-outs in total Participants' mean age 72.0 years (exercise) 70.1 years (control). Male female ratio, 39/25 (exercise), 35/31 (control). Mean Hoehn and Yahr 2.6 (exercise), 2.4 (control). Mean duration of PD 9.1 years (exercise), 8.2 years (control) Inclusion criteria: Diagnosis of idiopathic PD (confirmed by specialist), self-reported history of 2 or more falls in the past year, able to mobilise independently with/without a walking aid, resident in Devon, willingness to be randomised and provide written informed consent. Exclusion criteria: needed supervision or assistance from another person to mobilise indoors, significant co-morbidity that affect ability or safety to exercise (e.g. unstable angina, unstable diabetes, significant postural hypotension, severe pain, significant dyskinesia), were unable to follow verbal or written instructions in English
Interventions	Exercise: 10 weeks of supervised group strength and balance training plus unsupervised home exercises Control: Usual care. Drug therapy could vary.

Goodwin 2009 (*Continued*)

Outcomes	Falls Incidence. Number of fallers/recurrent faller. Injuries. Berg balance scale. Timed Up and Go. Fall Efficacy Scale - International. EQ-5D. Household and recreational physical activity (Phone-FITT). Not stated when examinations took place.
Notes	Abstract. Additional information and data obtained from author

Risk of bias

Bias	**Authors' judgement**	**Support for judgement**
Eligibility Criteria	Low risk	
Randomisation Method	Unclear risk	Telephone randomisation external to the research team with 1:1 allocation in geographical cohorts
Concealment of Allocation	Low risk	Telephone randomisation external to the research team with 1:1 allocation in geographical cohorts
Similarity at Baseline	Low risk	
Intention-to-Treat Analysis	Low risk	
Withdrawals Describe	Low risk	5% withdrawals.
Cointerventions Constant	Unclear risk	Participants changed their medication as appropriate as part of usual care
Credible Placebo	Unclear risk	Control group received usual care.
Blinded Assessors	High risk	Assessors were not blinded.

Hackney 2009

Methods	Parallel-group design. Randomisation was conducted by one author by selecting 1 of the 4 groups from a hat Method of analysis not described. Treated as outpatients for 20 hours within 13 weeks (1 hour sessions) Assessed at baseline and within one week of completing 20 sessions Assessors were blinded.

Hackney 2009 (*Continued*)

Participants	19 participants in the tango group, 19 in the waltz/foxtrot group, 17 in the Tai Chi group and 20 in the control group. 5, 2, 4 and 3 drop-outs from the tango, waltz/foxtrot, Tai Chi, and control group respectively Participants' mean age, 68.2 years (tango), 66.8 years (waltz/foxtrot), 64.9 years (Tai Chi), 66.5 years (control); male/female 11/3 (tango), 11/6 (waltz/foxtrot), 11/2 (Tai Chi), 12/5 (control). Mean Hoehn and Yahr 2.1 (tango), 2.0 (waltz/foxtrot), 2.0 (Tai Chi) and 2.2 (control). Mean duration of PD 6.9 years (tango), 9.2 years (waltz/foxtrot), 8.7 years (Tai Chi), 5.9 years (control). No baseline characteristics were given for drop-outs Inclusion criteria: Hoehn and Yahr stages 1-3, at least 40 years of age, could stand for at least 30 min, walk independently 3 or more metres with or without assistive device, diagnosis of Idiopathic PD using diagnostic criteria for clinically defined 'definite PD' based upon published standards, participants demonstrated clear benefit from levodopa, cognitively intact. Exclusion criteria: history of neurological deficit other than PD, dementia, another measure of cognitive function and a separate part of the study not reported where all participants were required to perform a subtraction task while walking (all completed with 85% accuracy), considered cognitively intact
Interventions	Dance: Experienced professional ballroom dancer taught progressive tango or waltz/foxtrot lessons for 1 hour twice weekly. Instructor equally versed in both dances attempted to give all students equal attention. Both genders spent equal time leading and following dance roles. All steps done in closed practice position where participants maintain contact through upper extremities and face one another Martial arts: Received progressive lessons for 1 hour twice weekly on Tai Chi's first and second circles including 37 postures of the Yang Short Style of Cheng Manching from an experienced instructor Control: No intervention. Drug therapy was kept constant during the trial.
Outcomes	PDQ-39. UPDRS III. Berg Balance Scale. Timed Up and Go. 6-minute walk test. Freezing of gait questionnaire. Forward and backward gait. Gait velocity. Stride length. Single support time. Exit questionnaire. Tandem Stance Test (TS). One Leg Stance test (OLS). Assessments took place at a standardised time when the participants were in the 'on' state
Notes	1 participant was excluded from the study due to medication change. Participants were instructed not to change their habitual exercise routines Data taken from all three publications. The tango and waltz/foxtrot arms assessed were suitably similar and were therefore combined to give one comparison of dance
Risk of bias	

Hackney 2009 (*Continued*)

Bias	Authors' judgement	Support for judgement
Eligibility Criteria	Low risk	
Randomisation Method	High risk	Conducted by one author by selecting 1 of the 4 groups from a hat
Concealment of Allocation	High risk	Conducted by one author by selecting 1 of the 4 groups from a hat
Similarity at Baseline	Low risk	
Intention-to-Treat Analysis	Unclear risk	Method of analysis not described.
Withdrawals Describe	High risk	19% withdrawals.
Cointerventions Constant	Low risk	Drug therapy was kept constant during the trial.
Blinded Assessors	Low risk	Assessors were blinded to group allocation.

Homann 1998

Methods	Parallel-group design. Participant's names were put into alphabetical order and then randomised using computer-generated random number tables Method of analysis not described. Treated as outpatients for 14 'units' over 5 weeks. Assessed at baseline and immediately after treatment. Not stated whether assessors were blinded.
Participants	8 participants in physiotherapy group and 7 in placebo group. No drop-outs were described No baseline characteristics available from abstract. Inclusion criteria: Idiopathic PD according to UK Brain Bank diagnostic criteria. No exclusion criteria
Interventions	Physiotherapy: Individual Bobath program focusing on proprioceptive skills to improve posture and gait Control: Untreated. Drugs were stable for duration of therapy.
Outcomes	UPDRS. Axial symptoms. Stride length. Walk velocity. Stride cadence.
Notes	Abstract and poster only. No numerical data available.

Homann 1998 (*Continued*)

Risk of bias		
Bias	**Authors' judgement**	**Support for judgement**
Eligibility Criteria	Low risk	
Randomisation Method	Low risk	Participant's names were put into alphabetical order and then randomised using computer-generated random number tables
Concealment of Allocation	Low risk	Based on information above, assumed treatment allocation performed once all patients recruited
Similarity at Baseline	Unclear risk	No baseline characteristics available from abstract.
Intention-to-Treat Analysis	Unclear risk	Method of analysis not described.
Withdrawals Describe	Unclear risk	No drop-outs described.
Cointerventions Constant	Low risk	Drugs were stable for duration of therapy.
Blinded Assessors	Unclear risk	Not stated whether assessors were blinded.

Keus 2007b

Methods	Parallel-group design. Randomised in blocks of four in order of enrolment. Independently assigned with concealed allocation The data were analysed on an intention-to-treat analysis. Treated as outpatients for an unspecified period of time, once or twice weekly for 10 weeks Assessed at baseline and immediately after treatment. Assessor was blinded.
Participants	14 participants in the physiotherapy group and 13 in the control group. 1 drop-out from the control group Participants' median age, 65 years (physiotherapy), 71 years (control). Male female ratio, 11/3 (physiotherapy), 11/2 (control). Mean Hoehn and Yahr 2.4 in both groups. Mean duration of PD 7 years (physiotherapy), 6 years (control) Inclusion criteria: Idiopathic PD according to the UK Parkinson's Disease Society Brain Bank Criteria, stable reaction to anti-Parkinsonian medication, at least one mobility-related activity limitation within core areas of physiotherapy practice in PD (gait, balance, posture and transfers) experienced by the participant as important. Exclusion criteria: Hoehn and Yahr stage 5 during the 'on' period, physiotherapy within 4 months prior to randomisation, severe co-morbidity influencing mobility or life threatening (e.g. cancer), not motivated to participate in physiotherapy, severe cognitive impairment defined by a MMSE score $\leq$ 24, presence of psychiatric impairments
Interventions	Physiotherapy: Once or twice weekly individual physiotherapy sessions. Delivered by a physiotherapist trained in the use of evidence based practice guidelines. Interventions included PD-specific techniques such as cueing, cognitive movement strategies and general techniques such as training of balance, leg

Keus 2007b (*Continued*)

	strength and physical fitness. The intervention targeted balance, transfers, posture, gait, dependent on the participant's main complaint Control: No physiotherapy. It was not stated whether drug therapy was kept constant during the trial
Outcomes	Patient preference outcome scale. The Parkinson Activity Scale. Mobility domain of the Dutch validated version of the PD questionnaire Assessments took place during the participants subjectively best 'on' phase
Notes	Most participants received six to thirteen sessions of physiotherapy in the nine week period

Risk of bias

Bias	Authors' judgement	Support for judgement
Eligibility Criteria	Low risk	
Randomisation Method	Low risk	Block size of 4.
Concealment of Allocation	Unclear risk	Independently assigned with concealed allocation.
Similarity at Baseline	Low risk	
Intention-to-Treat Analysis	Low risk	Data were analysed according to the intention-to-treat principles
Withdrawals Describe	Low risk	1 drop-out from control group (4%)
Cointerventions Constant	Unclear risk	It was not stated whether drug therapy was kept constant during the trial
Blinded Assessors	Low risk	Assessor was blinded to group allocation.

Klassen 2007

Methods	Parallel-group design. Randomisation method was not stated. Method of analysis not described. Treated as outpatients for 45 hours (exercise and education), 30 hours (exercise only) over 12 weeks Assessed at baseline, immediately and 3 months after treatment Assessors were blinded.
Participants	9 participants in the exercise and education group, 9 in the exercise group and 8 in the control group. 1 drop-out (exercise and education), 1 (exercise), 2 (control) Median age 62 years (exercise and education), 70 years (exercise), 66.5 years (control). Male/female ratio, 7/2 (exercise and education), 5/3 (exercise), 5/1 (control). Hoehn and Yahr 1.9 (exercise and education), 1.4 (exercise), 1.5 (control).Years since diagnosis 4 years (exercise and education), 3 years

	(exercise), 7 years (control). No baseline characteristics given for drop-outs Inclusion criteria: Clinical diagnosis of PD, 40-80 years of age, Hoehn and Yahr stages 1-3. Exclusion criteria: medical conditions that limit physical activity, dementia or significant cognitive impairment MMSE < 20, depression or other psychiatric disorder Beck Depression Inventory II score > 20, other neurological conditions
Interventions	Exercise and education: 1 hour and 15 min weekly of education delivered by physiotherapist, occupational therapist, speech language therapist, dietician, clinical psychologist and social worker. Education consisted of active learning methods, action plan development and discussion to complete each session. Report and discussion of action plan success/barriers to success at beginning of each session. An hour and 15 min twice weekly session of exercise which consisted of warm up, cool down, flexibility and strengthening exercises, posture and balance training, progressive aerobic training and functional task training e.g. sit-to-stand etc Exercise: As above, an hour 15 min twice weekly. Control: No intervention. It was not stated whether drug therapy was kept constant during the trial
Outcomes	PDQ-8. Stanford Self-Efficacy for managing chronic disease scale. North Western University Disability Scale. Schwab and England ADL Scale. Activities Balance Confidence Scale. Timed Up & Go. Not stated when examinations took place.
Notes	Abstract and presentation slides only. The education and exercise and exercise only arms assessed were suitably similar and were therefore combined to give one comparison of exercise Average attendance of the education and exercise classes ranged from 79.4% to 85.5%

Risk of bias

Bias	**Authors' judgement**	**Support for judgement**
Eligibility Criteria	Low risk	
Randomisation Method	Unclear risk	Randomisation method was not stated.
Concealment of Allocation	Unclear risk	Randomisation method was not stated.
Similarity at Baseline	Low risk	
Intention-to-Treat Analysis	Unclear risk	Method of analysis not described.
Withdrawals Describe	High risk	15% withdrawals
Cointerventions Constant	Unclear risk	It was not stated whether drug therapy was kept constant during the trial

Klassen 2007 (*Continued*)

Blinded Assessors	Low risk	Assessors were blinded to group allocation.

Kurtais 2008

Methods	Parallel-group design. Method of randomisation not stated. Method of analysis not described. Treated as outpatients 3 times a week for 6 weeks for a total period of 12 hours (40 minute sessions) Assessed at baseline and 7 weeks after baseline assessments. Assessors were blinded.
Participants	13 participants in the treadmill group and 14 in the control group. 1 drop-out in the treadmill group and 2 in the control group No baseline characteristics given for drop-outs. Participants' mean age 63.8 years (treadmill), 65.7 years (control); male/female 5/7 (treadmill), 7/5 (control); Hoehn and Yahr 2.5 (treadmill), 2.2 (placebo). Duration of PD 5.3 years (treadmill), 5.4 years (control) Inclusion criteria: Stable antiparkinsonian medication, ability to walk independently, not participated in a rehabilitation program in the previous 3 months Exclusion criteria: severe cognitive impairments or severe musculoskeletal, cardiopulmonary, neurologic or other system disorders
Interventions	Treadmill: gait training on a treadmill 3 times a week, attaining 70% to 80% of maximal heart rate. Either speed or incline was gradually increased over time Control: Untreated. Drug therapy was stable during the trial.
Outcomes	20-m walking time. Timed U-turn task. Turning around a chair. Climbing up and down a flight of stairs in participants preferred speed Standing on one foot. Standing up from an armless chair. Rate global physical status. Cardiopulmonary fitness levels. Examinations were done during the participants 'on' phase.
Notes	Both groups were taught exercises to maintain flexibility and range of motion One patient from the treadmill group was excluded due to non-compliance

Risk of bias

Bias	**Authors' judgement**	**Support for judgement**
Eligibility Criteria	Low risk	
Randomisation Method	Unclear risk	Randomisation method was not stated.
Concealment of Allocation	Unclear risk	Randomisation method was not stated.

Kurtais 2008 (*Continued*)

Similarity at Baseline	Low risk	
Intention-to-Treat Analysis	Unclear risk	Method of analysis not described.
Withdrawals Describe	High risk	11% withdrawals.
Cointerventions Constant	Low risk	Drug therapy was stable during the trial.
Blinded Assessors	Low risk	Assessors were blinded to group allocation.

Lehman 2005

Methods	Parallel-group design. Method of randomisation not stated. Method of analysis not described. Treated as outpatients for 10 days over 2 weeks. Assessed at baseline, immediately after, 1 week after and 1 month after intervention
Participants	5 participants in the cueing group and 6 participants in the control group. No drop-outs described Participants' mean age, 78 years (cueing), 74 years (control). Male/female ratio, 4/1 (cueing), 4/2 (control). Mean Hoehn and Yahr not stated. Duration of PD 7 years (cueing), 6.1 years (control) Inclusion criteria: participants with gait impairment due to PD, early stage PD. Exclusion criteria: persons with other neurological and/or orthopaedic impairments that could not walk the distances required of the training program were excluded
Interventions	Cueing: 10 day training programme of walking 1800 feet per day with instructions to 'take long steps'. One trip down the 30 foot pathway is a length. Each training set consisted of 20 lengths. Participants completed 3 training sets each day Controls: No change in lifestyle or medication. Drug therapy was not described.
Outcomes	Step length. Velocity. Cadence. Examinations took place at the same time each day.
Notes	Data on graphs - limited data.

Risk of bias

Bias	**Authors' judgement**	**Support for judgement**
Eligibility Criteria	Low risk	
Randomisation Method	Unclear risk	Randomisation method was not stated.
Concealment of Allocation	Unclear risk	Randomisation method was not stated.

Lehman 2005 (*Continued*)

Similarity at Baseline	Low risk	
Intention-to-Treat Analysis	Unclear risk	Method of analysis not described.
Withdrawals Describe	Unclear risk	No drop-outs described.
Cointerventions Constant	Unclear risk	Drug therapy was not described.
Blinded Assessors	Unclear risk	Not stated whether assessors were blinded.

Mak 2008

Methods	Parallel-group design. Participants randomly allocated to groups by drawing lots. Method of analysis not described. Treated as outpatients for 4 hours (audio-visual), 6 hours (exercise) over 4 weeks Assessed at baseline, at 2 weeks, immediately after and 2 weeks after treatment had ended Assessor was blinded.
Participants	21 participants in the cueing group, 21 participants in the exercise group and 18 in the control group. 2 drop-outs from the cueing group, 2 from the exercise group and 4 from the control group No baseline characteristics given for drop-outs. Participants' mean age 63 (cueing), 66 (exercise), 63 (control). No data given for the sex of participants. Hoehn and Yahr stage 2.8 (cueing), 2.7 (exercise) and 2.7 (control). Duration of PD 5.9 years (cueing), 6.1 years (exercise), 5.9 years (control) Inclusion criteria: diagnosed with PD according to Quinn, stable on anti-PD medications without dyskinesia, orthopaedic, arthritic or heart problems, aged between 50-75 years old, perform sit to stand independently, can follow instructions. No exclusion criteria stated
Interventions	Cueing: Audio-visual cued task-specific training for 20 min three times per week. Received cued sit-to-stand training using Equitest-Balance Master. Visual cue was given on a computer screen with verbal command as auditory cue. Each task lasted 2 min, repeated once with a 30 second rests in between Exercise: 45 min of conventional exercise twice a week. Conventional mobility and strengthening exercises for flexors and extensors of trunk, hips, knees and ankles followed by sit-to-stand practice Control: No treatment. Drugs stable during therapy.
Outcomes	Peak horizontal velocity (used in meta-analysis). Peak vertical velocity. Movement time. 3D Kinematics data of sit-to-stand. Not stated when during the day tests took place.
Notes	

Risk of bias

Bias	**Authors' judgement**	**Support for judgement**

Mak 2008 (*Continued*)

Eligibility Criteria	Low risk	
Randomisation Method	High risk	Drawing lots.
Concealment of Allocation	High risk	Drawing lots.
Similarity at Baseline	Low risk	
Intention-to-Treat Analysis	Unclear risk	Method of analysis not described.
Withdrawals Describe	High risk	13% withdrawals.
Cointerventions Constant	Low risk	Drugs stable during therapy.
Blinded Assessors	Low risk	Assessor was blinded to group allocation.

Marjama-Lyons 2002

Methods	Parallel-group design. Method of randomisation not stated. Method of analysis not described. Treated as outpatients for 24 hours over 12 weeks. Assessed at baseline and immediately after treatment. Assessors were blinded.
Participants	30 participants. No drop-outs were described. No baseline characteristics available. Inclusion criteria: Levodopa responsive PD, Hoehn and Yahr Stage 1.5-3. No exclusion criteria
Interventions	Martial arts: Two one hour weekly Tai Chi classes. Control: Continued baseline exercise program and added no new exercises Drug therapy was stable during the study.
Outcomes	UPDRS motor score (part III). Fall frequency form. Balance master Limits of Stability. Global Assessment of Change. Examinations took place when participants were in the 'on' state
Notes	All participants did not practice Tai Chi before entry. Abstract. No means and SDs, just P values available.

Risk of bias

Bias	**Authors' judgement**	**Support for judgement**
Eligibility Criteria	Low risk	

Marjama-Lyons 2002 (*Continued*)

Randomisation Method	Unclear risk	Randomisation method was not stated.
Concealment of Allocation	Unclear risk	Randomisation method was not stated.
Similarity at Baseline	Unclear risk	No baseline characteristics provided.
Intention-to-Treat Analysis	Unclear risk	Method of analysis not described.
Withdrawals Describe	Unclear risk	Drop-outs not described.
Cointerventions Constant	Low risk	Drug therapy was stable during study.
Blinded Assessors	Low risk	Assessors were blinded to group allocation.

Meek 2010

Methods	Parallel-group design. Participants were randomised using computer-generated random block sizes of four The data were analysed on an basis. Treated as outpatients for 12 sessions over 12 weeks. Assessed at baseline and immediately after treatment, and at 6 months Assessor was blinded.
Participants	20 participants in the exercise group and 19 in the control group. 1 drop-out in the control group Participants mean age, 63.4 years (exercise), 64.9 years (control); male/female ratio 15/5 (exercise), 16/3 (control); mean duration of PD 5.1 years (exercise), 4.7 (control). Mean Hoehn and Yahr was not reported Inclusion criteria: A diagnosis of idiopathic PD, aged 18 years or over, no cognitive, sensory or psychological impairments that may prevent engagement in participation in the study or put the participant at risk (judged by the referring clinician), able to participate in the study for its full duration, able to walk 10m using any aid or assistance required. Exclusion criteria: Participants unable to meet inclusion criteria, or those unwilling to participate, participants with additional impairments resulting in a restriction of mobility, or any contraindications to exercise
Interventions	Exercise: collaborated with fitness instructors to design a 3-month individualised, progressive exercise program Control: received usual care. Drug therapy was allowed to change during the study.
Outcomes	Physical Activity Scale for the Elderly. Accelerometer monitored physical activity. 10-m walk test. 2-min walk test. Lower limb muscle strength and grip strength. Fatigue severity scale. PDQ-39. Falls. There were no constraints on timing of assessments.

Meek 2010 (*Continued*)

Notes	Abstract and further information provide by author. Gym attendance during the pooled intervention periods was high overall, with a mean of 14.5 visits and median of 12 visits

Risk of bias

Bias	**Authors' judgement**	**Support for judgement**
Eligibility Criteria	Low risk	
Randomisation Method	Low risk	Computer-generated random block sizes of four.
Concealment of Allocation	Low risk	Randomisation done centrally.
Similarity at Baseline	Low risk	
Intention-to-Treat Analysis	Low risk	Intention-to-treat analysis.
Withdrawals Describe	Low risk	1 drop-out in the control group (3%).
Cointerventions Constant	Unclear risk	Drug therapy was allowed to change during the study.
Blinded Assessors	Low risk	Assessors were blinded to group allocation.

Nieuwboer 2007

Methods	Cross-over design. Participants were randomly allocated in permuted blocks of six to an early or late intervention group by an independent investigator not involved in data analysis. Allocation was concealed by the use of opaque sealed envelopes The data were analysed on an intention-to-treat basis. Treated at home for 4.5 hours over 3 weeks. Assessed at baseline, immediately after 1st and 2nd treatment and at 12 weeks Assessors were blinded.
Participants	76 participants in the cueing group and 77 in the control group. 1 drop-out in the cueing group Participants' mean age, 66.9 years (cueing), 67.2 years (control). Male/female ratio 48/28 (cueing), 40/37 (control). Hoehn and Yahr 2.7 (cueing), 2.8 (control). Mean duration of PD 7 years (cueing), 8 years (control) Inclusion criteria: Diagnosis of Idiopathic PD (defined by the UK Brain Bank Criteria), Hoehn and Yahr stage 2-4, showing mild to severe gait disturbance with score > 1 on the UPDRS item 29, stable drug usage, age 18-80 years. Exclusion criteria: undergone DBS or stereotactic neurosurgery, had cognitive impairment (MMSE < 24), had disorders interfering with participation in cueing training including neurological (stroke, multiple sclerosis, tumour), cardiopulmonary (chronic obstructive disorders, angina pectoris) and orthopaedic (osteoarthritis, rheumatoid arthritis and back pain) conditions, had predictable and long lasting off periods (score 1 on item 37 and score > 2 on item 39 on UPDRS). Had

	participated in a physio programme 2 months before starting the trial
Interventions	Cueing: Cueing programme delivered at home over 3 weeks by 1 therapist in 9 sessions lasting 30 min. A prototype cueing device specifically developed for the study provided 3 rhythmical cueing modalities: 1. auditory (a beep delivered through an ear piece), 2. visual (light flashes delivered through a light-emitting diode attached to a pair of glasses), 3. somatosensory (pulsed vibrations delivered by a miniature cylinder worn under a wristband). Participants tried all cueing modalities in the first week, but trained with their preferred modality. Cued practice was applied during a variety of tasks and aimed to improve step length and walking speed, prevent freezing episodes and improve balance Control: No training. Drug therapy was kept constant throughout the trial.
Outcomes	Posture and gait score. Gait and balance measures (including 10-m test of walking, gait speed, step length, step frequency, functional reach, timed single leg and tandem stance, Freezing of Gait Questionnaire, Timed Up and Go Test Activity measures (including Nottingham Extended Activities of Daily Living Index, Falls Efficacy Scale) Participation measures (including Parkinson's Disease Questionnaire-39, Carer Strain Index) Falls diary. Assessments were performed at the same time of day when participant was in the 'on' phase approximately 1 hour after drug intake
Notes	

Risk of bias

Bias	**Authors' judgement**	**Support for judgement**
Eligibility Criteria	Low risk	
Randomisation Method	Low risk	Permuted block size of 6.
Concealment of Allocation	High risk	Sealed envelopes.
Similarity at Baseline	Low risk	
Intention-to-Treat Analysis	Low risk	The data were analysed on an intention-to-treat basis.
Withdrawals Describe	Low risk	1 drop-out in the cueing group (<1%).
Cointerventions Constant	Low risk	All medication remained constant.
Blinded Assessors	Low risk	Assessors were blinded to group allocation.

Protas 2005

Methods	Parallel-group design. Method of randomisation not stated. Method of data analysis not described. Treated as outpatients for 24 hours over 8 weeks. Assessed at baseline and immediately after treatment. Assessors were blinded.
Participants	9 participants in both groups. No drop-outs described. Participants' mean age 71.3 years (treadmill), 73.7 years (control); male/female all male participants for both groups. Mean Hoehn and Yahr 2.8 (treadmill), 2.9 (control). Duration of PD 7.1 years (treadmill) , 8.1 years (control) Inclusion criteria: Idiopathic PD, postural instability-gait difficulty predominant PD, experiences with freezing episodes, and or history of falls, stable regimen of antiparkinsonian medications, ability to stand and walk with or without assistance, stage 2 or 3 Hoehn and Yahr, scores of moderate or higher on all scales on the Neurobehavioural Cognitive Status Examination (Cognistat). No exclusion criteria
Interventions	Treadmill: Gait and step training 3 times per week. Using a harness for safety the participant walks forward on a treadmill at fastest speed for 5-7 min, backwards at fastest self-selected speed for 5-7 min. Then left and right sideways walking at fastest selected speed for 2-3 min each way. Participants then had 5 min rest before starting step training, which consisted of turning on the treadmill suddenly to perturb the participant's standing balance (15-20 forward and backward perturbations, 10-15 left and right perturbations) Control: No intervention. Drug therapy was stable throughout the trial.
Outcomes	Gait speed. Cadence. Stride length. 5-Step test. Reports of falls. Freezing of gait. Assessments took place when participants were at their best 'on' state
Notes	

Risk of bias

Bias	**Authors' judgement**	**Support for judgement**
Eligibility Criteria	Low risk	
Randomisation Method	Unclear risk	Randomisation method was not stated.
Concealment of Allocation	Unclear risk	Randomisation method was not stated.
Similarity at Baseline	Low risk	
Intention-to-Treat Analysis	Unclear risk	Method of data analysis not described.

Protas 2005 (*Continued*)

Withdrawals Describe	Unclear risk	No drop-outs described.
Cointerventions Constant	Low risk	Drug therapy was stable throughout the trial.
Blinded Assessors	Low risk	Assessors were blinded to group allocation.

Purchas 2007

Methods	Cross-over design. Method of randomisation not stated. Method of data analysis not described. 1 session per week for a total of 12 weeks. Assessed at baseline and immediately after 1st and 2nd treatment Not stated whether the assessors were blinded.
Participants	10 participants in the martial arts group and 10 participants in the control group. One drop-out from both groups Mean age of participants 70 years in both groups. Male/female ratio, 7/2 (martial arts), 4/5 (control). Mean Hoehn and Yahr 2 (martial arts), 2.3 (control). No baseline characteristics given for drop-outs Inclusion criteria: maintenance phase of PD. No exclusion criteria
Interventions	Martial arts: 1 hour weekly Tai Chi training. Control: no treatment. Drug therapy not described.
Outcomes	Timed Up and Go Test. PDQ-39. UPDRS. Hoehn and Yahr stage. Falls diary. Not stated when during the day examinations took place.
Notes	Abstract and poster only.

Risk of bias

Bias	**Authors' judgement**	**Support for judgement**
Eligibility Criteria	Unclear risk	Maintenance phase of PD.
Randomisation Method	Unclear risk	Randomisation method was not stated.
Concealment of Allocation	Unclear risk	Randomisation method was not stated.
Similarity at Baseline	Low risk	
Intention-to-Treat Analysis	Unclear risk	Method of data analysis not described.

Purchas 2007 (*Continued*)

Withdrawals Describe	Low risk	10% drop-out
Cointerventions Constant	Unclear risk	Drug therapy was not described.
Blinded Assessors	Unclear risk	Not stated whether assessors were blinded.

Sage 2009a

Methods	Parallel-group design. Method of randomisation not stated. Data analysed on an intention-to-treat basis. Treated as outpatients for 18 hours (exercise), 20-24 hours (PDSAFEx) over 10-12 weeks Assessed at baseline and after treatment. Assessors were blinded.
Participants	17 participants in the exercise group, 21 participants in the PDSAFEx group and 15 in control. 4 drop-outs (exercise) and 3 drop-outs (PDSAFEx) Participants' mean age 65.1 years (exercise), 64.2 years (PDSAFEx), 68.6 years (control). Male/female ratio, 6/7 (exercise), 12/6 (PDSAFEx), 7/8 (control). Hoehn and Yahr score not given. Duration of PD 3.2 years (exercise), 4.7 years (PDSAFEx) and 2.5 years (control). No baseline characteristics given for drop-outs Inclusion criteria: diagnosis of idiopathic PD with no other major medical, physiological or neurological problem, a stable medication schedule, mild to moderate PD defined as a score of less than 35 on UPDRS motor section
Interventions	Exercise: lower limb aerobic training, exercise for 30 min (5 min warm up, 20 min aerobic training, 5 min cool down) three times a week in groups of 4 on Biostep semi-recumbent elliptical's in the seated position. The machine was primarily leg driven with arms moving in a coordinated pattern. Intensity maintained by achieving a pace of 50 RPM, a heart rate of 60% to 75% of age related max and a Borg rate of perceived exertion of below 5 PDSAFEx: Sensory attention focused exercise for 40-60 min three times a week. 20-30 min of non-aerobic gait exercises focused on body coordination followed by 20-30 min of sensory attention exercises utilising latex Thera-bands® attached to arm rests of office chairs. Exercises were completed with eyes closed and cued to the sensory feedback from specific portions of each exercise. Examples of exercises, tandem walking for balance and coordination, side stretches down side of chair for sensory feedback Control: Non-exercise control group, maintained regular activity level Drug therapy remained unchanged during the trial.
Outcomes	UPDRS III. Timed Up and Go. Spatiotemporal aspects of gait. Assessments took place when participants were a 'peak' dose (approximately 90 min after administration)
Notes	3-arm trial. The PD SAFEx and exercise arms assessed were suitably similar and were therefore combined to give one comparison of exercise Both exercise groups attended an equivalent number of training sessions, overall 90%

Sage 2009a (*Continued*)

Risk of bias		
Bias	**Authors' judgement**	**Support for judgement**
Eligibility Criteria	Low risk	
Randomisation Method	Unclear risk	Randomisation method was not stated.
Concealment of Allocation	Unclear risk	Randomisation method was not stated.
Similarity at Baseline	Low risk	
Intention-to-Treat Analysis	Low risk	Statisicial analysis was done using intention-to-treat principles
Withdrawals Describe	High risk	13% withdrawals.
Cointerventions Constant	Low risk	Drug therapy remained unchanged during the trial.
Blinded Assessors	Low risk	Assessors were blinded to group allocation.

Schenkman 1998

Methods	Parallel-group design. Participants were stratified according to gender and then randomised using computer-generated assignment Randomisation schedule kept in office of statistician until participants were assigned Method of data analysis not described. Treated as outpatients for 30 hours over 10-13 weeks. Assessed at baseline and immediately after treatment. Assessors were blinded.
Participants	27 participants in exercise group, 24 participants in control group. 4 drop-outs from exercise group, 1 from control group No baseline characteristics given for drop-outs. Participants mean age 70.6 years (exercise), 71.2 years (control); male/female 18/5 (exercise), 16/7 (control); Hoehn and Yahr 2.6 (exercise), 2.7 (control) Inclusion criteria: PD as diagnosed by a neurologist, Hoehn and Yahr stage 2 or 3, functional axial rotation of 120 degrees or less to either side. Exclusion criteria: Hospitalised within last 3 months, PD drugs changed in last month, other neurological disorders, Folstein MMSE < 23
Interventions	Exercise: Individual exercises to improve spinal flexibility and coordinated movement. Standardised programme included a series of exercises divided into 7 graduated stages, from supine to standing. Exercises learned at each stage are continued throughout with progressively higher level activities added. Exercises are incorporated into daily routine at end of formal training sessions Control: No treatment. ('Wait listed' for exercise programme) Drug therapy constant during trial.

Schenkman 1998 (*Continued*)

Outcomes	Functional axial rotation. Functional reach. Timed tests. Timed walk. Cervical and lumbar range of motion. Walking velocity. Participants with fluctuations assessed during 'on' time.
Notes	Abstract, further information obtained from author. All 46 participants completed 30 treatment sessions within their allotted time

Risk of bias

Bias	**Authors' judgement**	**Support for judgement**
Eligibility Criteria	Low risk	
Randomisation Method	Low risk	Computer-generated assignment.
Concealment of Allocation	Low risk	Randomisation schedule kept in office of statistician until participants were assigned
Similarity at Baseline	Low risk	
Intention-to-Treat Analysis	Unclear risk	Method of data analysis not described.
Withdrawals Describe	Low risk	10% withdrawals.
Cointerventions Constant	Low risk	Drug therapy was kept constant during the trial.
Blinded Assessors	Low risk	Assessors were blinded to group allocation.

Schilling 2008

Methods	Parallel-group design. Participants were gender matched then randomly assigned. Method of randomisation not stated Method of data analysis not described. Treated as outpatients for 16 sessions of an unspecified time over 8 weeks Assessed at baseline and immediately after treatment.
Participants	9 participants in the exercise group and 9 participants in the control group. 1 drop-out form the exercise group, 2 drop-outs from the control group Participants' mean age 61.3 years (exercise), 57 years (control); male/female 5/4 (exercise), 6/3 (control) ; Hoehn and Yahr 2.1 (exercise), 1.9 (control) Inclusion criteria: mild to moderate PD, Hoehn and Yahr stage 1-2.5, ability to walk a 20-foot path, turn and return to the start without use of assistive device. Exclusion criteria: orthostatic hypotension, dementia (MMSE < 24), other significant co-morbidities (i.e. stroke, severe degenerative osteoarthritis)

Schilling 2008 (*Continued*)

	, other causes of Parkinsonism such as PSP, vascular PD and multiple system atrophy as determined by board-certified neurologist
Interventions	Exercise: moderate volume, high-load lower-body resistance training twice weekly. After a warm-up participants performed three sets of 5-8 repetitions for the leg press, seated leg curl, and calf press under direct supervision of a Certified Strength and Conditioning Specialist. Participants were instructed to lift the weight as fast a possible with good form and to slowly return the weight to the start position. Progression was planned so that when eight repetitions could be completed for all the sets the weight was increased by 5% to 10% Control: Continue standard care. Drug therapy was not described.
Outcomes	Maximum strength for the lower body. Activities-Specific Balance Confidence. Timed Up and Go. 6-minute Walk Test. All testing done when participants were in their optimally medicated state, typically within 30 min to 2 hours of their first morning dose
Notes	Control group were given the opportunity to complete the training intervention after the 8 week control period

Risk of bias

Bias	**Authors' judgement**	**Support for judgement**
Eligibility Criteria	Low risk	
Randomisation Method	Unclear risk	Method of randomisation not stated.
Concealment of Allocation	Unclear risk	Method of randomisation not stated.
Similarity at Baseline	Low risk	
Intention-to-Treat Analysis	Unclear risk	Method of data analysis not described.
Withdrawals Describe	High risk	17% withdrawals.
Cointerventions Constant	Unclear risk	Drug therapy was not described.
Blinded Assessors	Unclear risk	Not stated whether assessors were blinded.

Schmitz-Hubsch 2006

Methods	Parallel-group design. Participants were sorted randomly, matched for disease severity, presence or absence of dyskinesia and type of clinical manifestation. Randomisation was carried out using a list of pseudonyms generated by one investigator and transferred by fax to a 2nd investigator The data were analysed on an intention-to-treat basis. Treated as outpatients for 8 hours over 8 weeks, then for 0 hours for 8 weeks then 8 hours for 8 weeks. Total of 16 hours over 24 weeks Assessed at baseline, 3, 6 and 12 months. Not stated whether assessors were blinded.
Participants	32 participants in the martial arts group and 24 in the control group. 2 drop-outs in the martial arts group and 5 in the control group Participants' mean age, 64 years (martial arts), 63 years (control); male/female 24/8 (martial arts), 19/5 (control). Hoehn and Yahr score not given. Duration of PD 6 years (martial arts) and 5.6 years (control) Inclusion criteria: participants diagnosed with PD according to the UK Brain Bank Criteria at any stage of the disease with or without motor complications, MMSE > 24. Exclusion criteria: previous practical experience with Qigong, recent (< 1 month) or planned change of medication, signs of central nervous system disease other than PD e.g. aphasia or dementia (defined by MMSE < 24)
Interventions	Martial Arts: 1 hour weekly group lesson of Qigong delivered by an experienced teacher. Exercises were carried out standing or in the sitting position adjusted to participants physical abilities. Teacher repeatedly stressed importance of home self-exercise Control: no intervention. Drug therapy varied throughout the trial.
Outcomes	UPDRS III. PDQ-39. Montogmery-Asperg Depression Rating Scale. Non-motor symptoms. Self-reporting questionnaire. Assessments were carried out when participants were in the 'on' state (time of optimal medication effect as defined by the participant). Follow-up assessments were done at similar times of the day
Notes	Participants were asked not to change their medication during the study but if their medical condition required adaptations this would not lead to exclusion Compliance at one year follow-up was fair.

Risk of bias

Bias	**Authors' judgement**	**Support for judgement**
Eligibility Criteria	Low risk	
Randomisation Method	High risk	List of pseudonyms.
Concealment of Allocation	High risk	Randomisation was carried out using a list of pseudonyms generated by one investigator and transferred by fax to a 2nd investigator

Schmitz-Hubsch 2006 (*Continued*)

Similarity at Baseline	Low risk	
Intention-to-Treat Analysis	Low risk	All analyses were carried out on an intention-to-treat-basis
Withdrawals Describe	High risk	13% withdrawals.
Cointerventions Constant	Unclear risk	Drug therapy varied throughout the trial.
Blinded Assessors	Unclear risk	Not stated whether assessors were blinded.

Shankar 2008

Methods	Parallel-group design. Random allocation using computer-generated random list. Method of analysis not described. Treated as an outpatient for 36 hours over 3 months. Assessed at baseline and immediately after treatment. Assessors were blinded.
Participants	14 participants in the cueing group and 14 in the control group. No drop-outs described Participants' mean age, 70 years (cueing), 62 years (control); male/female 6/8 (cueing), 8/6 (control), mean Hoehn and Yahr score 2.4 (cueing), 2.3 (control). Duration of PD 7.5 years (cueing), 7.9 years (control) Inclusion criteria: diagnosis of idiopathic PD as per UK Brain Bank criteria, Hoehn Yahr disease stages 2 and 3, stable PD medication for 1 month prior to baseline visit, ability to walk with headphones unaided for 30 minutes three times per week, absence of pre-existing walking to music. Exclusion criteria: presence of dementia (MMSE < 26), presence of co-morbidities that affect the ability to walk, hearing deficits
Interventions	Cueing: walking for 30 min three times per week whilst listening to a battery of musical pieces. Music was self-selected based upon participant input and cadence-matched to the participant's ideal walking speed Control: maintained their normal walking activity. Minor medication changes allowed, as deemed appropriate by team neurologist
Outcomes	Gait and Balance Scale. UPDRS III. Adjusted PDQ-39. Activities-Specific Balance Confidence Scale. Not stated when examinations took place.
Notes	Abstract. Information on trial quality and data obtained from author

Risk of bias

Bias	**Authors' judgement**	**Support for judgement**

Shankar 2008 (*Continued*)

Eligibility Criteria	Low risk	
Randomisation Method	Low risk	Computer-generated random list.
Similarity at Baseline	Low risk	
Intention-to-Treat Analysis	Unclear risk	Method of analysis not described.
Withdrawals Describe	Unclear risk	No drop-outs described.
Cointerventions Constant	Unclear risk	Minor medication changes allowed, as deemed appropriate by team neurologist
Blinded Assessors	Low risk	Assessors were blinded to group allocation.

Shankar 2009

Methods	Parallel-group design. Randomisation method not stated. Method of analysis not described. Treated as outpatients for 8 hours over 8 weeks. Assessed at baseline and immediately after treatment. Assessor was blinded.	
Participants	10 participants in the treadmill + cueing group, 10 participants in the cueing group. No drop-outs described Baseline characteristics only given for all three treatment groups combined - Mean age 64.4 years, 62% were male Inclusion criteria: Moderate PD. No exclusion criteria.	
Interventions	Treadmill + cueing: Walking on the treadmill with music for 30 min twice a week. Music was selected based upon participant input and cadence-matched to the participant's preferred walking speed Treadmill: Walking on the treadmill without music for 30 min twice a week Cueing: Listening to music for 30 min twice a week. Drug therapy was not described.	
Outcomes	Gait and Balance Scale. UPDRS III. PDQ-39. Not stated when examinations took place.	
Notes	Abstract only. The 3rd arm, treadmill only was excluded from our analysis	
Risk of bias		
Bias	**Authors' judgement**	**Support for judgement**

Shankar 2009 (*Continued*)

Randomisation Method	Unclear risk	Randomisation method was not stated.
Concealment of Allocation	Unclear risk	Randomisation method was not stated.
Similarity at Baseline	Unclear risk	Baseline characteristics only given for all three treatments groups combined
Intention-to-Treat Analysis	Unclear risk	Method of analysis not described.
Withdrawals Describe	Unclear risk	No drop-outs described.
Cointerventions Constant	Unclear risk	Drug therapy was not described.
Credible Placebo	Low risk	
Blinded Assessors	Low risk	Assessor was blinded to group allocation.

Stozek 2003

Methods	Parallel-group design. Method of randomisation not stated. Method of analysis not described. Treated as outpatients for 56 hours over 4 weeks. Assessed at baseline, immediately and 1 month after treatment Not stated whether assessors were blinded or not.
Participants	30 participants in the exercise group and 31 participants in the control group. No drop-outs described Participants' mean age 64 years (exercise), 67 years (control); Male/female 13/17 (exercise), 16/15 (control); Hoehn and Yahr 2.3 for both groups. Mean duration of PD 4.6 years (exercise), 4.3 years (control) Inclusion criteria: Idiopathic PD diagnosed by a neurologist, disease stage based on the Hoehn and Yahr scale 1.5-beginning of 3, stable pharmacological treatment for at least the last 3 months, age 35-85, no other neurological disease or serious movement disorders, no contraindications for physical exercise, participants written consent to participate in the study
Interventions	Exercise: Complex rehabilitation for 2 hours twice daily for first 2 weeks then once a day three times a week for 2 weeks for a total of 28 sessions. Sensory reinforcements were used during all exercises: verbal, visual, auditory, extero- and proprioceptive stimulation. Complex rehabilitation consisted of: relaxation and breathing exercises, exercises increasing the range of movement, functional exercises, exercises for posture, balance, gait, music-dance exercises, mimic exercises of facial muscle and tongue, articulation and voice exercises, group therapy and patient education Control: Without rehabilitation. It was not stated whether drug therapy was stable throughout the trial
Outcomes	Functional reach test. Tinetti's Balance Performance Oriented Mobility Assessment. Static and dynamic balance. Timed Up and Go.

Stozek 2003 (*Continued*)

	10m walk. Locomotion test. 360° turn. All assessments were carried out during one day in the morning when participants were in the 'on' phase
Notes	

Risk of bias

Bias	Authors' judgement	Support for judgement
Eligibility Criteria	Low risk	
Randomisation Method	Unclear risk	Randomisation method was not stated.
Concealment of Allocation	Unclear risk	Randomisation method was not stated.
Similarity at Baseline	Low risk	
Intention-to-Treat Analysis	Unclear risk	Method of analysis not described.
Withdrawals Describe	Unclear risk	No drop-outs described.
Cointerventions Constant	Unclear risk	It was not stated whether drug therapy was stable throughout trial
Blinded Assessors	Unclear risk	Not stated whether assessors were blinded.

Thaut 1996

Methods	Parallel-group design. Randomised by a 'random draw', but concealment of allocation unclear Method of analysis not described. Treated at home or in the community for 10.5 hours over 3 weeks Assessed in the laboratory at baseline, and immediately after treatment Not stated whether the assessors were blinded.
Participants	15 participants in the cueing group, 11 participants in the exercise and 11 participants in control group. No drop-outs described Participants' mean age, 69 (cueing), 74 (exercise), 71 (control); Male/female 10/5 (cueing) 8/3 (exercise) , 8/3 (control); Hoehn and Yahr 2.4 (cueing), 2.5 (exercise), 2.6 (control). Mean duration of PD 7.2 years (cueing), 5.4 years (exercise), 8.5 years (control) Inclusion criteria: Idiopathic PD with significant gait deficits regarding velocity, stride length and cadence but able to walk without physical assistance. No exclusion criteria
Interventions	Cueing: Exercised for 30 min daily according to a prescribed program using rhythmic auditory stimulation (RAS). The RAS program consisted of walking on a flat surface, stair stepping, and stop-and-

Thaut 1996 (*Continued*)

	go exercises to rhythmically accentuated music at three different tempos. The tempos were labelled 'normal', 'quick' and 'fast' Exercise (self-paced therapy, SPT): Performed their 30 min daily walking sessions without RAS, following the same training protocol and training exercises for the same length of time. Walking was divided equally into walking at normal pace, quick pace and fast pace Control: No treatment. Drugs stable during therapy.
Outcomes	Walk velocity. Stride cadence. Stride length. EMG analysis on leg muscles. Footfall pattern. All testing done 90-120 minutes after first medication intake in morning
Notes	3 arms to trial; RAS, SPT and no treatment. SPT vs. RAS are examined in 'A comparison of physiotherapy techniques for participants with Parkinson's disease.' Cochrane review

Risk of bias

Bias	**Authors' judgement**	**Support for judgement**
Eligibility Criteria	Low risk	
Randomisation Method	High risk	Random draw.
Concealment of Allocation	Unclear risk	No information provided to allow assessment.
Similarity at Baseline	Low risk	
Intention-to-Treat Analysis	Unclear risk	Method of analysis not described.
Withdrawals Describe	Unclear risk	No drop-outs described.
Cointerventions Constant	Low risk	Medication remained stable throughout study.
Blinded Assessors	Unclear risk	Not stated whether assessors were blinded.

MMSE: Mini-Mental State Examination
PD: Parkinson's disease
QoL: quality of life
SD: standard deviation
UPDRS: Unified Parkinson's Disease Rating Scale

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

Study	Reason for exclusion
Bergen 2002	No outcome measures relevant to our review.
Blackington 2002	Initially identified as a suitable study for inclusion but was excluded due to the number of drop-outs (47%; final number of participants analysed n=8), which left the two groups unmatched by age and duration of Parkinson's disease
Bridgewater 1997	Although this trial was designed as an RCT, after discussion with the authors it was discovered that the method of randomisation was compromised. 'In order of response to advertising, participants were allocated alternately to group A (period of exercise then no exercise) and group B (control, then complimentary exercise classes) .' Although alternate allocation is an acceptable method of randomisation, the authors went on to change participants from group A to B if their personal circumstances dictated that they would be unavailable for the physiotherapy e.g. if they were leaving the state on holiday. We feel that this compromised the randomisation procedure and therefore excluded the trial
Byl 2009	After email correspondence with the author, this trial was found out not to be randomised
Christofoletti 2010	Excluded as although the abstract for the study states 'randomised controlled trial', after translating the full paper the study did not appear to be randomised; 'allocated to groups on convenience basis, following availability of participants at treatment site'. Attempted to contact author to clarify randomisation method but were unsuccessful
Cianci 2010	Excluded as confounded due to use of rolling walker.
Comella 1994	The study did not report outcomes for the first assessment period and therefore has been excluded to prevent any bias of carry over or order effects
Forkink 1996	No outcome measures relevant to our review.
Formisano 1992	Although this trial was controlled, the authors did not state that the allocation of the participants into the two groups was random
Gibberd 1981	The study did not report outcomes for the first assessment period and therefore has been excluded to prevent any bias of carry-over or order effects
Guo 2009	Multidisciplinary rehabilitation trail. Percentage component of physiotherapy was not specified, therefore unable to differentiate the contribution of physiotherapy to any change in the outcome measures
Haas 2006	Excluded as the study was a randomised cross-over over a couple of hours
Hurwitz 1989	No outcome measures relevant to our review.
Katsikitis 1996	No outcome measures relevant to our review.
King 2009	Excluded as the study was a randomised cross-over on the same day

(*Continued*)

Patti 1996	Multidisciplinary rehabilitation trail. Percentage component of physiotherapy was not specified, therefore unable to differentiate the contribution of physiotherapy to any change in the outcome measures
Pohl 2003	Randomised multiple intervention cross-over, over 4 consecutive days. Randomisation was of the sequence of the interventions, therefore not RCT
Sage 2009b	After contacting the author it was found that the study was not properly randomised
Stallibrass 2002	The method of therapy used - Alexander Technique - is not used by physiotherapists. Therefore this trial was excluded
Tickle-Degnen 2010	Multidisciplinary rehabilitation trail. Percentage component of physiotherapy was not specified, therefore unable to differentiate the contribution of physiotherapy to any change in the outcome measures
Van Gerpen 2010	Excluded as confounded due to use of four-wheeled walker.
Wade 2003	Multidisciplinary rehabilitation trail. Percentage component of physiotherapy was not specified, therefore unable to differentiate the contribution of physiotherapy to any change in the outcome measures
Wells 1999	Although not stated in the text, after personal communication with the author this trial was determined to be an RCT. However the method of therapy used - osteopathic manipulative treatment - is not used by physiotherapists. Therefore this trial was excluded

RCT: randomised controlled trial

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

Canning 2009

Trial name or title	Exercise therapy for prevention of falls in people with Parkinson's disease: a randomised controlled trial
Methods	Parallel-group design. Randomisation was stratified by falls history (0-10 falls in the previous 12 months/more than 10 falls in the previous 12 months) using a computer-generated random number schedule with variable block sizes of 2-6. Randomisation was performed centrally by an investigator not involved in recruitment or assessments Assessors were blinded.
Participants	230 participants. Inclusion criteria: Diagnosis of Idiopathic Parkinson's disease. Adapted to their current antiparkinsonian medication for at least 2 weeks. Aged 40 years or over. Able to walk independently (with or without walking aid). Have a history of falls (at least one fall in the previous 12 months) or are at risk of falls Exclusions criteria: Have a Mini-Mental State Examination score of < 24. Suffer from unstable cardiovascular disease or other uncontrolled chronic conditions that would interfere with the safety and conduct of the training and testing protocol or interpretation of the results

Canning 2009 (*Continued*)

Interventions	Exercise: 40-60 minute program of home-based balance and leg strength exercises three times a week for 6 months. Participants can choose to participate in a once a month exercise class (for 6 months) conducted by a physiotherapist in association with their local Parkinson's NSW/ACT Support Group or hospital. Participants will be provided with a booklet containing safety precautions, instructions and photographs of exercises for use in exercise sessions at home, as well as information sheets detailing strategies for managing freezing. In addition, they will be provided with a logbook for recording exercises completed and any adverse effects of exercise. Participants will also receive standardised falls prevention advice and will be provided with a falls diary for recording falls Control: Will have standardised falls prevention advice and will be provided with a falls diary for recording falls
Outcomes	Falls diary*. Parkinson's Disease Falls Risk Score. Maximal muscle strength, Knee extension (quadriceps). Step test component from the Berg Balance Scale. Short Physical Performance Battery. Freezing of Gait Questionnaire. SF12v2^{TM} health survey. Falls Efficacy Scale International questionnaire. Habitual Physical Activity Questionnaire. PDQ-39. Positive and Negative Affect Schedule (PANAS). Total cost*. Tested at baseline and at the end of the 6 month intervention period. *Data collected monthly
Starting date	01/05/2008
Contact information	Dr Colleen Canning (c.canning@usyd.edu.au). Discipline of Physiotherapy, Faculty of Health Sciences, The University of Sydney
Notes	Australian New Zealand Clinical Trials Registry Number: ACTRN12608000303347

Ledger 2008

Trial name or title	A randomised controlled trial (RCT) to evaluate use of an auditory cueing device's (IACD's) on freezing and gait in people with Parkinson's disease (PD)
Methods	Randomised using sealed, computer-generated random numbers.
Participants	47 participants. Inclusion criteria: Parkinson's disease, medically stable, willing to give informed consent, freeze at least once per week (minimum score of 2 on item 3 of the FOGQ) for at least 2 seconds (minimum score of 1 on item 4 of FOGQ), MMSE score greater than 24 Exclusion criteria: attending physiotherapy at time of recruitment, unwilling to give informed consent, not medically stable, cognitive impairment (MMSE score less than 24), acute co-morbidity that prevents mobility

Ledger 2008 (*Continued*)

Interventions	Cross-over trial. Cueing: iPod containing and auditory cue in the form of a continuous metronome beat, individualised to the participants walking frequency (less 10%). Participants instructed to listen to cueing when performing any mobility-related tasks for 8 days Control: iPod shuffle with no music or metronome beat for 8 days
Outcomes	Freezing of Gait Questionnaire. Timed Up and Go Test. Modified Falls Efficacy Scale. 10-Metre Walk Test. Tested on day 8, 15, 23 and at 3 months.
Starting date	Study not yet open for recruitment.
Contact information	Dr Emma K Stokes (estokes@tcd.ie).
Notes	On days 1-8 of the trial both groups given an iPod with some music on to allow all participants to become familiar with the device. They will be instructed to use the device only when sitting at home and that the device should not be turned on when walking or performing any mobility related or daily tasks NCT00727467.

Martin 2009

Trial name or title	Home based rehabilitation to reduce falls in people with Parkinson's disease (PD): a randomised controlled trial
Methods	Parallel-group design.
Participants	180 participants. Inclusion criteria: Idiopathic Parkinson's disease, living in the community, Hoehn and Yahr stage 1-4 Exclusion criteria: suffer from cardiopulmonary, musculoskeletal, endocrine or other medical condition that prevents safe participation in a home exercise program, participant or their carer/family are unwilling to have therapy and assessments in their home, unable to communicate in English, have dementia score MMSE score < 24, unable to provide informed consent
Interventions	Active intervention: 6-week individualised home-based rehabilitation program comprising a once-weekly 1 hour program delivered by a trained therapist, together with a once-weekly 1 hour self-directed exercise program. The intervention is designed to provide participants with an integrated 'package' of evidence based therapy, including movement strategy training, strengthening and falls education Active control: 6-week individualised home-based 'life skills' program comprising a once-weekly 1 hour program delivered by trained therapist, together with a once-weekly self-directed life skills home program. The active control is designed to provide education on medication, managing stress, driving and other daily activities and include content related to falls, physical exercise and gait rehabilitation
Outcomes	Fall frequency and injuries*. UPDRS total and motor. PDQ-39. EuroQOL*.

Martin 2009 (*Continued*)

	Tested at baseline, 6 weeks and at 12 months. * 12 months only
Starting date	01/08/2008
Contact information	Dr C Martin (cmartin@unimelb.edu.au) Centre for Health Exercise and Sports Medicine, School of Physiotherapy, The University of Melbourne
Notes	ACTRN12608000390381

Schenkman 2009

Trial name or title	Exercise, physical function and Parkinson's disease
Methods	3-arm parallel-group design.
Participants	
Interventions	Exercise 1: General Endurance Training. Exercise 2: PD Specific Flexibility and functional training. Control: Usual care based on a booklet based on the American Parkinson Foundation
Outcomes	Continuous-Scale Physical Functional Performance Test. Functional Reach. O2 Consumption at a set walking speed. Assessed at baseline, after treatment and at 10 and 16 months
Starting date	11/04/2003
Contact information	Nancy Shinowara (shinowara@nih.gov).
Notes	Information obtained from CRISP/RePORT database.

Watts 2008

Trial name or title	A randomized controlled trial of strategy training compared to exercises to prevent falls and improve mobility in people with Parkinson's disease
Methods	3-arm parallel-group design. Randomised by telephone randomisation service.
Participants	330 participants. Inclusion criteria: Neurologist-confirmed diagnosis of idiopathic Parkinson's disease. Cognitively intact (a MMSE score of > 24). Minimum age 18 years Exclusion criteria: Other neurological disorders known to affect balance and gait. Cognitive impairment (MMSE < 24). Currently taking tranquillizer medication. Inability to walk

Watts 2008 (*Continued*)

Interventions	Movement Strategy Training (MST): once-weekly 2 hour individualised program given for 8 weeks. Program comprises of strategies to prevent falls, enhance balance and improve mobility, along with education about risk factors for falls and general education about Parkinson's disease. Participants will also receive a once-weekly individualised and structured home program to reinforce the content of each outpatient session. The person will also receive one home visit by an Occupational Therapist who will conduct a detailed environmental analysis using a standardized home assessment checklist and recommend home modifications to minimize falls risk Progressive Strength Training (PST): Once-weekly 2 hour individualised program given for 8 weeks. Program for functional strengthening of muscles such as quadriceps, hamstrings, calf, tibialis anterior, glutei, abductor and trunk muscles plus education about methods to prevent falls and general education about Parkinson's disease. Each person will receive a strength program that is tailored to their individual needs and reinforced by a once-weekly individualised and structured home program. An Occupational Therapist will perform one home visit as above Control: Once-weekly 2 hour outpatient social activity program (games, crafts, cooking, general education about Parkinson's) delivered by an Occupational Therapist over 8 weeks. Participants will also receive a once-weekly individualised and structured home program of activities. During the program the person will receive one home visit by a nurse to check on general well-being, mobility or physical function
Outcomes	Falls frequency*. Walking speed over 10 metres. Locomotor function (Timed up and go test). Activity limitation. Measured at 3 and 12 months, *12months only.
Starting date	25/09/2006
Contact information	Professor M Morris (m.morris@unimelb.edu.au). School of Physiotherapy University of Melbourne.
Notes	ACTRN12606000344594

Woo 2010

Trial name or title	The effectiveness of physiotherapy interventions for patients with Parkinson's disease
Methods	2 arm Parallel-group design
Participants	Estimated enrolment: 112 Inclusion criteria: Stable medication usage. Hoehn and Yahr stage II to IV. At least 1 score of 2 or more for at least 1 limb of either the tremor, rigidity, or bradykinesia item of the Unified Parkinson's Disease Rating Scale (UPDRS). Able to walk independently. No severe cognitive impairments (Mini-Mental State Examination - Chinese Cantonese version) score greater than 24 Exclusion criteria: Other severe neurological, cardiopulmonary, or orthopedic disorders. Having participated in a physiotherapy or rehabilitation program in previous 2 months
Interventions	Physiotherapy intervention: Physiotherapy interventions including strengthening exercise, balance training, gait training with visual cue, gait training with treadmill Education intervention: Education classes.

Woo 2010 (*Continued*)

Outcomes	Movement Disorder Society-Unified Parkinson's Disease Rating Scale Levodopa equivalent daily dosage (LEDD) Timed Up and Go Test Activities-Specific Balance Confidence Scale (Chinese Version) Parkinson's Disease Questionnaire (Standard Chinese Version) Number of injurious falls.
Starting date	03/2010
Contact information	CW Woo (woocx@ha.org.hk).
Notes	NCT01076712

DATA AND ANALYSES

Comparison 1. Gait Outcomes

Outcome or subgroup title	No. of studies	No. of participants	Statistical method	Effect size
1 2- or 6- Minute Walk Test (m)	4	172	Mean Difference (IV, Fixed, 95% CI)	16.40 [1.90, 30.90]
1.1 Exercise v Control	3	98	Mean Difference (IV, Fixed, 95% CI)	10.14 [-5.70, 25.97]
1.2 Dance v Control	1	48	Mean Difference (IV, Fixed, 95% CI)	61.7 [-4.95, 128.35]
1.3 Martial Arts v Control	1	26	Mean Difference (IV, Fixed, 95% CI)	43.6 [0.71, 86.49]
2 10- or 20- m Walk Test (s)	4	169	Mean Difference (IV, Fixed, 95% CI)	0.40 [0.00, 0.80]
2.1 Exercise v Control	3	145	Mean Difference (IV, Fixed, 95% CI)	0.41 [0.02, 0.81]
2.2 Treadmill v Control	1	24	Mean Difference (IV, Fixed, 95% CI)	-0.8 [-4.41, 2.81]
3 Velocity (m/s)	11	629	Mean Difference (IV, Fixed, 95% CI)	0.05 [0.02, 0.07]
3.1 General Physiotherapy v Control	3	137	Mean Difference (IV, Fixed, 95% CI)	0.09 [0.01, 0.17]
3.2 Exercise v Control	4	146	Mean Difference (IV, Fixed, 95% CI)	0.03 [-0.01, 0.07]
3.3 Treadmill v Control	2	38	Mean Difference (IV, Fixed, 95% CI)	0.07 [-0.07, 0.21]
3.4 Cueing v Control	4	234	Mean Difference (IV, Fixed, 95% CI)	0.06 [0.02, 0.09]
3.5 Dance v Control	1	48	Mean Difference (IV, Fixed, 95% CI)	0.03 [-0.16, 0.22]
3.6 Martial Arts v Control	1	26	Mean Difference (IV, Fixed, 95% CI)	-0.09 [-0.22, 0.04]
4 Cadence (steps/min)	6	327	Mean Difference (IV, Fixed, 95% CI)	-1.72 [-4.01, 0.58]
4.1 General Physiotherapy v Control	1	20	Mean Difference (IV, Fixed, 95% CI)	-2.40 [-11.12, 6.32]
4.2 Exercise v Control	2	68	Mean Difference (IV, Fixed, 95% CI)	-1.70 [-6.30, 2.90]
4.3 Treadmill v Control	2	38	Mean Difference (IV, Fixed, 95% CI)	-0.04 [-6.48, 6.39]
4.4 Cueing v Control	3	201	Mean Difference (IV, Fixed, 95% CI)	-2.03 [-5.11, 1.05]
5 Stride Length (m)	5	202	Mean Difference (IV, Fixed, 95% CI)	0.03 [-0.02, 0.09]
5.1 General Physiotherapy v Control	1	20	Mean Difference (IV, Fixed, 95% CI)	-0.02 [-0.19, 0.15]
5.2 Exercise v Control	1	22	Mean Difference (IV, Fixed, 95% CI)	0.17 [-0.03, 0.37]
5.3 Treadmill v Control	2	38	Mean Difference (IV, Fixed, 95% CI)	0.03 [-0.07, 0.14]
5.4 Cueing v Control	2	48	Mean Difference (IV, Fixed, 95% CI)	0.09 [-0.02, 0.20]
5.5 Dance v Control	1	48	Mean Difference (IV, Fixed, 95% CI)	0.07 [-0.10, 0.24]
5.6 Martial Arts v Control	1	26	Mean Difference (IV, Fixed, 95% CI)	-0.1 [-0.23, 0.03]
6 Step Length (m)	3	239	Mean Difference (IV, Fixed, 95% CI)	0.03 [8.27, 0.06]
6.1 General Physiotherapy v Control	1	20	Mean Difference (IV, Fixed, 95% CI)	-0.02 [-0.10, 0.06]
6.2 Exercise v Control	1	46	Mean Difference (IV, Fixed, 95% CI)	0.03 [-0.04, 0.09]
6.3 Treadmill v Control	1	20	Mean Difference (IV, Fixed, 95% CI)	0.01 [-0.08, 0.10]
6.4 Cueing v Control	1	153	Mean Difference (IV, Fixed, 95% CI)	0.04 [0.01, 0.07]
7 Freezing of Gait Questionnaire	3	246	Mean Difference (IV, Fixed, 95% CI)	-1.19 [-2.54, 0.16]
7.1 Exercise v Control	1	45	Mean Difference (IV, Fixed, 95% CI)	-2.40 [-5.76, 0.96]
7.2 Cueing v Control	1	153	Mean Difference (IV, Fixed, 95% CI)	-0.87 [-2.43, 0.69]
7.3 Dance v Control	1	48	Mean Difference (IV, Fixed, 95% CI)	-1.7 [-6.30, 2.90]

Comparison 2. Functional Mobility and Balance Outcomes

Outcome or subgroup title	No. of studies	No. of participants	Statistical method	Effect size
1 Timed Up & Go (s)	7	495	Mean Difference (IV, Fixed, 95% CI)	-0.61 [-1.06, -0.17]
1.1 Exercise v Control	5	268	Mean Difference (IV, Fixed, 95% CI)	-0.22 [-0.93, 0.50]
1.2 Dance v Control	1	48	Mean Difference (IV, Fixed, 95% CI)	-3.10 [-7.76, 1.56]
1.3 Cueing v Control	1	153	Mean Difference (IV, Fixed, 95% CI)	-0.25 [-1.90, 1.40]
1.4 Martial Arts v Control	1	26	Mean Difference (IV, Fixed, 95% CI)	-0.9 [-1.50, -0.30]
2 Functional Reach (cm)	4	393	Mean Difference (IV, Fixed, 95% CI)	2.16 [0.89, 3.43]
2.1 Exercise v Control	3	240	Mean Difference (IV, Fixed, 95% CI)	2.46 [0.94, 3.97]
2.2 Cueing v Control	1	153	Mean Difference (IV, Fixed, 95% CI)	1.46 [-0.88, 3.80]
3 Berg Balance Scale	4	361	Mean Difference (IV, Fixed, 95% CI)	3.36 [1.91, 4.81]
3.1 Exercise v Control	2	256	Mean Difference (IV, Fixed, 95% CI)	1.59 [-0.90, 4.07]
3.2 Treadmill v Control	1	31	Mean Difference (IV, Fixed, 95% CI)	8.29 [1.07, 15.51]
3.3 Dance v Control	1	48	Mean Difference (IV, Fixed, 95% CI)	5.15 [0.42, 9.88]
3.4 Martial Arts v Control	1	26	Mean Difference (IV, Fixed, 95% CI)	3.80 [1.81, 5.79]
4 Activity Specific Balance Confidence	3	66	Mean Difference (IV, Fixed, 95% CI)	2.40 [-2.78, 7.57]
4.1 Exercise v Control	2	38	Mean Difference (IV, Fixed, 95% CI)	3.63 [-2.09, 9.36]
4.2 Cueing v Control	1	28	Mean Difference (IV, Fixed, 95% CI)	-3.1 [-15.18, 8.98]

Comparison 3. Falls

Outcome or subgroup title	No. of studies	No. of participants	Statistical method	Effect size
1 Falls Efficacy Scale	4	353	Mean Difference (IV, Fixed, 95% CI)	-1.91 [-4.76, 0.94]
1.1 Exercise v Control	3	200	Mean Difference (IV, Fixed, 95% CI)	-2.53 [-5.55, 0.48]
1.2 Cueing v Control	1	153	Mean Difference (IV, Fixed, 95% CI)	3.32 [-5.38, 12.02]

Comparison 4. Clinician-Rated Disability

Outcome or subgroup title	No. of studies	No. of participants	Statistical method	Effect size
1 UPDRS - Total	2	105	Mean Difference (IV, Fixed, 95% CI)	-4.46 [-7.16, -1.75]
1.1 General Physiotherapy v Control	2	85	Mean Difference (IV, Fixed, 95% CI)	-4.84 [-7.63, -2.04]
1.2 Treadmill v Control	1	20	Mean Difference (IV, Fixed, 95% CI)	1.1 [-9.60, 11.80]
2 UPDRS - Mental	2	105	Mean Difference (IV, Fixed, 95% CI)	-0.44 [-0.98, 0.09]
2.1 General Physiotherapy v Control	2	85	Mean Difference (IV, Fixed, 95% CI)	-0.47 [-1.05, 0.11]
2.2 Treadmill v Control	1	20	Mean Difference (IV, Fixed, 95% CI)	-0.3 [-1.64, 1.04]
3 UPDRS - ADL	3	157	Mean Difference (IV, Fixed, 95% CI)	-1.36 [-2.41, -0.30]

3.1 General Physiotherapy v Control	2	85	Mean Difference (IV, Fixed, 95% CI)	-1.62 [-2.77, -0.47]
3.2 Treadmill v Control	1	20	Mean Difference (IV, Fixed, 95% CI)	1.50 [-1.81, 4.81]
3.3 Dance v Control	1	52	Mean Difference (IV, Fixed, 95% CI)	-2.50 [-6.83, 1.83]
4 UPDRS - Motor	9	431	Mean Difference (IV, Fixed, 95% CI)	-4.09 [-5.59, -2.59]
4.1 General Physiotherapy v Control	3	137	Mean Difference (IV, Fixed, 95% CI)	-3.08 [-5.24, -0.92]
4.2 Exercise v Control	1	46	Mean Difference (IV, Fixed, 95% CI)	-4.9 [-9.51, -0.29]
4.3 Treadmill v Control	1	20	Mean Difference (IV, Fixed, 95% CI)	-0.10 [-7.96, 7.76]
4.4 Cueing v Control	2	50	Mean Difference (IV, Fixed, 95% CI)	-4.58 [-9.02, -0.15]
4.5 Dance v Control	2	100	Mean Difference (IV, Fixed, 95% CI)	-6.17 [-10.52, -1.83]
4.6 Martial Arts v Control	2	78	Mean Difference (IV, Fixed, 95% CI)	-5.82 [-9.79, -1.85]

Comparison 5. Patient-Rated Quality of Life

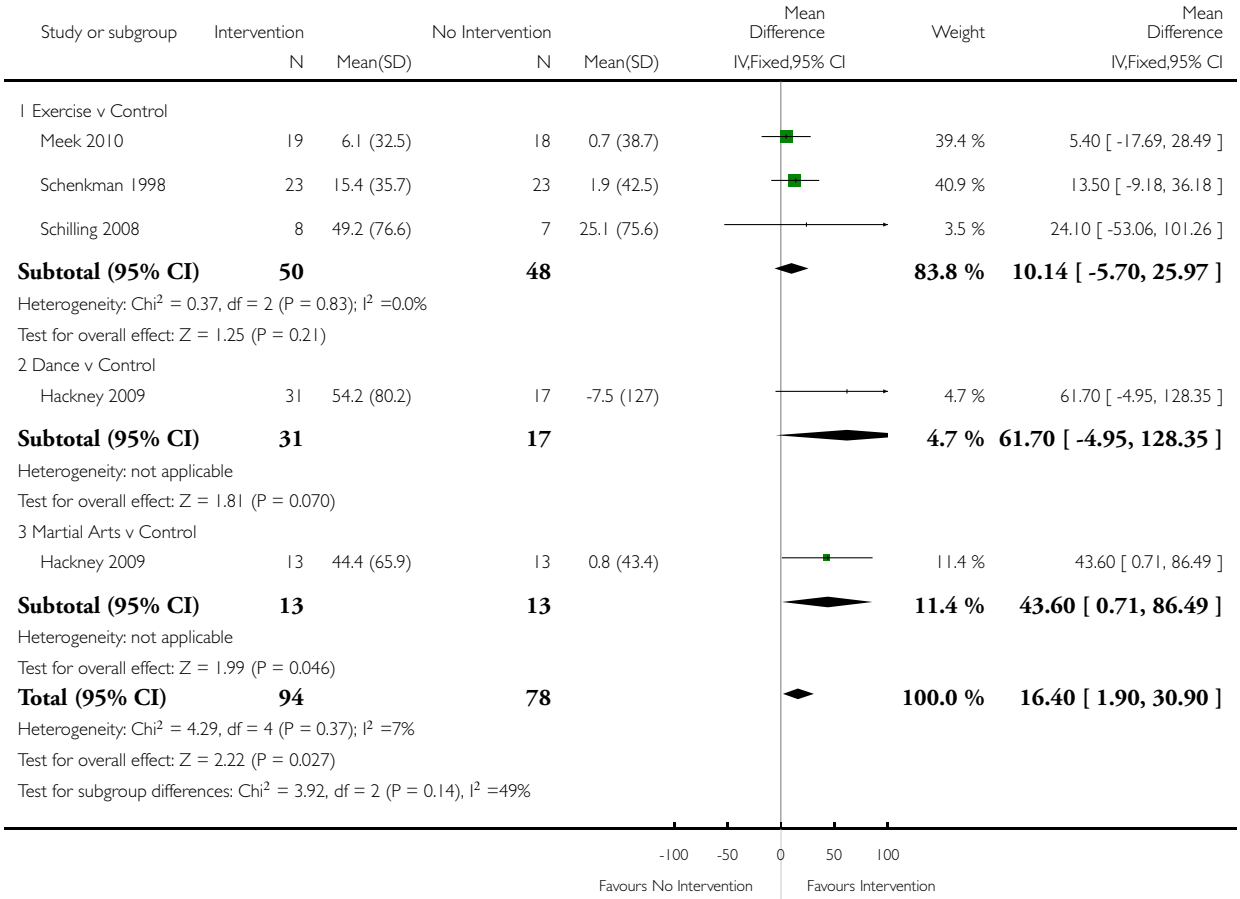
Outcome or subgroup title	No. of studies	No. of participants	Statistical method	Effect size
1 PDQ-39 Summary Index	6	387	Mean Difference (IV, Fixed, 95% CI)	-0.35 [-2.66, 1.96]
1.1 General Physiotherapy v Control	1	52	Mean Difference (IV, Fixed, 95% CI)	0.68 [-6.84, 8.20]
1.2 Exercise v Control	3	104	Mean Difference (IV, Fixed, 95% CI)	0.32 [-3.83, 4.48]
1.3 Cueing v Control	1	153	Mean Difference (IV, Fixed, 95% CI)	-1.58 [-5.45, 2.29]
1.4 Dance v Control	1	48	Mean Difference (IV, Fixed, 95% CI)	-2.34 [-8.83, 4.15]
1.5 Martial Arts v Control	1	30	Mean Difference (IV, Fixed, 95% CI)	3.05 [-3.81, 9.91]
2 PDQ-39 Mobility	2	105	Mean Difference (IV, Fixed, 95% CI)	-1.43 [-8.03, 5.18]
2.1 General Physiotherapy v Control	1	27	Mean Difference (IV, Fixed, 95% CI)	6.23 [-3.85, 16.31]
2.2 Dance v Control	1	48	Mean Difference (IV, Fixed, 95% CI)	-10.41 [-22.50, 1.68]
2.3 Martial Arts v Control	1	30	Mean Difference (IV, Fixed, 95% CI)	-3.65 [-16.30, 9.00]

Analysis 1.1. Comparison 1 Gait Outcomes, Outcome 1 2- or 6- Minute Walk Test (m).

Review: Physiotherapy versus placebo or no intervention in Parkinson's disease

Comparison: 1 Gait Outcomes

Outcome: 1 2- or 6- Minute Walk Test (m)

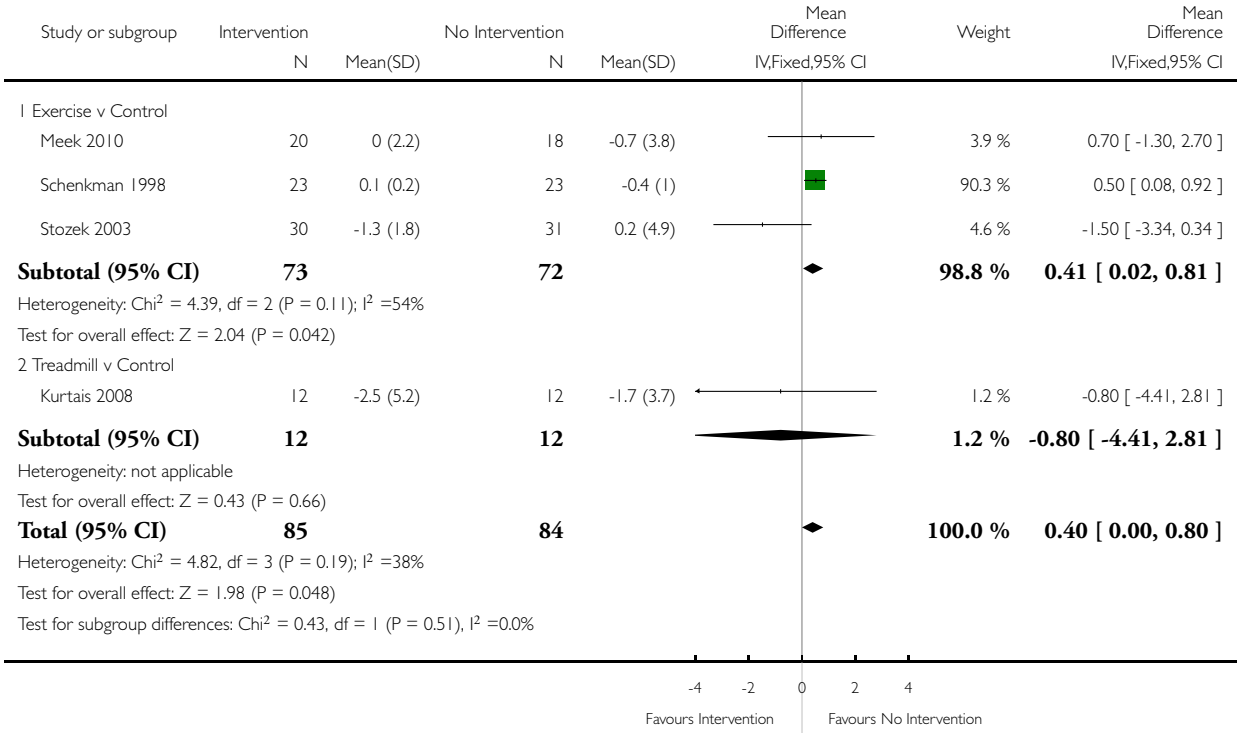


Analysis 1.2. Comparison 1 Gait Outcomes, Outcome 2 10- or 20- m Walk Test (s).

Review: Physiotherapy versus placebo or no intervention in Parkinson's disease

Comparison: 1 Gait Outcomes

Outcome: 2 10- or 20- m Walk Test (s)



Analysis 1.3. Comparison 1 Gait Outcomes, Outcome 3 Velocity (m/s).

Review: Physiotherapy versus placebo or no intervention in Parkinson's disease

Comparison: 1 Gait Outcomes

Outcome: 3 Velocity (m/s)

Study or subgroup	Intervention N	Mean(SD)	No Intervention N	Mean(SD)	Mean Difference IV,Fixed,95% CI	Weight	Mean Difference IV,Fixed,95% CI
1 General Physiotherapy v Control							
Chandler 1999	26	0.13 (0.36)	26	0.1 (0.3)		1.7 %	0.03 [-0.15, 0.21]
Ellis 2005	32	0.16 (0.22)	33	0.01 (0.21)		5.2 %	0.15 [0.05, 0.25]
Fisher 2008	10	0.02 (0.18)	10	0.02 (0.17)		2.4 %	0.0 [-0.15, 0.15]
Subtotal (95% CI)	**68**		**69**			**9.3 %**	**0.09 [0.01, 0.17]**
Heterogeneity: Chi^2 = 3.01, df = 2 (P = 0.22); I^2 =34%							
Test for overall effect: Z = 2.23 (P = 0.025)							
2 Exercise v Control							
Allen 2010	21	0.02 (0.27)	24	0.02 (0.29)		2.1 %	0.0 [-0.16, 0.16]
Mak 2008	19	0.02 (0.08)	14	0 (0.06)		24.9 %	0.02 [-0.03, 0.07]
Sage 2009a	31	0.06 (0.2)	15	0 (0.22)		3.3 %	0.06 [-0.07, 0.20]
Thaut 1996	11	0.07 (0.18)	11	-0.05 (0.27)		1.5 %	0.12 [-0.07, 0.31]
Subtotal (95% CI)	**82**		**64**			**31.8 %**	**0.03 [-0.01, 0.07]**
Heterogeneity: Chi^2 = 1.39, df = 3 (P = 0.71); I^2 =0.0%							
Test for overall effect: Z = 1.30 (P = 0.19)							
3 Treadmill v Control							
Fisher 2008	10	0.06 (0.2)	10	0.02 (0.17)		2.1 %	0.04 [-0.12, 0.20]
Protas 2005	9	0.17 (0.35)	9	0.01 (0.23)		0.8 %	0.16 [-0.11, 0.43]
Subtotal (95% CI)	**19**		**19**			**2.9 %**	**0.07 [-0.07, 0.21]**
Heterogeneity: Chi^2 = 0.55, df = 1 (P = 0.46); I^2 =0.0%							
Test for overall effect: Z = 1.00 (P = 0.32)							
4 Cueing v Control							
de Bruin 2010a	11	0.03 (0.22)	11	-0.02 (0.17)		2.1 %	0.05 [-0.11, 0.21]
Mak 2008	19	0.05 (0.06)	14	0 (0.06)		33.0 %	0.05 [0.01, 0.09]
Nieuwboer 2007	76	0.08 (0.16)	77	0.02 (0.23)		14.4 %	0.06 [0.00, 0.12]
Thaut 1996	15	0.16 (0.22)	11	-0.05 (0.27)		1.5 %	0.21 [0.02, 0.40]
Subtotal (95% CI)	**121**		**113**			**51.1 %**	**0.06 [0.02, 0.09]**
Heterogeneity: Chi^2 = 2.50, df = 3 (P = 0.48); I^2 =0.0%							
Test for overall effect: Z = 3.38 (P = 0.00072)							
5 Dance v Control							

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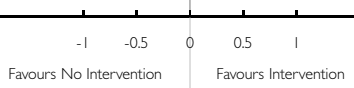
Study or subgroup	Intervention N	Mean(SD)	No Intervention N	Mean(SD)	Mean Difference IV,Fixed,95% CI	Weight	Mean Difference IV,Fixed,95% CI
Hackney 2009	31	0.05 (0.2)	17	0.02 (0.38)		1.5 %	0.03 [-0.16, 0.22]
Subtotal (95% CI)	**31**		**17**			**1.5 %**	**0.03 [-0.16, 0.22]**
Heterogeneity: not applicable							
Test for overall effect: Z = 0.30 (P = 0.76)							
6 Martial Arts v Control							
Hackney 2009	13	0.01 (0.21)	13	0.1 (0.11)		3.4 %	-0.09 [-0.22, 0.04]
Subtotal (95% CI)	**13**		**13**			**3.4 %**	**-0.09 [-0.22, 0.04]**
Heterogeneity: not applicable							
Test for overall effect: Z = 1.37 (P = 0.17)							
Total (95% CI)	**334**		**295**			**100.0 %**	**0.05 [0.02, 0.07]**
Heterogeneity: Chi^2 = 14.19, df = 14 (P = 0.44); I^2 =1%							
Test for overall effect: Z = 3.79 (P = 0.00015)							
Test for subgroup differences: Chi^2 = 6.75, df = 5 (P = 0.24), I^2 =26%							

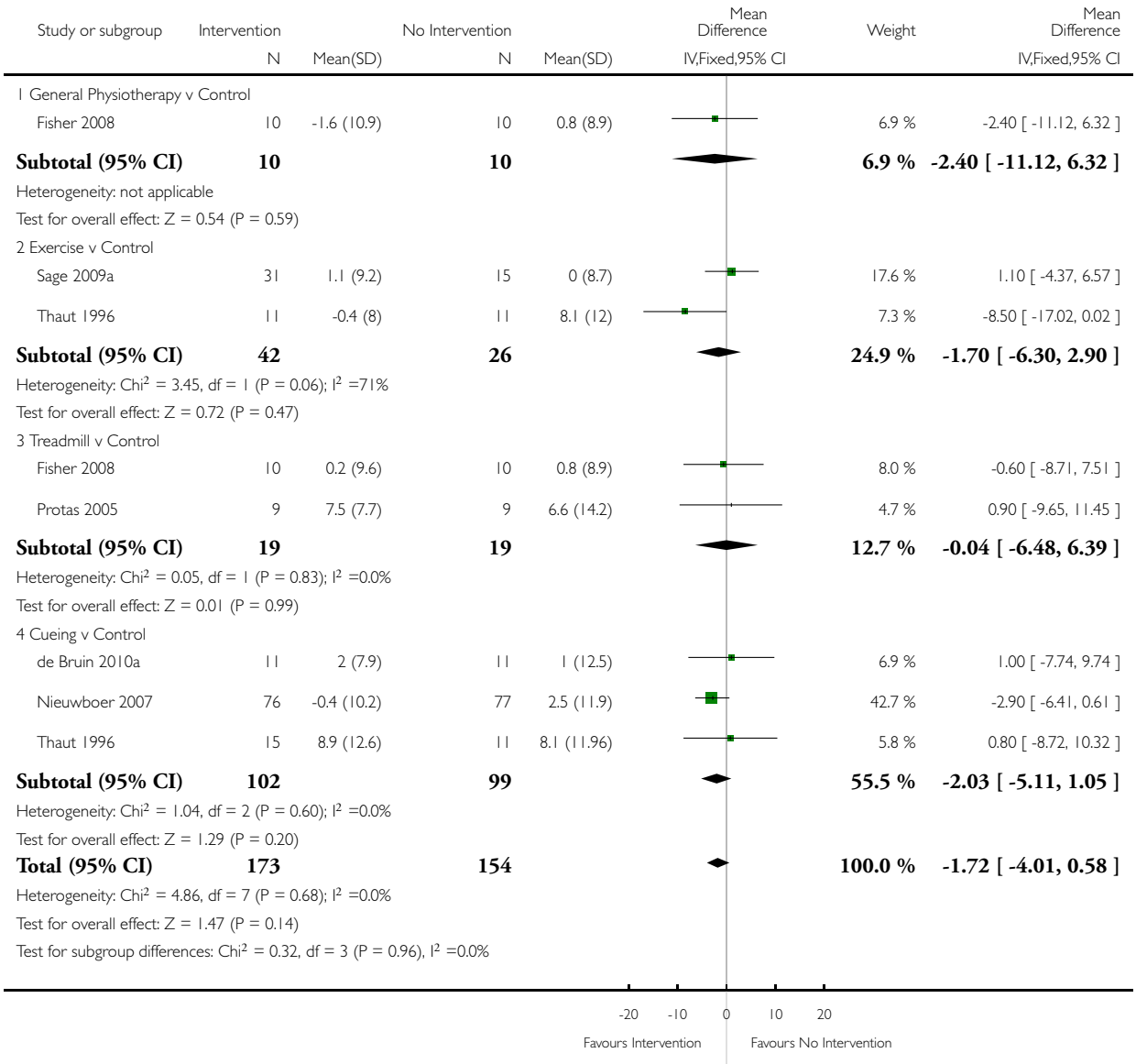


Analysis 1.4. Comparison 1 Gait Outcomes, Outcome 4 Cadence (steps/min).

Review: Physiotherapy versus placebo or no intervention in Parkinson's disease

Comparison: 1 Gait Outcomes

Outcome: 4 Cadence (steps/min)



Analysis 1.5. Comparison 1 Gait Outcomes, Outcome 5 Stride Length (m).

Review: Physiotherapy versus placebo or no intervention in Parkinson's disease

Comparison: 1 Gait Outcomes

Outcome: 5 Stride Length (m)

Study or subgroup	Intervention N	Mean(SD)	No Intervention N	Mean(SD)	Mean Difference IV,Fixed,95% CI	Weight	Mean Difference IV,Fixed,95% CI
1 General Physiotherapy v Control							
Fisher 2008	10	0.02 (0.15)	10	0.04 (0.23)		10.7 %	-0.02 [-0.19, 0.15]
Subtotal (95% CI)	**10**		**10**			**10.7 %**	**-0.02 [-0.19, 0.15]**
Heterogeneity: not applicable							
Test for overall effect: Z = 0.23 (P = 0.82)							
2 Exercise v Control							
Thaut 1996	11	0.08 (0.19)	11	-0.09 (0.29)		7.4 %	0.17 [-0.03, 0.37]
Subtotal (95% CI)	**11**		**11**			**7.4 %**	**0.17 [-0.03, 0.37]**
Heterogeneity: not applicable							
Test for overall effect: Z = 1.63 (P = 0.10)							
3 Treadmill v Control							
Fisher 2008	10	0.06 (0.17)	10	0.04 (0.23)		9.8 %	0.02 [-0.16, 0.20]
Protas 2005	9	0.04 (0.15)	9	0 (0.13)		18.4 %	0.04 [-0.09, 0.17]
Subtotal (95% CI)	**19**		**19**			**28.2 %**	**0.03 [-0.07, 0.14]**
Heterogeneity: Chi^2 = 0.03, df = 1 (P = 0.86); I^2 =0.0%							
Test for overall effect: Z = 0.62 (P = 0.54)							
4 Cueing v Control							
de Bruin 2010a	11	0.01 (0.18)	11	-0.03 (0.14)		17.0 %	0.04 [-0.09, 0.17]
Thaut 1996	15	0.11 (0.18)	11	-0.09 (0.29)		8.2 %	0.20 [0.01, 0.39]
Subtotal (95% CI)	**26**		**22**			**25.2 %**	**0.09 [-0.02, 0.20]**
Heterogeneity: Chi^2 = 1.76, df = 1 (P = 0.18); I^2 =43%							
Test for overall effect: Z = 1.63 (P = 0.10)							
5 Dance v Control							
Hackney 2009	31	0.05 (0.2)	17	-0.02 (0.33)		10.5 %	0.07 [-0.10, 0.24]
Subtotal (95% CI)	**31**		**17**			**10.5 %**	**0.07 [-0.10, 0.24]**
Heterogeneity: not applicable							
Test for overall effect: Z = 0.80 (P = 0.42)							
6 Martial Arts v Control							
Hackney 2009	13	-0.1 (0.23)	13	0 (0.07)		18.1 %	-0.10 [-0.23, 0.03]
Subtotal (95% CI)	**13**		**13**			**18.1 %**	**-0.10 [-0.23, 0.03]**
Heterogeneity: not applicable							
Test for overall effect: Z = 1.50 (P = 0.13)							

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Study or subgroup	Intervention N	Mean(SD)	No Intervention N	Mean(SD)	Mean Difference IV,Fixed,95% CI	Weight	Mean Difference IV,Fixed,95% CI
Total (95% CI)	**110**		**92**			**100.0 %**	**0.03 [-0.02, 0.09]**
Heterogeneity: Chi² = 9.13, df = 7 (P = 0.24); I² =23%							
Test for overall effect: Z = 1.13 (P = 0.26)							
Test for subgroup differences: Chi² = 7.34, df = 5 (P = 0.20), I² =32%							

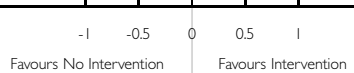
Analysis 1.6. Comparison 1 Gait Outcomes, Outcome 6 Step Length (m).

Review: Physiotherapy versus placebo or no intervention in Parkinson's disease

Comparison: 1 Gait Outcomes

Outcome: 6 Step Length (m)

Study or subgroup	Intervention N	Mean(SD)	No Intervention N	Mean(SD)	Mean Difference IV,Fixed,95% CI	Weight	Mean Difference IV,Fixed,95% CI
1 General Physiotherapy v Control							
Fisher 2008	10	0.01 (0.08)	10	0.03 (0.11)		10.7 %	-0.02 [-0.10, 0.06]
Subtotal (95% CI)	**10**		**10**			**10.7 %**	**-0.02 [-0.10, 0.06]**
Heterogeneity: not applicable							
Test for overall effect: Z = 0.46 (P = 0.64)							
2 Exercise v Control							
Sage 2009a	31	0.03 (0.1)	15	0 (0.11)		17.5 %	0.03 [-0.04, 0.09]
Subtotal (95% CI)	**31**		**15**			**17.5 %**	**0.03 [-0.04, 0.09]**
Heterogeneity: not applicable							
Test for overall effect: Z = 0.80 (P = 0.42)							
3 Treadmill v Control							
Fisher 2008	10	0.04 (0.09)	10	0.03 (0.11)		9.8 %	0.01 [-0.08, 0.10]
Subtotal (95% CI)	**10**		**10**			**9.8 %**	**0.01 [-0.08, 0.10]**
Heterogeneity: not applicable							
Test for overall effect: Z = 0.22 (P = 0.82)							
4 Cueing v Control							
Nieuwboer 2007	76	0.04 (0.1)	77	0 (0.12)		62.0 %	0.04 [0.01, 0.07]



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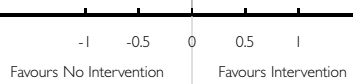
Study or subgroup	Intervention N	Mean(SD)	No Intervention N	Mean(SD)	Mean Difference IV,Fixed,95% CI	Weight	Mean Difference IV,Fixed,95% CI
Subtotal (95% CI)	**76**		**77**			**62.0 %**	**0.04 [0.01, 0.07]**
Heterogeneity: not applicable							
Test for overall effect: Z = 2.24 (P = 0.025)							
Total (95% CI)	**127**		**112**			**100.0 %**	**0.03 [0.00, 0.06]**
Heterogeneity: Chi^2 = 1.86, df = 3 (P = 0.60); I^2 =0.0%							
Test for overall effect: Z = 2.02 (P = 0.044)							
Test for subgroup differences: Chi^2 = 1.86, df = 3 (P = 0.60), I^2 =0.0%							



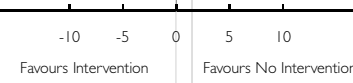
Analysis 1.7. Comparison 1 Gait Outcomes, Outcome 7 Freezing of Gait Questionnaire.

Review: Physiotherapy versus placebo or no intervention in Parkinson's disease

Comparison: 1 Gait Outcomes

Outcome: 7 Freezing of Gait Questionnaire

Study or subgroup	Experimental N	Mean(SD)	Control N	Mean(SD)	Mean Difference IV,Fixed,95% CI	Weight	Mean Difference IV,Fixed,95% CI
1 Exercise v Control							
Allen 2010	21	-1.3 (5.5)	24	1.1 (6)		16.2 %	-2.40 [-5.76, 0.96]
Subtotal (95% CI)	**21**		**24**			**16.2 %**	**-2.40 [-5.76, 0.96]**
Heterogeneity: not applicable							
Test for overall effect: Z = 1.40 (P = 0.16)							
2 Cueing v Control							
Nieuwboer 2007	76	-0.95 (4.74)	77	-0.08 (5.09)		75.2 %	-0.87 [-2.43, 0.69]
Subtotal (95% CI)	**76**		**77**			**75.2 %**	**-0.87 [-2.43, 0.69]**
Heterogeneity: not applicable							
Test for overall effect: Z = 1.09 (P = 0.27)							
3 Dance v Control							
Hackney 2009	31	-0.5 (5)	17	1.2 (8.95)		8.6 %	-1.70 [-6.30, 2.90]
Subtotal (95% CI)	**31**		**17**			**8.6 %**	**-1.70 [-6.30, 2.90]**
Heterogeneity: not applicable							
Test for overall effect: Z = 0.72 (P = 0.47)							



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Study or subgroup	Experimental N	Mean(SD)	Control N	Mean(SD)	Mean Difference IV,Fixed,95% CI	Weight	Mean Difference IV,Fixed,95% CI
Total (95% CI)	**128**		**118**			**100.0 %**	**-1.19 [-2.54, 0.16]**
Heterogeneity: Chi² = 0.71, df = 2 (P = 0.70); I² =0.0%							
Test for overall effect: Z = 1.72 (P = 0.085)							
Test for subgroup differences: Chi² = 0.71, df = 2 (P = 0.70), I² =0.0%							

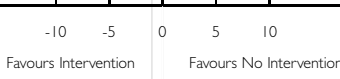
Analysis 2.1. Comparison 2 Functional Mobility and Balance Outcomes, Outcome 1 Timed Up & Go (s).

Review: Physiotherapy versus placebo or no intervention in Parkinson's disease

Comparison: 2 Functional Mobility and Balance Outcomes

Outcome: 1 Timed Up % Go (s)

Study or subgroup	Intervention N	Mean(SD)	No Intervention N	Mean(SD)	Mean Difference IV,Fixed,95% CI	Weight	Mean Difference IV,Fixed,95% CI
1 Exercise v Control							
Goodwin 2009	61	0.13 (11.09)	62	-0.48 (13.92)		1.0 %	0.61 [-3.83, 5.05]
Klassen 2007	17	-1.3 (2.5)	6	-0.2 (1.85)		5.4 %	-1.10 [-3.00, 0.80]
Sage 2009a	31	-0.6 (2.21)	15	0 (2.33)		9.8 %	-0.60 [-2.01, 0.81]
Schilling 2008	8	-0.1 (0.7)	7	-0.75 (1.2)		19.0 %	0.65 [-0.36, 1.66]
Stozek 2003	30	-2.36 (2.63)	31	1.1 (7.15)		2.7 %	-3.46 [-6.15, -0.77]
Subtotal (95% CI)	**147**		**121**			**37.9 %**	**-0.22 [-0.93, 0.50]**
Heterogeneity: Chi² = 9.66, df = 4 (P = 0.05); I² =59%							
Test for overall effect: Z = 0.59 (P = 0.55)							
2 Dance v Control							
Hackney 2009	31	-1.1 (4.31)	17	2 (9.28)		0.9 %	-3.10 [-7.76, 1.56]
Subtotal (95% CI)	**31**		**17**			**0.9 %**	**-3.10 [-7.76, 1.56]**
Heterogeneity: not applicable							
Test for overall effect: Z = 1.30 (P = 0.19)							
3 Cueing v Control							
Nieuwboer 2007	76	-1.59 (4.59)	77	-1.34 (5.78)		7.1 %	-0.25 [-1.90, 1.40]



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Study or subgroup	Intervention N	Mean(SD)	No Intervention N	Mean(SD)	Mean Difference IV,Fixed,95% CI	Weight	Mean Difference IV,Fixed,95% CI
Subtotal (95% CI)	**76**		**77**			**7.1 %**	**-0.25 [-1.90, 1.40]**
Heterogeneity: not applicable							
Test for overall effect: Z = 0.30 (P = 0.77)							
4 Martial Arts v Control							
Hackney 2009	13	-1 (0.1)	13	-0.1 (1.1)		54.1 %	-0.90 [-1.50, -0.30]
Subtotal (95% CI)	**13**		**13**			**54.1 %**	**-0.90 [-1.50, -0.30]**
Heterogeneity: not applicable							
Test for overall effect: Z = 2.94 (P = 0.0033)							
Total (95% CI)	**267**		**228**			**100.0 %**	**-0.61 [-1.06, -0.17]**
Heterogeneity: Chi^2 = 12.99, df = 7 (P = 0.07); I^2 =46%							
Test for overall effect: Z = 2.73 (P = 0.0064)							
Test for subgroup differences: Chi^2 = 3.33, df = 3 (P = 0.34), I^2 =10%							

Analysis 2.2. Comparison 2 Functional Mobility and Balance Outcomes, Outcome 2 Functional Reach (cm).

Review: Physiotherapy versus placebo or no intervention in Parkinson's disease

Comparison: 2 Functional Mobility and Balance Outcomes

Outcome: 2 Functional Reach (cm)

Study or subgroup	Intervention N	Mean(SD)	No Intervention N	Mean(SD)	Mean Difference IV,Fixed,95% CI	Weight	Mean Difference IV,Fixed,95% CI
1 Exercise v Control							
Ashburn 2007	67	0.4 (6.56)	66	-1 (7)		30.3 %	1.40 [-0.91, 3.71]
Schenkman 1998	23	1.57 (4.45)	23	-0.28 (4.17)		26.0 %	1.85 [-0.64, 4.34]
Stozek 2003	30	5.8 (6.01)	31	-0.03 (7.38)		14.2 %	5.83 [2.46, 9.20]
Subtotal (95% CI)	**120**		**120**			**70.5 %**	**2.46 [0.94, 3.97]**
Heterogeneity: Chi^2 = 4.88, df = 2 (P = 0.09); I^2 =59%							
Test for overall effect: Z = 3.18 (P = 0.0015)							
2 Cueing v Control							
Nieuwboer 2007	76	1.8 (5.28)	77	0.34 (9.02)		29.5 %	1.46 [-0.88, 3.80]

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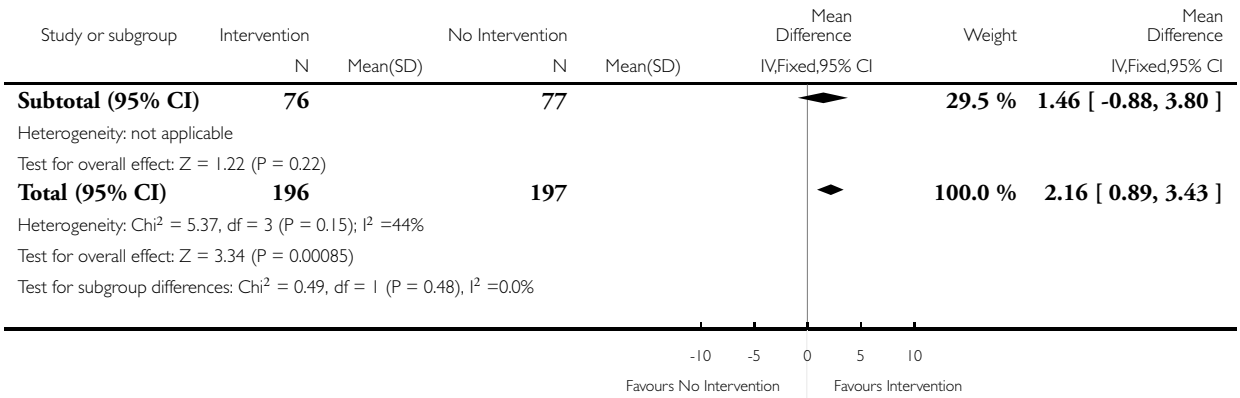
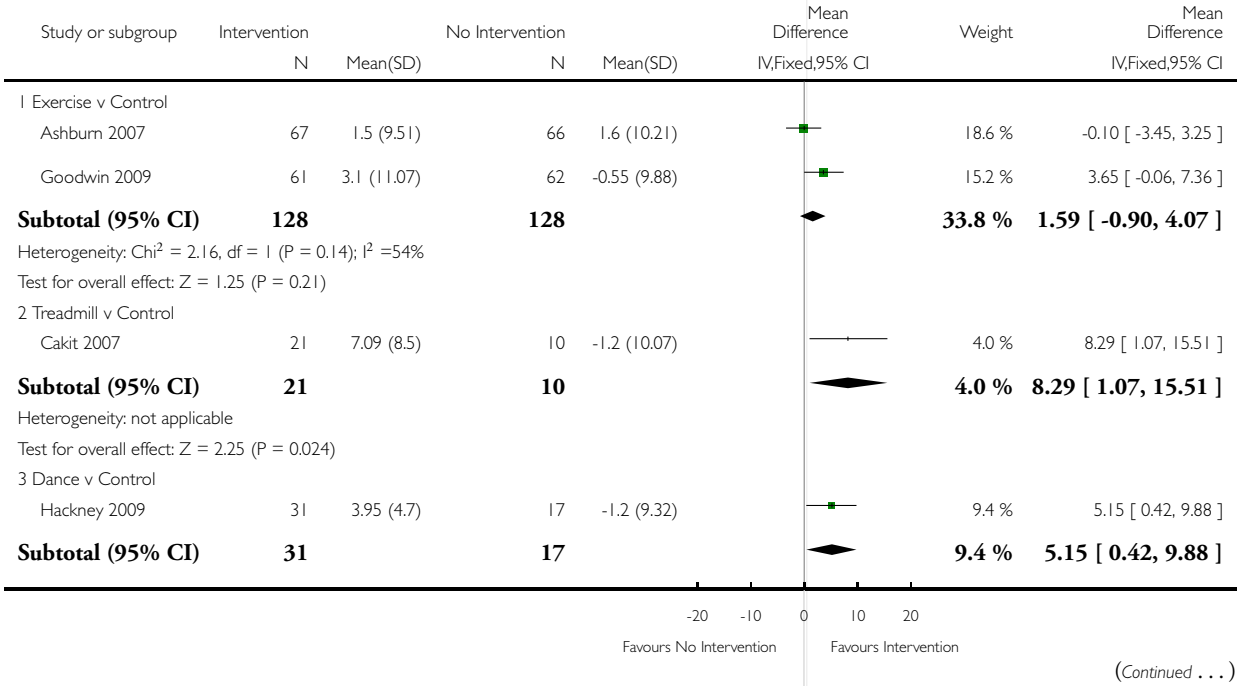


Analysis 2.3. Comparison 2 Functional Mobility and Balance Outcomes, Outcome 3 Berg Balance Scale.

Review: Physiotherapy versus placebo or no intervention in Parkinson's disease

Comparison: 2 Functional Mobility and Balance Outcomes

Outcome: 3 Berg Balance Scale



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Study or subgroup	Intervention N	Mean(SD)	No Intervention N	Mean(SD)	Mean Difference IV,Fixed,95% CI	Weight	Mean Difference IV,Fixed,95% CI
Heterogeneity: not applicable							
Test for overall effect: Z = 2.13 (P = 0.033)							
4 Martial Arts v Control							
Hackney 2009	13	3.3 (3)	13	-0.5 (2.1)		52.8 %	3.80 [1.81, 5.79]
Subtotal (95% CI)	**13**		**13**			**52.8 %**	**3.80 [1.81, 5.79]**
Heterogeneity: not applicable							
Test for overall effect: Z = 3.74 (P = 0.00018)							
Total (95% CI)	**193**		**168**			**100.0 %**	**3.36 [1.91, 4.81]**
Heterogeneity: Chi^2 = 6.64, df = 4 (P = 0.16); I^2 =40%							
Test for overall effect: Z = 4.55 (P < 0.00001)							
Test for subgroup differences: Chi^2 = 4.48, df = 3 (P = 0.21), I^2 =33%							

Analysis 2.4. Comparison 2 Functional Mobility and Balance Outcomes, Outcome 4 Activity Specific Balance Confidence.

Review: Physiotherapy versus placebo or no intervention in Parkinson's disease

Comparison: 2 Functional Mobility and Balance Outcomes

Outcome: 4 Activity Specific Balance Confidence

Study or subgroup	Intervention N	Mean(SD)	No Intervention N	Mean(SD)	Mean Difference IV,Fixed,95% CI	Weight	Mean Difference IV,Fixed,95% CI
1 Exercise v Control							
Klassen 2007	17	1.75 (6.76)	6	-1.7 (6.87)		66.0 %	3.45 [-2.92, 9.82]
Schilling 2008	8	3.3 (8.35)	7	-1.1 (15.85)		15.6 %	4.40 [-8.69, 17.49]
Subtotal (95% CI)	**25**		**13**			**81.6 %**	**3.63 [-2.09, 9.36]**
Heterogeneity: Chi^2 = 0.02, df = 1 (P = 0.90); I^2 =0.0%							
Test for overall effect: Z = 1.24 (P = 0.21)							
2 Cueing v Control							
Shankar 2008	14	-2.1 (16.5)	14	1 (16.1)		18.4 %	-3.10 [-15.18, 8.98]
Subtotal (95% CI)	**14**		**14**			**18.4 %**	**-3.10 [-15.18, 8.98]**
Heterogeneity: not applicable							

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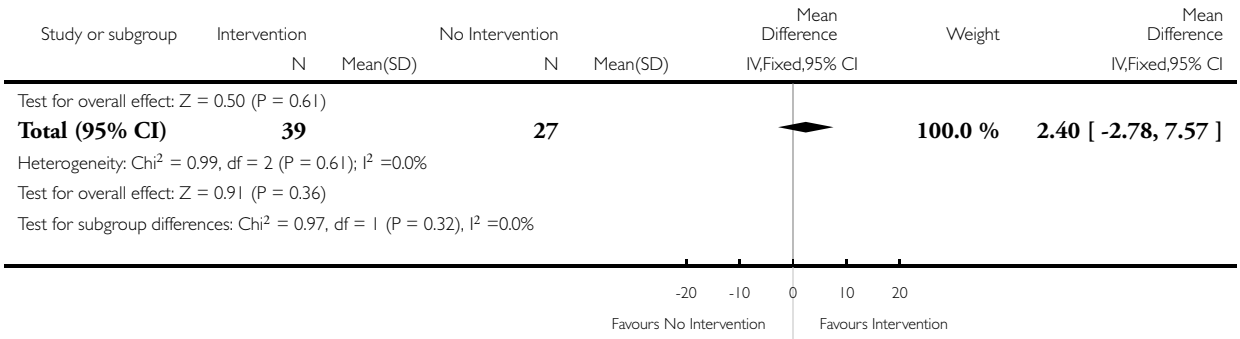
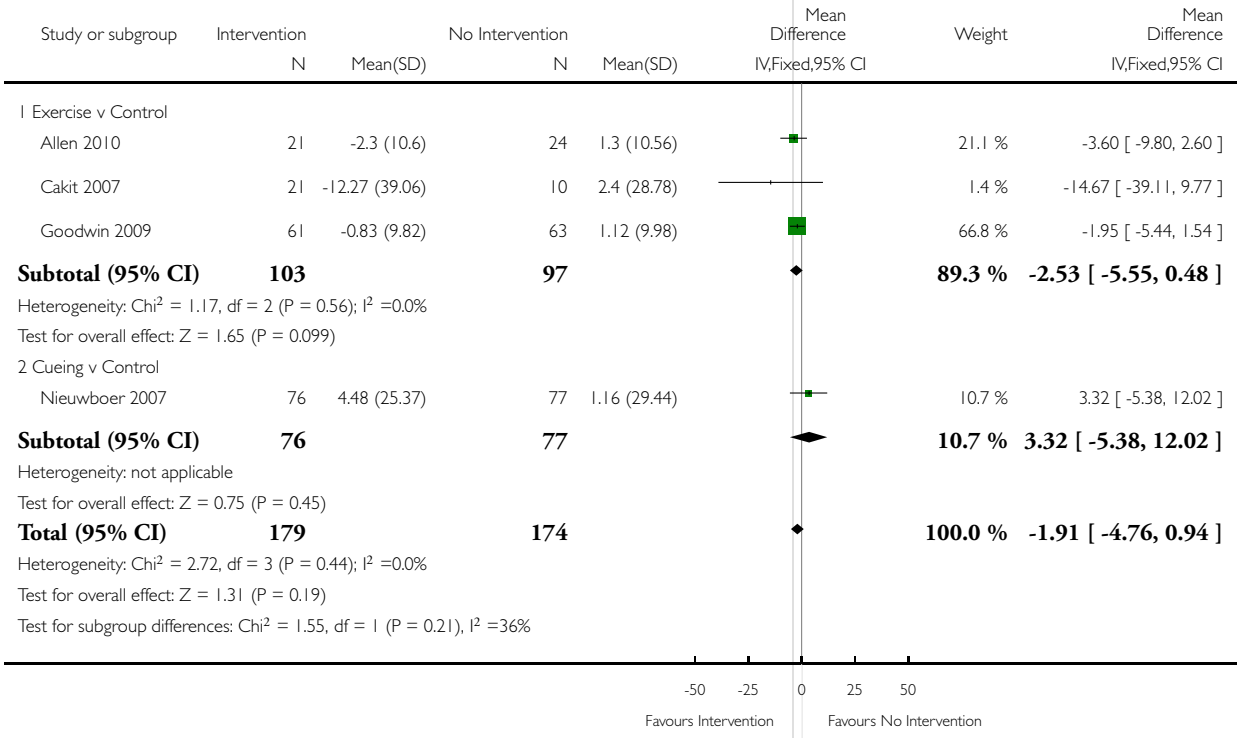


Analysis 3.1. Comparison 3 Falls, Outcome 1 Falls Efficacy Scale.

Review: Physiotherapy versus placebo or no intervention in Parkinson's disease

Comparison: 3 Falls

Outcome: 1 Falls Efficacy Scale

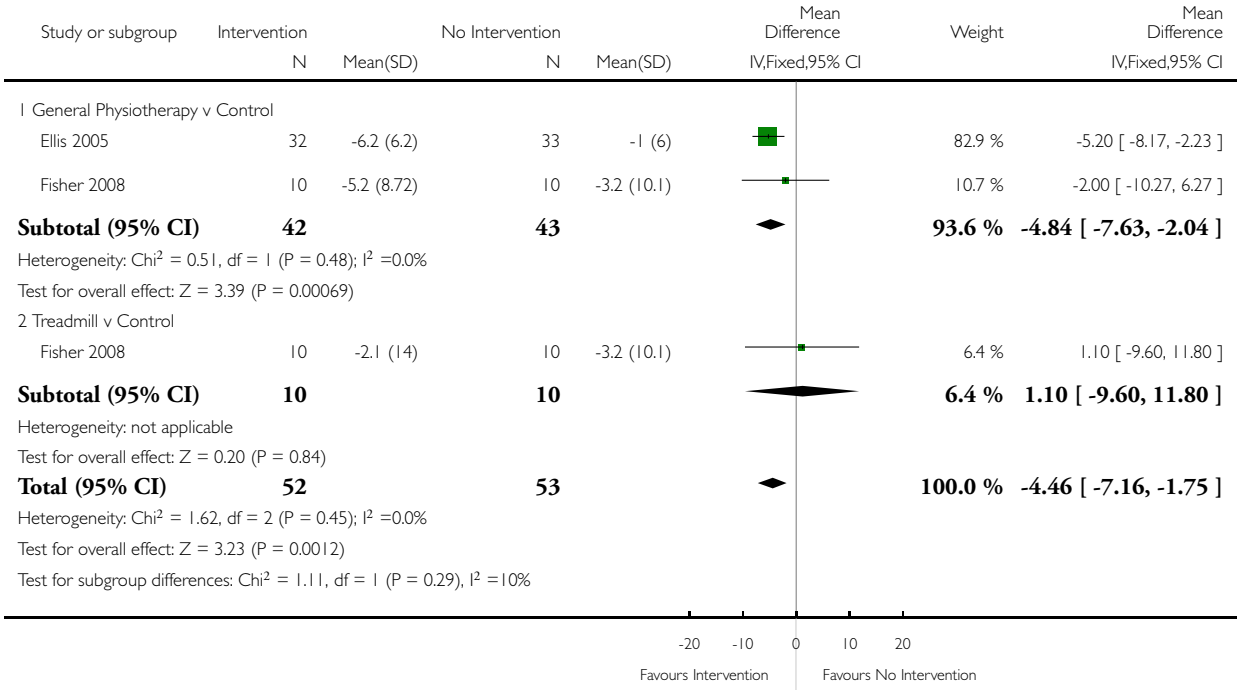


Analysis 4.1. Comparison 4 Clinician-Rated Disability, Outcome 1 UPDRS - Total.

Review: Physiotherapy versus placebo or no intervention in Parkinson's disease

Comparison: 4 Clinician-Rated Disability

Outcome: 1 UPDRS - Total



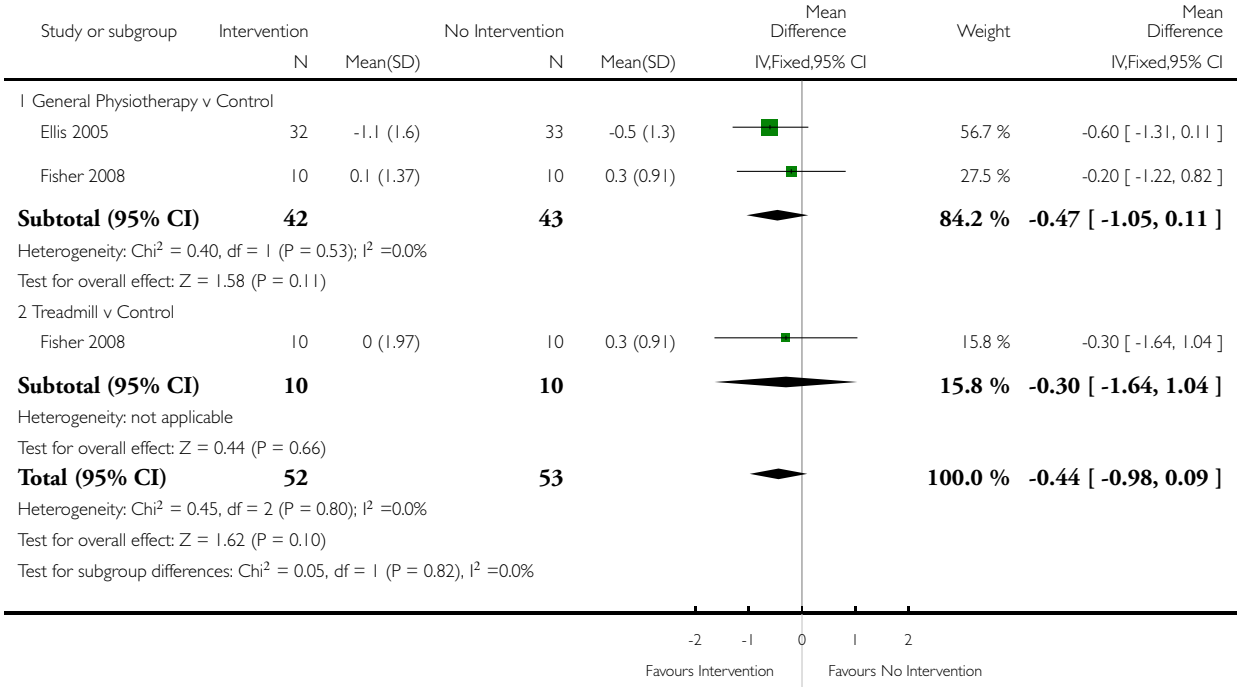
Analysis 4.2. Comparison 4 Clinician-Rated Disability, Outcome 2 UPDRS - Mental.

Review: Physiotherapy versus placebo or no intervention in Parkinson's disease

Comparison: 4 Clinician-Rated Disability

Outcome: 2 UPDRS - Mental

Study or subgroup	Intervention N	Mean(SD)	No Intervention N	Mean(SD)	Mean Difference IV,Fixed,95% CI	Weight	Mean Difference IV,Fixed,95% CI
1 General Physiotherapy v Control							
Ellis 2005	32	-1.1 (1.6)	33	-0.5 (1.3)		56.7 %	-0.60 [-1.31, 0.11]
Fisher 2008	10	0.1 (1.37)	10	0.3 (0.91)		27.5 %	-0.20 [-1.22, 0.82]
Subtotal (95% CI)	**42**		**43**			**84.2 %**	**-0.47 [-1.05, 0.11]**
Heterogeneity: Chi^2 = 0.40, df = 1 (P = 0.53); I^2 =0.0%							
Test for overall effect: Z = 1.58 (P = 0.11)							
2 Treadmill v Control							
Fisher 2008	10	0 (1.97)	10	0.3 (0.91)		15.8 %	-0.30 [-1.64, 1.04]
Subtotal (95% CI)	**10**		**10**			**15.8 %**	**-0.30 [-1.64, 1.04]**
Heterogeneity: not applicable							
Test for overall effect: Z = 0.44 (P = 0.66)							
Total (95% CI)	**52**		**53**			**100.0 %**	**-0.44 [-0.98, 0.09]**
Heterogeneity: Chi^2 = 0.45, df = 2 (P = 0.80); I^2 =0.0%							
Test for overall effect: Z = 1.62 (P = 0.10)							
Test for subgroup differences: Chi^2 = 0.05, df = 1 (P = 0.82), I^2 =0.0%							

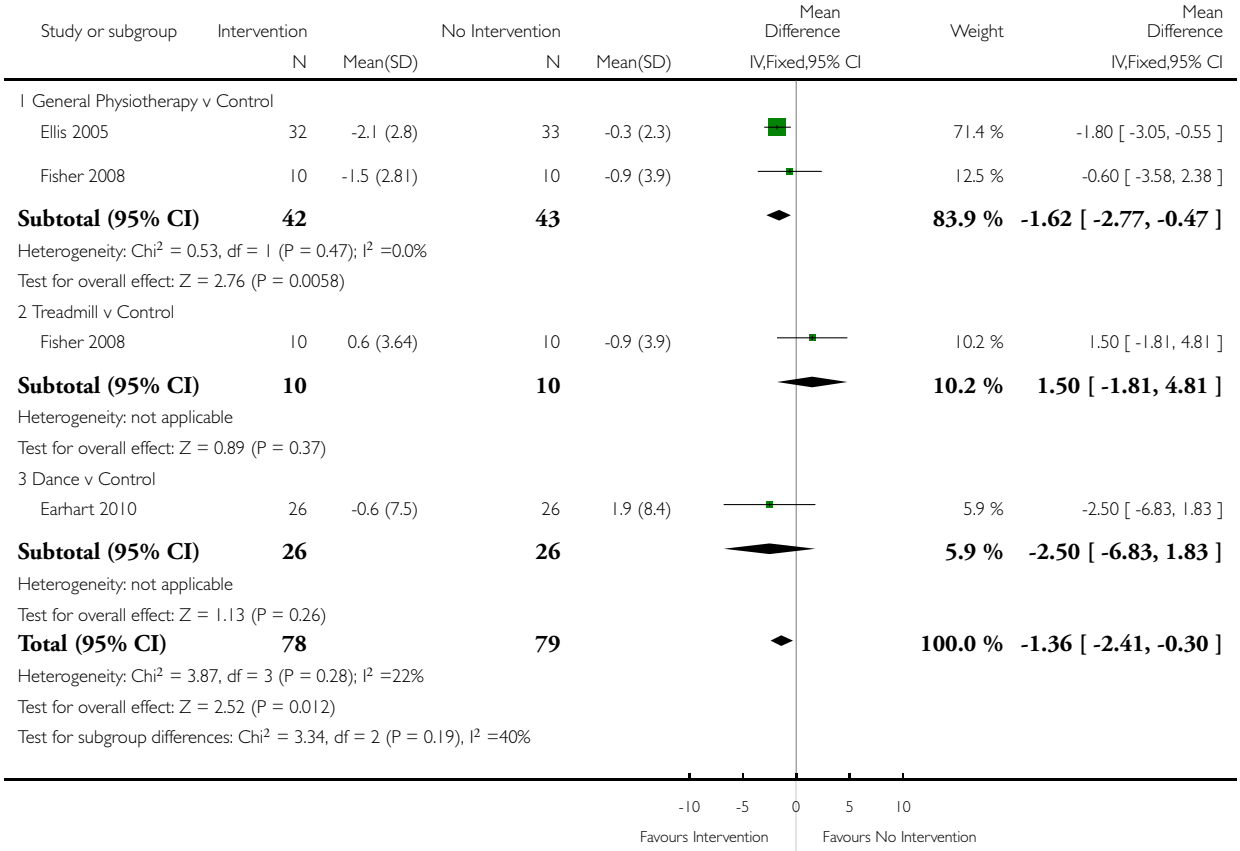


Analysis 4.3. Comparison 4 Clinician-Rated Disability, Outcome 3 UPDRS - ADL.

Review: Physiotherapy versus placebo or no intervention in Parkinson's disease

Comparison: 4 Clinician-Rated Disability

Outcome: 3 UPDRS - ADL



Analysis 4.4. Comparison 4 Clinician-Rated Disability, Outcome 4 UPDRS - Motor.

Review: Physiotherapy versus placebo or no intervention in Parkinson's disease

Comparison: 4 Clinician-Rated Disability

Outcome: 4 UPDRS - Motor

Study or subgroup	Intervention N	Mean(SD)	No Intervention N	Mean(SD)	Mean Difference IV,Fixed,95% CI	Weight	Mean Difference IV,Fixed,95% CI
1 General Physiotherapy v Control							
Chandler 1999	26	-1 (7)	26	3 (6.24)		17.3 %	-4.00 [-7.60, -0.40]
Ellis 2005	32	-3 (6.6)	33	-0.2 (5.3)		26.5 %	-2.80 [-5.72, 0.12]
Fisher 2008	10	-3.8 (8.17)	10	-2.7 (8.15)		4.4 %	-1.10 [-8.25, 6.05]
Subtotal (95% CI)	**68**		**69**			**48.1 %**	**-3.08 [-5.24, -0.92]**
Heterogeneity: Chi^2 = 0.58, df = 2 (P = 0.75); I^2 =0.0%							
Test for overall effect: Z = 2.79 (P = 0.0053)							
2 Exercise v Control							
Sage 2009a	31	-3.7 (6.72)	15	1.2 (7.81)		10.6 %	-4.90 [-9.51, -0.29]
Subtotal (95% CI)	**31**		**15**			**10.6 %**	**-4.90 [-9.51, -0.29]**
Heterogeneity: not applicable							
Test for overall effect: Z = 2.08 (P = 0.037)							
3 Treadmill v Control							
Fisher 2008	10	-2.8 (9.72)	10	-2.7 (8.15)		3.6 %	-0.10 [-7.96, 7.76]
Subtotal (95% CI)	**10**		**10**			**3.6 %**	**-0.10 [-7.96, 7.76]**
Heterogeneity: not applicable							
Test for overall effect: Z = 0.02 (P = 0.98)							
4 Cueing v Control							
de Bruin 2010a	11	-5.6 (9.17)	11	-1.8 (6.53)		5.1 %	-3.80 [-10.45, 2.85]
Shankar 2008	14	-4 (8.29)	14	1.21 (7.75)		6.4 %	-5.21 [-11.15, 0.73]
Subtotal (95% CI)	**25**		**25**			**11.4 %**	**-4.58 [-9.02, -0.15]**
Heterogeneity: Chi^2 = 0.10, df = 1 (P = 0.76); I^2 =0.0%							
Test for overall effect: Z = 2.03 (P = 0.043)							
5 Dance v Control							
Earhart 2010	26	-5.4 (11.9)	26	-0.1 (10.3)		6.1 %	-5.30 [-11.35, 0.75]
Hackney 2009	31	-2.1 (10.96)	17	5 (10.33)		5.8 %	-7.10 [-13.34, -0.86]
Subtotal (95% CI)	**57**		**43**			**11.9 %**	**-6.17 [-10.52, -1.83]**
Heterogeneity: Chi^2 = 0.16, df = 1 (P = 0.68); I^2 =0.0%							
Test for overall effect: Z = 2.78 (P = 0.0054)							
6 Martial Arts v Control							
Hackney 2009	13	-1.5 (6.6)	13	4.3 (5.6)		10.2 %	-5.80 [-10.51, -1.09]

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Study or subgroup	Intervention N	Mean(SD)	No Intervention N	Mean(SD)	Mean Difference IV,Fixed,95% CI	Weight	Mean Difference IV,Fixed,95% CI
Schmitz-Hubsch 2006	31	-0.32 (10.9)	21	5.54 (14.77)		4.1 %	-5.86 [-13.25, 1.53]
Subtotal (95% CI)	**44**		**34**			**14.3 %**	**-5.82 [-9.79, -1.85]**
Heterogeneity: Chi² = 0.00, df = 1 (P = 0.99); I² =0.0%							
Test for overall effect: Z = 2.87 (P = 0.0041)							
Total (95% CI)	**235**		**196**			**100.0 %**	**-4.09 [-5.59, -2.59]**
Heterogeneity: Chi² = 4.45, df = 10 (P = 0.92); I² =0.0%							
Test for overall effect: Z = 5.35 (P < 0.00001)							
Test for subgroup differences: Chi² = 3.61, df = 5 (P = 0.61), I² =0.0%							

Analysis 5.1. Comparison 5 Patient-Rated Quality of Life, Outcome 1 PDQ-39 Summary Index.

Review: Physiotherapy versus placebo or no intervention in Parkinson's disease

Comparison: 5 Patient-Rated Quality of Life

Outcome: 1 PDQ-39 Summary Index

Study or subgroup	Intervention N	Mean(SD)	No Intervention N	Mean(SD)	Mean Difference IV,Fixed,95% CI	Weight	Mean Difference IV,Fixed,95% CI
1 General Physiotherapy v Control							
Chandler 1999	26	4 (14.94)	26	3.32 (12.65)		9.4 %	0.68 [-6.84, 8.20]
Subtotal (95% CI)	**26**		**26**			**9.4 %**	**0.68 [-6.84, 8.20]**
Heterogeneity: not applicable							
Test for overall effect: Z = 0.18 (P = 0.86)							
2 Exercise v Control							
Allen 2010	21	-1 (14.3)	24	4.9 (26.7)		3.5 %	-5.90 [-18.21, 6.41]
Klassen 2007	17	0.25 (4.06)	6	-1 (5.54)		22.9 %	1.25 [-3.58, 6.08]
Meek 2010	19	-2.6 (15.6)	17	-3.1 (17.42)		4.5 %	0.50 [-10.35, 11.35]
Subtotal (95% CI)	**57**		**47**			**30.9 %**	**0.32 [-3.83, 4.48]**
Heterogeneity: Chi² = 1.12, df = 2 (P = 0.57); I² =0.0%							
Test for overall effect: Z = 0.15 (P = 0.88)							
3 Cueing v Control							

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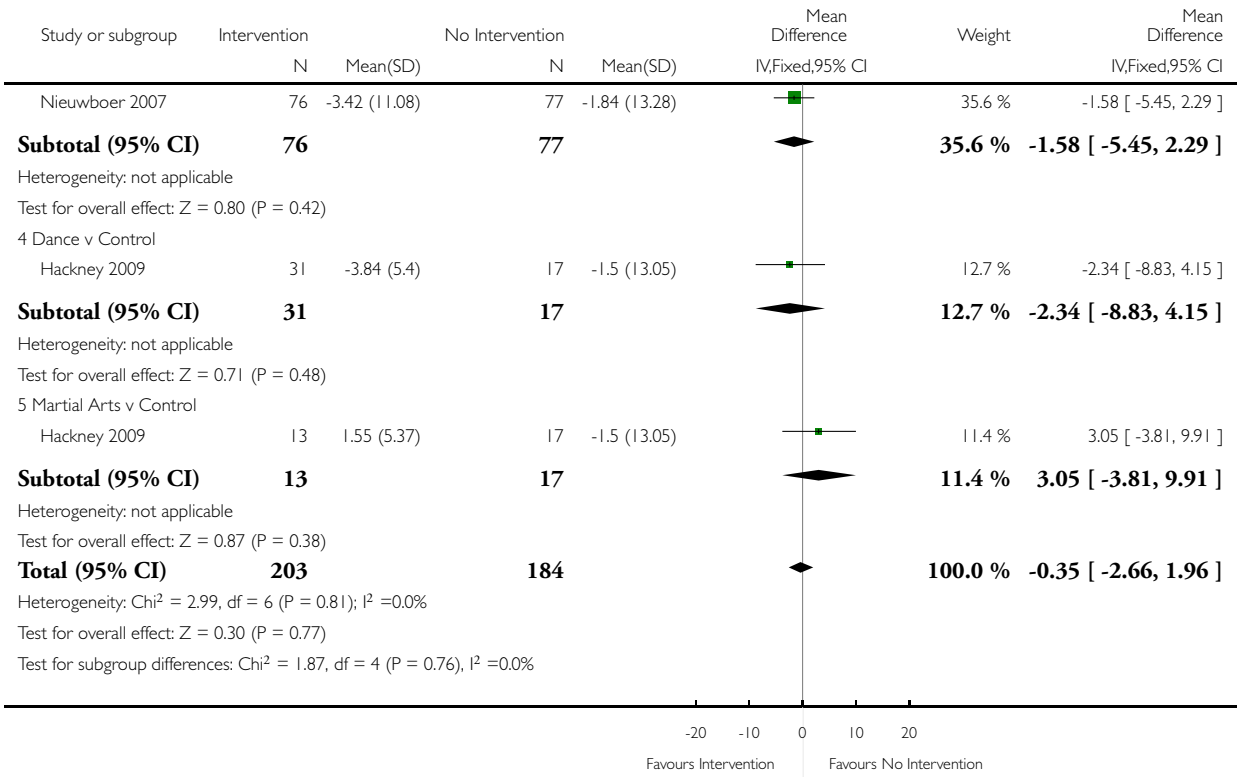
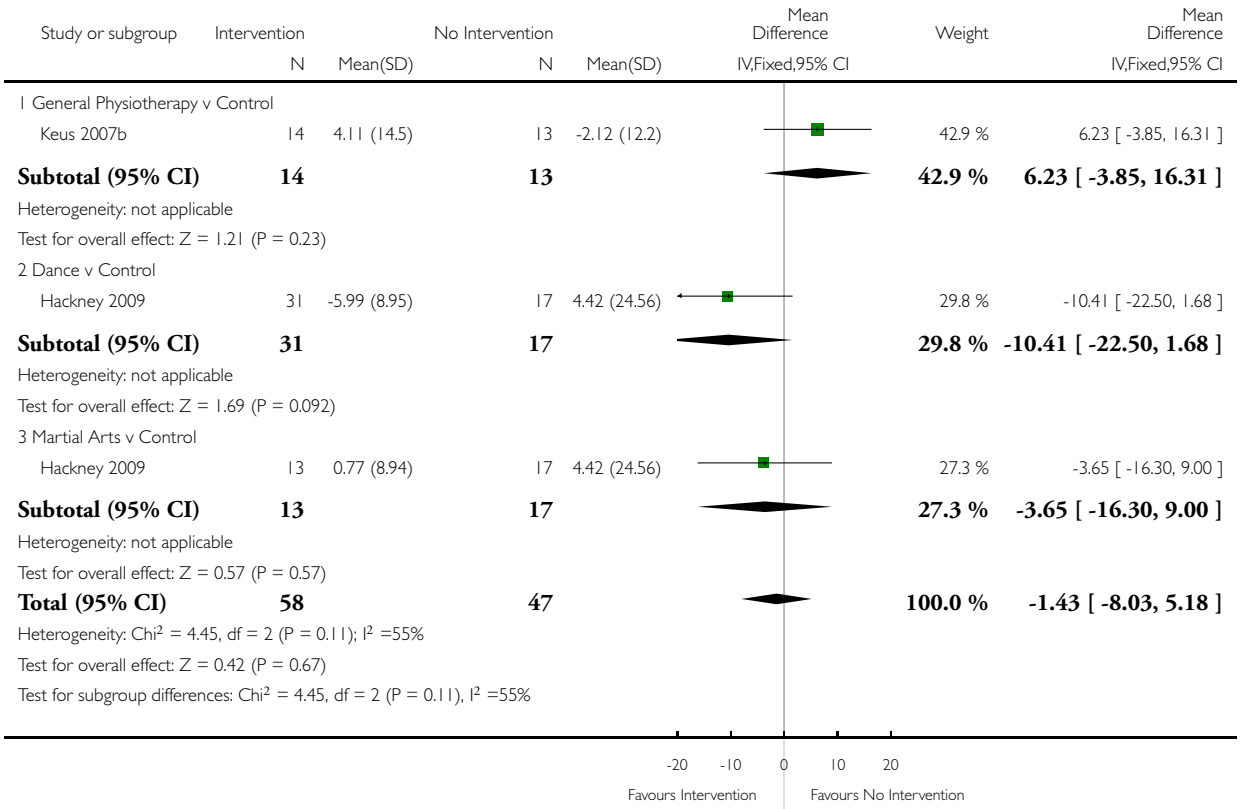


Analysis 5.2. Comparison 5 Patient-Rated Quality of Life, Outcome 2 PDQ-39 Mobility.

Review: Physiotherapy versus placebo or no intervention in Parkinson's disease

Comparison: 5 Patient-Rated Quality of Life

Outcome: 2 PDQ-39 Mobility



ADDITIONAL TABLES

Table 1. Key Characteristics of Studies

Study	Number Randomised	Mean Age (yrs)	Mean Hoehn & Yahr Stage	Duration of Disease (yrs)	% Male	Duration of Treatment	Design	Location	Type of Treatment
Allen 2010	48	67		8	54	48-72hrs/ 24 weeks	Parallel	Outpatient	Exercise
Ashburn 2007	142	72.15	3.13	8.35	61	42hrs/6 weeks	Parallel	Home	Exercise

Table 1. Key Characteristics of Studies (*Continued*)

Cakit 2007	54	71.8		5.58	52	30 mins sessions/ 8 weeks	Parallel	Outpatient	Treadmill
Canning 2008	20	61				9-12hrs/6 weeks	Parallel	Home	Treadmill
Cerri 1994	6					15hrs/3 weeks	Parallel	Outpatient/Home	Exercise
Chandler 1999	67	65.5	2.6		60	5 times/52 weeks	Parallel	Home	Physio
de Bruin 2010a	22	65.6	2.2	5.5	50	18hrs/12 weeks	Parallel	Outpatient	Cueing
de Bruin 2010b	13					3 per week/ 13 weeks	Parallel	Outpatient	Cueing
Earhart 2010	62	70.3	2.5		56	24hrs/2 weeks	Parallel		Dance
Ellis 2005	68	64	2.4		75	18hrs/6 weeks	Cross-over	Outpatient	Physio
Fisher 2008	30	62.9	1.9	1.1	63	24 sessions/ 8 weeks	Parallel	Outpatient	Treadmill/ Physio
Ganesan 2010	20					8hrs/4 weeks	Parallel	Outpatient	Treadmill
Goodwin 2009	130	71.1	2.5	8.7	57	10 weeks	Parallel	Outpatient	Exercise
Hackney 2009	75	66.6	2.1	7.7	74	20hrs/13 weeks	Parallel	Outpatient	Dance/ Martial Arts
Homann 1998	15					14 units/5 weeks	Parallel	Outpatient	Physio
Keus 2007	27	67.95	2.4	6.5	81	1 or 2 per week/ 10 weeks	Parallel	Outpatient	Physio
Klassen 2007	26	66.2	1.6	4.7	74	15-30hrs/ 12 weeks	Parallel	Outpatient	Exercise
Kurtais 2008	27	64.75	2.1	5	50	12hrs/6 weeks	Parallel	Outpatient	Treadmill

Table 1. Key Characteristics of Studies (*Continued*)

Lehman 2005	11	75.8		6.5	73	5 per week/ 2 weeks	Parallel	Outpatient	Cueing
Mak 2008	60	64	2.7	6		4-6hrs/4 weeks	Parallel	Outpatient	Cueing/ Exercise
Marjama-Lyons 2002	30					24hrs/12 weeks	Parallel	Outpatient	Martial Arts
Meek 2010	39	64.2		4.9	79	12 weeks	Parallel	Outpatient	Exercise
Nieuw-boer 2007	153	67.1	2.8	7.5	58	4.5hrs/3 weeks	Cross-over	Home	Cueing
Protas 2005	18	72.5	2.9	7.6	100	24hrs/8 weeks	Parallel	Outpatient	Treadmill
Purchas 2007	20	70	2.15		61	12hrs/12 weeks	Cross-over		Martial Arts
Sage 2009a	53	66		3.5	54	18-24hrs/ 10-12 weeks	Parallel	Outpatient	Exercise
Schenkman 1998	51	70.9	2.7		74	22.5-30rs/ 10 weeks	Parallel	Outpatient	Exercise
Schilling 2008	18	59.2	2		61	2 per week/ 8 weeks	Parallel	Outpatient	Exercise
Schmitz-Hubsch 2006	56	63.5		5.8	77	16hrs/24 weeks	Parallel	Outpatient	Martial Arts
Shankar 2008	28	66	2.4	7.7	50	18hrs/12 weeks	Parallel	Outpatient	Cueing
Shankar 2009	20					8hrs/8 weeks	Parallel	Outpatient	Treadmill
Stozek 2003	61	65.5	2.3	4.5	48	56hrs/4 weeks	Parallel	Outpatient	Exercise
Thaut 1996	37	71.3	2.5	7.7	70	10.5hrs/3 weeks	Parallel	Home	Exercise/ Cueing

WHAT'S NEW

Last assessed as up-to-date: 31 December 2010.

Date	Event	Description
30 August 2011	New citation required and conclusions have changed	Converted to new review format. Updated search till 31 December 2010. New studies, conclusions changed.

HISTORY

Protocol first published: Issue 4, 2000

Review first published: Issue 3, 2001

Date	Event	Description
14 March 2001	New citation required and conclusions have changed	Substantive amendment

CONTRIBUTIONS OF AUTHORS

Claire Tomlinson was involved in searching and selection of studies, data extraction, analysis and interpretation of the review.

Smitaa Patel was involved in selection of studies, data extraction, analysis and interpretation of the review.

Charmaine Meek was involved in data extraction and provided expert physiotherapy input into the interpretation of the review.

Carl Clarke contributed to the design of the protocol and was involved in the interpretation of the review providing clinical input.

Rebecca Stowe contributed to the design of the protocol and was involved in searching and selection of studies, analysis and interpretation of the review.

Laila Shah was involved in searching and selection of studies for the review.

Catherine Sackley contributed to the design of the protocol and provided expert physiotherapy input into the interpretation of the review.

Katherine Deane undertook the 2001 Cochrane Review, and was involved in the interpretation of this review.

Keith Wheatley contributed to the design of the protocol and was involved in the interpretation of the review.

Natalie Ives contributed to the design of the protocol and was involved in the analysis and interpretation of the review.

DECLARATIONS OF INTEREST

Carl Clarke, Natalie Ives, Charmaine Meek, Smitaa Patel, Catherine Sackley and Keith Wheatley are either recruiting or involved in the running of the UK PD REHAB trial.

SOURCES OF SUPPORT

Internal sources

- No sources of support supplied

External sources

- Parkinson's UK, UK.
- Department of Health, UK.

INDEX TERMS

Medical Subject Headings (MeSH)

*Physical Therapy Modalities; Parkinson Disease [*rehabilitation]; Randomized Controlled Trials as Topic

MeSH check words

Humans