Physical fitness training for stroke patients (Review)

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[Intervention Review]

Physical fitness training for stroke patients

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ABSTRACT

Background

Levels of physical fitness are low after stroke. It is unknown whether improving physical fitness after stroke reduces disability.

Objectives

To determine whether fitness training after stroke reduces death, dependence, and disability. The secondary aims were to determine the effects of training on physical fitness, mobility, physical function, quality of life, mood, and incidence of adverse events.

Search methods

We searched the Cochrane Stroke Group Trials Register (last searched April 2010), the Cochrane Central Register of Controlled Trials (CENTRAL) (*The Cochrane Library*, July 2010), MEDLINE (1966 to March 2010), EMBASE (1980 to March 2010), CINAHL (1982 to March 2010), SPORTDiscus (1949 to March 2010), and five additional databases (March 2010). We also searched ongoing trials registers, handsearched relevant journals and conference proceedings, screened reference lists, and contacted experts in the field.

Selection criteria

Randomised trials comparing either cardiorespiratory training or resistance training, or both, with no intervention, a non-exercise intervention, or usual care in stroke survivors.

Data collection and analysis

Two review authors independently selected trials, assessed quality, and extracted data. We analysed data using random-effects meta-analyses. Diverse outcome measures limited the intended analyses.

Main results

We included 32 trials, involving 1414 participants, which comprised cardiorespiratory (14 trials, 651 participants), resistance (seven trials, 246 participants), and mixed training interventions (11 trials, 517 participants). Five deaths were reported at the end of the intervention and nine at the end of follow-up. No dependence data were reported. Diverse outcome measures made data pooling difficult. The majority of the estimates of effect were not significant. Cardiorespiratory training involving walking improved maximum

walking speed (mean difference (MD) 8.66 metres per minute, 95% confidence interval (CI) 2.98 to 14.34), preferred gait speed (MD 4.68 metres per minute, 95% CI 1.40 to 7.96) and walking capacity (MD 47.13 metres per six minutes, 95% CI 19.39 to 74.88) at the end of the intervention. These training effects were retained at the end of follow-up. Mixed training, involving walking, increased preferred walking speed (MD 2.93 metres per minute, 95% CI 0.02 to 5.84) and walking capacity (MD 30.59 metres per six minutes, 95% CI 8.90 to 52.28) but effects were smaller and there was heterogeneity amongst the trial results. There were insufficient data to assess the effects of resistance training. The variability in the quality of included trials hampered the reliability and generalizability of the observed results.

Authors' conclusions

The effects of training on death, dependence, and disability after stroke are unclear. There is sufficient evidence to incorporate cardiorespiratory training involving walking within post-stroke rehabilitation programmes to improve speed, tolerance, and independence during walking. Further well-designed trials are needed to determine the optimal exercise prescription and identify long-term benefits.

PLAIN LANGUAGE SUMMARY

Physical fitness training for stroke patients

Fitness training is considered beneficial for stroke patients. Physical fitness is important for the performance of everyday activities. The physical fitness of stroke patients is impaired after their stroke and this may reduce their ability to perform everyday activities and also exacerbate any stroke-related disability. This review of 32 trials involving 1414 participants found that cardiorespiratory fitness training after stroke can improve walking performance. There are too few data for other reliable conclusions to be drawn.

BACKGROUND

Physical activity and exercise recommendations exist for a wide range of healthy, older, and patient populations (Nelson 2007; O'Donovan 2010) including those with specific health problems such as stroke (Gordon 2004). Although exercise and physical activity are promoted positively the evidence is still incomplete.

What is physical fitness training?

Exercise refers to a subset of physical activity which is planned, structured, repetitive, and deliberately performed to train (improve) one or more components of physical fitness (USDHHS 2008). Since the term 'exercise' is used more generically within stroke care we will refer to exercise as 'physical fitness training'.

What is physical fitness?

Physical fitness describes a set of physiological attributes that a person has or achieves, which confer the ability to perform physical activities without undue fatigue. Activities can range from day-to-day tasks to leisure activities (USDHHS 2008). The most important components of physical fitness are those responsible for muscular work, as follows.

1. Cardiorespiratory fitness is the ability to transport and use oxygen and is usually expressed as maximal oxygen uptake (VO_2 max). Cardiorespiratory fitness confers 'endurance', that is the ability to perform physical activity for an extended period.
2. Muscle strength refers to the ability of a specific muscle or muscle group to exert force. Strength is associated with the ability to perform forceful movements such as pushing or lifting.
3. Muscle power refers to the rate at which muscular work can be performed during a single explosive contraction. Power is associated with the ability to carry out forceful movements, in particular those that are dynamic.

In addition, other components of fitness can influence the ability to perform physical activities, including flexibility (range of motion about a specific joint), balance (ability to maintain stability and posture), and body composition (for example relative amounts of fat and fat-free mass).

Determinants of fitness

Physical fitness is lower in women compared to men and it deteriorates due to increasing age (1% to 4% in one year) (Young 2001), physical inactivity (12% to 14% in 10 days) (Kortebein 2008), and other secondary consequences of chronic disease such

as inflammation (Degens 2006).

Functional importance of fitness

When the level of fitness is low (regardless of the reason) physical activities may either become limited by fatigue or impossible to perform (Young 2001). Levels of fitness below a threshold needed to perform instrumental activities of daily living (ADL) may mean loss of independence, for example cardiorespiratory fitness (Shephard 2009) and muscle strength (Hasegawa 2008).

Description of the condition

A common neurological consequence of stroke is unilateral loss or limitation of muscle function; the direct consequence can be limitation or loss of movement, mobility, and functional ability. In addition, a whole range of indirect complications occur after stroke (Indredavik 2008; Langhorne 2000). Low levels of physical activity are therefore common soon after stroke (Bernhardt 2004; Bernhardt 2007). In community-dwelling stroke patients cardiorespiratory fitness is around 50% of the value expected in age and gender-matched healthy people (Patterson 2007). Muscle strength (Gerrits 2009; Horstman 2008) and muscle power (Saunders 2008) are also impaired with bilateral deficits, which suggest the influence of physical inactivity. The level of post-stoke fitness may be low due to a range of factors directly and indirectly connected to stroke.

1. Pre-stroke fitness levels may already be low since physical inactivity (Lee 2002) and low levels of fitness (Kurl 2003) are both risk factors for stroke. In addition, most stroke patients are elderly (more than 70 years of age) so levels of fitness will be low due to the effects of age (Malbut 2002) and the presence of comorbid diseases.
2. Direct neurological effects of stroke reduce the muscle mass available for activation (e.g. hemiparesis).
3. Post-stroke physical inactivity (for whatever reason) will cause a longitudinal loss of fitness alongside the effects of comorbid diseases and increasing age. Limitation or loss of functional abilities after stroke (e.g. walking, stair climbing, chair rising) are associated with low cardiorespiratory fitness levels, muscle strength, and muscle power (Flansbjer 2006; Patterson 2007; Saunders 2008).

Therefore, inactivity, which commonly occurs after stroke, may result in low levels of physical fitness. This may exacerbate or cause some common post-stroke physical limitations. Restoration of motor function in order to improve functional ability is a key focus within stroke rehabilitation and a number of interventions have been investigated that involve physical activities and physical fitness training (Langhorne 2009).

Description of the intervention

Although the design of physical fitness training interventions varies across healthy people, older people, and patient groups, the structure and content remains guided by a common set of well-established principles (ACSM 1998).

Type of training

Most physical fitness training programmes are classified as either: (1) cardiorespiratory training (to improve cardiorespiratory fitness), (2) resistance training (to improve muscular strength and muscle power), or (3) mixed training, which combines cardiorespiratory and resistance training. With regard to other aspects of fitness, all types of training programme have the potential to influence body composition (increase lean mass and reduce adiposity) and some may also incorporate elements which improve flexibility (stretching exercises) and balance.

Mode of training

The type of fitness training influences the mode(s) of exercise. For example, cardiorespiratory training commonly employs walking and cycling, whilst resistance training employs activities involving muscle contractions resisted by weights, body mass, or elastic devices.

Dose of training

The dose of training is controlled by influencing: (1) the amount of training (for example programme length (weeks, months), frequency (days/week), and duration (minutes) of sessions), and (2) the intensity of training (amount of work or effort).

It is the manipulation of type, mode, and dose which defines an exercise prescription; however, the effectiveness is also influenced by some other critically important principles of training (ACSM 1998) including progression of training, whether training is task-related (specific), and the fact that training effects are reversible if training is reduced or stopped.

Physical fitness training is, therefore, very much a complex intervention with numerous component parts and this can give rise to variation in plausible benefits.

How the intervention might work

Regular physical activity is currently recommended where possible to people of all ages, including those with disabilities, in order to promote and maintain health (Haskell 2007; USDHHS 2008). The dose-response relationship means additional benefits exist if physical fitness training is employed, in particular with regard to physical function. Physical fitness training interventions improve physical function in healthy elderly people (Chodzko-Zajko 2009).

Post-stroke physical activity and fitness levels are low, and these low levels are associated with common post-stroke functional limitations. Increased fitness and physical function could benefit a range of other common post-stroke problems, such as reducing fatigue, reducing the incidence of falls and fractures, compensating for the increased energetic cost of a hemiparetic gait, reducing disability and improving independence, and improving quality of life and mood. Therefore, increasing fitness may benefit a range of common post-stroke problems.

Physical therapies are known to promote structural brain remodelling (Gauthier 2008) and this can influence post-stroke motor deficits. There is systematic review evidence that repetitive practice of some common day-to-day activities produces some modest improvements in mobility and ADL in stroke patients (French 2010). Therefore, participation in repetitive, task-related fitness training may have functional benefits even if fitness is not improved.

Engagement with group training activities may have some psychosocial benefits in people with stroke (Carin-Levy 2009; Mead 2005; Patterson 2009). Therefore, simply participating in physical fitness training may be beneficial, particularly where group activities are involved.

Physical fitness training is known to be beneficial for people with a number of conditions that are comorbid conditions or risk factors for stroke. Systematic review evidence shows that interventions involving physical fitness training reduce blood pressure (Dickinson 2006), improve vascular risk factors in obesity (Shaw 2006) and type II diabetes (Thomas 2006), reduce mortality in coronary heart disease (CHD) patients (Jolliffe 2000), and may have some benefits for patients diagnosed with depression (Mead 2008). Therefore, post-stroke cardiorespiratory training, in particular, could reduce morbidity and mortality through secondary prevention of stroke and comorbid disease.

In summary, physical fitness training does not simply provide a mechanism to increase fitness, it has multiple mechanisms of action and has a spectrum of plausible benefits that are relevant to many people with stroke. However, there may also be risks, such as training-induced soft tissue injuries, altered muscle tone, falls, and vascular events.

Why it is important to do this review

Physical fitness training for stroke survivors remains under-investigated in two key areas. Firstly, the range of possible benefits is not fully explored. Secondly, the optimal exercise prescription for people with stroke has yet to be defined. There is clearly a growing interest in physical fitness interventions for stroke. The 2004 original version of this review contained only 12 trials, the 2009 update doubled the number of included trials to 24 and this has been among the top 10 most accessed Cochrane stroke reviews (Saunders 2004; Saunders 2009). Considering the degree of incomplete knowledge and the high level of interest we believe it is important to update this review.

OBJECTIVES

To determine the effects of cardiorespiratory training and resistance training, individually or in combination (mixed training), compared with no intervention, usual care, or other specific control interventions in stroke survivors.

METHODS

Criteria for considering studies for this review

Types of studies

All trials described as randomised controlled trials (RCTs), single-blinded or open, that examined the effects of cardiorespiratory, resistance, or mixed training using any of the following six comparisons.

- Cardiorespiratory training versus control: (1) at the end of intervention, (2) at the end of follow-up.
- Resistance training versus control: (3) at the end of intervention, (4) at the end of follow-up.
- Mixed training (cardiorespiratory plus resistance training) versus control: (5) at the end of intervention, (6) at the end of follow-up.

In this review 'end of intervention' refers to the time-point when a training programme finishes; 'end of follow-up' refers to any time-point occurring after the end of the intervention. Measures at the end of follow-up allow us to examine whether training effects (if any) are retained after training is completed.

We included studies in which controls were exposed to either physical activity occurring during usual care or no training after usual care. By 'no training' we meant either no intervention or a non-exercise intervention (for example cognitive tasks or sham training). Therefore, we deemed the following comparisons suitable for inclusion:

- training plus usual care versus usual care (during usual care);
- training versus no training (after usual care).

We included only full-text reports of published and unpublished trials. We did not include conference proceedings (that is abstract and poster presentations) because usually they provide only limited data and do not allow full assessment of study quality. We did not exclude trials on the basis of their sample size. We included studies published in languages other than English only when a translation could be arranged. Where investigators published several reports based on data from a single study population, we selected the most recent or most complete report for data extraction and we listed the other reports as duplicate publications.

Types of participants

Adult stroke survivors who were considered suitable for fitness training by the trials' authors. Participants were considered eligible irrespective of the time since stroke onset.

Types of interventions

We assessed the following interventions.

Cardiorespiratory training

The aim of this type of training is to improve the cardiorespiratory component of physical fitness. It is typically performed for extended periods of time on devices or ergometers (for example treadmill, cycling, rowing) or by utilising modes of activity such as walking or climbing stairs.

Resistance training

This type of training is performed primarily to improve muscle strength and muscular endurance or muscle power output, or both. It is typically carried out by making repeated muscle contractions resisted by body weight, elastic devices, masses, free weights or specialised machine weights, and isokinetic devices.

Mixed training

This describes training interventions that comprise different activity components, some intended to improve cardiorespiratory fitness and others to improve strength, power or muscular endurance; for example, a training programme comprising both cycling and weight training.

We only included trials that aimed at training stroke survivors. We defined 'training' as a systematic, progressive increase in the intensity or resistance, frequency or duration of the physical activity throughout a scheduled programme. We categorised the 'dose' of the cardiorespiratory or resistance training components of a training programme as falling within or below the American College of Sports Medicine (ACSM) criteria for developing and maintaining fitness (ACSM 1998). We sought measures of adherence to training since this can modify the dose of training received by trial participants. For the purposes of this review, adherence included both: (1) attendance at training sessions, and (2) compliance with exercise instructions during training sessions.

We excluded trials that focused on different types of standard rehabilitation techniques but did not include a physical fitness component. We also excluded trials that combined fitness training with assistive technologies, such as robotic and electromechanical-assisted gait training devices during body weight-supported locomotor training, as well as trials investigating virtual reality approaches. We excluded studies which compared upper and lower body training if an additional non-exercise control group was not considered.

If any description of a training regimen was unclear, we contacted the authors for further information.

Types of outcome measures

We anticipated that existing trials in the literature would use different measures to assess outcomes relevant to this review; in particular they would use a variety of rating scales. For each outcome of interest we tried, therefore, to list the most common and relevant measures or tools. We only included rating scales that had been described in peer-reviewed journals.

Primary outcome measures

1. Case fatality: numbers of deaths from all causes.
2. Death or dependence.
3. Disability: assessed by functional scales such as the Functional Independence Measure (Hamilton 1994); Barthel Index (Collin 1988); Rivermead Mobility Index (Collen 1991); Functional Ambulation Category (Holden 1984); Nottingham Extended Activities of Daily Living Scale (Wade 1992); Lawton Index of Activities of Daily Living (Lawton 1969); and the Stroke Impact Scale (Duncan 1999).

Since the review protocol was originally written, the use of the International Classification of Functioning, Disability and Handicap (ICF) is becoming more widespread (WHO 2001). In the ICF classification the term 'disability' is an umbrella term for impairments and activity limitations. In this version of the review the primary outcome measure 'disability' refers to 'global indices of activity limitation'. Secondary outcome measures of mobility and physical function refer to 'specific activity limitations'.

Secondary outcome measures

- Adverse effects: recurrent non-fatal cardiovascular or cerebrovascular events; altered muscle tone; training-induced injury; incidence of falls; incidence of fractures.
- Vascular risk factors: resting systolic and diastolic blood pressure; resting heart rate; total cholesterol.
- Physical fitness: exercise heart rate and maximum or peak oxygen uptake (peak VO_2); muscle strength and power output; body mass index (BMI).
- Mobility: gait speed (maximum or preferred speed); gait capacity (e.g. 6-metre walking test (6-MWT)).
- Physical function: stair climbing; weight bearing; 'timed up and go' test.
- Health-related quality of life: any relevant scale such as the Short Form 36 Health Survey Questionnaire (http://www.sf-36.org) and the Nottingham Health Profile (Hunt 1980).
- Mood: any relevant scale such as the Hospital Anxiety and Depression Scale (HADS) (Zigmond 1983); the Beck Depression Index (Beck 1961).

Search methods for identification of studies

See the 'Specialized register' section in the Cochrane Stroke Group module.

Electronic searches

We searched the Cochrane Stroke Group Trials Register, which was last searched by the Managing Editor in April 2010. In addition, we searched the following electronic bibliographic databases:

- Cochrane Central Register of Controlled Trials (CENTRAL) (*The Cochrane Library* July 2010) in Ovid (Appendix 1);
- MEDLINE (1966 to March 2010) in Ovid (Appendix 2);
- EMBASE (1980 to March 2010) in Ovid (Appendix 3);
- CINAHL (1982 to March 2010) in EBSCO (Appendix 4);
- SPORTDiscus (1949 to March 2010) in EBSCO (Appendix 5).

We developed a MEDLINE search strategy, which comprised both MeSH controlled vocabulary (/) and free text terms (.tw.) for the relevant target condition (for example stroke, cerebrovascular diseases) and for specific interventions (for example fitness training, muscle strengthening, cycling, rowing, treadmill, circuit training). We limited the search to clinical trials and intervention studies carried out in humans. We did not apply any language restrictions. We adapted the MEDLINE search strategy, and accommodated differences in indexing and syntax, to search the other major electronic databases. We imported all citations identified by the electronic searches into a Reference Manager database and removed duplicate records.

Searching other resources

We scrutinized the proceedings of relevant stroke meetings listed on the Internet Stroke Centre's website (www.strokecenter.org/) including the European Stroke Conference (2000 to 2006), the International Stroke Conference (2000 to 2007), and the World Stroke Conference (2000, 2004).

We handsearched relevant scientific journals that focus on exercise and physical fitness and are not currently included in the The Cochrane Collaboration handsearching programme:

- *Adapted Physical Activity Quarterly* (1984 to March 2010);
- *British Journal of Sports Medicine* (1974 to March 2010);
- *International Journal of Sports Medicine* (1980 to March 2010);
- *Journal of Science and Medicine in Sport* (1998 to March 2010);
- *Research Quarterly for Exercise and Sport* (1985 to March 2010;
- *Sports Medicine* (1984 to 2010).

We also searched the following electronic databases and websites using the terms 'stroke', 'exercise', and 'physical fitness' to identify additional relevant trials, ongoing trials, and thesis dissertations:

- Science Citation Index Expanded (1981 to March 2010) (WOK);
- Web of Science Proceedings (1982 to March 2010) (WOK);
- Physiotherapy Evidence Database (PEDro) (last searched March 2010) (www.pedro.fhs.usyd.edu.au/);
- REHABDATA (1956 to March 2010) (www.naric.com/search/rhab/);
- Index to Theses in Great Britain and Ireland (1970 to March 2010) (www.theses.com/);
- Internet Stroke Centre's Stroke Trials Directory database (last searched September 2010) (www.strokecenter.org/trials/);
- metaRegister of Controlled Trials (last searched September 2010) (www.controlled-trials.com/mrct/).

We performed citation tracking of all reports selected for inclusion using Google Scholar (http://scholar.google.co.uk/) (last searched September 2010).

We examined the references lists of all relevant studies identified by the above methods and perused all relevant systematic reviews identified during the entire search process for further trials. We also contacted experts in the field and principal investigators of relevant studies to enquire about unpublished and ongoing trials.

Data collection and analysis

Study selection

One review author (MB) inspected the title and abstract of all citations identified by the electronic searches and discarded any obviously irrelevant reports. We retrieved each paper thought to be potentially relevant in full and two review authors (MB and DS) assessed whether the pre-specified criteria for inclusion were satisfied. The same two review authors resolved any disagreements by discussion or referred the disagreement to a third review author (GM). One review author (DS) also screened the correspondence with experts and trial investigators for details of any additional published or unpublished trials.

Methodological quality assessment

Two review authors (MB and DS) assessed the methodological quality of all studies selected for inclusion. For each study we recorded the following information:

- method of randomisation;
- method of allocation concealment;
- blinding procedures;
- incomplete outcome data;
- whether results were analysed using an intention-to-treat (ITT) approach.

Data extraction

Two review authors (MB and DS) independently extracted data from the selected studies. We designed a data extraction form specifically for this review and recorded the following characteristics for each individual study.

- Publication details: authors, year of publication, publication status (published, unpublished, or ongoing), number of studies included in the paper, citation of other relevant trials.
- Details of study conduct: study design, method of recruitment, inclusion and exclusion criteria, number of participants enrolled, number of participants excluded, number of participants assessed, losses to follow-up, geographical location of the trial, setting in which the trial was conducted (e.g. hospital, community).
- Characteristics of participants: total number, age, gender, stage of care, severity of stroke, time since stroke onset, co-morbidity, walking ability.
- Details of intervention: total number of intervention groups, type of training (i.e. cardiorespiratory, resistance, or mixed), training mode (e.g. treadmill walking, weight training), dose (i.e. intensity, frequency of delivery), timing (i.e. during or after usual care), length of training (i.e. duration and programme length), adherence to intervention (i.e. attendance, compliance).
- Details of outcome measures: choice of outcomes (i.e. death, dependence, disability, physical fitness measures, gait assessment, physical function measures, health status and quality of life, mood, adverse events, risk factors), reported outcomes, missing outcomes.

We classified all outcome data as being from time-points at either: (1) the end of intervention, or (2) the end of follow-up (that was defined as any period of time after the training intervention was completed). We resolved any disagreement by consensus or arbitration.

Data analysis

We carried out statistical analysis using RevMan 5 (RevMan 2011). We calculated a summary statistic for each outcome measure to describe the observed treatment effect. All summary statistics reported in this review refer to effects at either: (1) the end of intervention, or (2) the end of follow-up. We qualitatively assessed whether clinical heterogeneity was present among included studies and we combined studies in a meta-analysis only when we judged them reasonably homogeneous in terms of participants, interventions, and outcomes.

Continuous and dichotomous data

The data required for meta-analyses of continuous data in RevMan were mean and standard deviation (SD). When collecting continuous data we took some precautions to check whether standard error (SE) was mistakenly reported as SD. We used SE or 95% confidence interval (CI) to compute SD, when missing. The included studies presented results of continuous data either as mean and SD of change from baseline for each intervention group or mean and SD of final measurement values, or both. We extracted change from baseline scores instead of final measurement values when possible. In our analyses we combined final measurement values with change from baselines scores using the mean difference (MD) method as we assumed that mean differences based on changes from baseline scores addressed the same underlying treatment effects as mean differences based on final measurements.
The data required for meta-analyses of dichotomous data in RevMan were number of events in each intervention group and total number of participants in each intervention group.
In the case of missing outcome data, we attempted to analyse data according to the ITT approach. When individual patient data were available we used the 'last observation carried forward' (LOCF) approach (that is the most recently reported outcome was assumed to hold for all subsequent outcome assessments).

Measures of effect

For continuous data we calculated mean differences with 95% CIs if the studies used the same instrument to measure the same outcome (for example disability). However, if studies used a variety of instruments (for example rating scales), we calculated the standardised mean difference (SMD) with 95% CI.
For dichotomous data we calculated odds ratios (OR) with 95% CIs.
We assessed statistical homogeneity between trial results by means of the Chi^2 test for heterogeneity, which is included in the forest plots in RevMan 5. Because the Chi^2 test has notoriously low power in meta-analyses when studies have small sample size, or when the number of events is small, we decided: (1) to set the significance level at 0.10 rather than at the conventional level of 0.05, and (2) to analyse data using a random-effects model (a fixed-effect model would have given the same quantitative conclusions but with narrower CI).
To quantify inconsistency across studies we used the I^2 statistic, which is included in the meta-analysis graphs in RevMan 5.
Where possible, we investigated publication bias by entering data from studies included in the relevant meta-analyses in funnel plots (treatment effect versus trial size).

Subgroup analyses

When sufficient data were available, we planned to investigate heterogeneity between included studies (both clinical and statistical) by means of subgroup analyses. We attempted to compare effect estimates in different subgroups as follows:

- time of training (during usual care versus after usual care);
- training programmes that met the ACSM guidelines (ACSM 1998) versus those that did not;

- type of training (cardiorespiratory versus resistance training versus mixed training);
- type of control interventions (no intervention versus non-exercise intervention versus other intervention);
- duration of training (less than 12 weeks versus 12 weeks or more);
- severity of stroke (mild symptoms versus severe symptoms).

Sensitivity analyses

When sufficient data were available we planned to explore the influence of some study characteristics by means of sensitivity analyses. We considered the following study characteristics:

- concealment of allocation;
- blinding;
- extent of withdrawals and dropouts.

RESULTS

Description of studies

See: Characteristics of included studies; Characteristics of excluded studies; Characteristics of ongoing studies.
See: Characteristics of included studies; Characteristics of excluded studies; Characteristics of ongoing studies
From the initial searches performed in 2004 and 2009 we identified 215 potentially relevant citations. Of these, 19 were systematic and narrative reviews, which were further screened for additional trials (Ada 2006; Ada 2007; Andersen 2001; Barreca 2003; Eng 2004; Ernst 1990; Giuliani 1995; Hiraoka 2001; Manning 2003; Meek 2003; Morris 2004; Moseley 2005; Pang 2006a; Ramas 2007; Urton 2007; Van de Port 2007; Van der Lee 2001; Van Peppen 2004; Wagenaar 1991); 96 studies failed to meet the inclusion criteria; 58 potentially relevant studies remained unclassified because they were recently published and required either additional information or translation into English in order to apply the inclusion criteria; 19 trials were still ongoing; 23 trials met the inclusion criteria.
We updated the previous electronic search strategies and other relevant searches (for example handsearching, screening of conference proceedings and relevant websites) in 2010. We also checked all the references in both the studies awaiting classification and ongoing studies sections of the previous version of this review. We screened a total of 9481 citations. We identified 11 additional completed trials (Aidar 2007; Bale 2008; Cooke 2010; Donaldson 2009; Flansbjer 2008; Langhammer 2007; Lennon 2008; Moore 2010; Mudge 2009; Sims 2009; Smith 2008), two additional publications of an already included study (Katz-Leurer 2003), two papers reporting secondary analyses of an already included study (Duncan 2003), and seven ongoing trials. Five of the 11 new trials were previously in the waiting assessment section. Six of the seven ongoing trials were new and one was a published protocol of a study already included in Ongoing studies. We added a further 29 studies to the table Characteristics of excluded studies. The most common reasons for exclusion were: a controlled trial in which the intervention did not meet the criteria for fitness training or did not include a suitable comparison, or a confounding of training with another active physical intervention. We also excluded two trials that were previously included: Dean 2000 because the control group contained a degree of physical activity, and Pohl 2007 because an assistive device was used as an adjunct to gait training. We revised the list of the excluded studies and we deleted studies that did not meet the pre-specified inclusion criteria for the type of study design or publication (that is not an RCT, abstract publication). This was done with the purpose of making the list of excluded studies more efficient and manageable.
we included 32 trials in total. Two trials are dissertations (Cuviello-Palmer 1988; James 2002) and 14 trials have secondary publications (Cooke 2010; da Cunha 2002; Donaldson 2009; Duncan 2003; Eich 2004; Flansbjer 2008; Katz-Leurer 2003; Langhammer 2007; Mead 2007; Salbach 2004; Sims 2009; Richards 1993; Teixeira 1999; Winstein 2004). There were 121 excluded studies and 16 ongoing studies.

Participants

A total of 1414 stroke survivors (range 13 to 100 individuals, mean 44.5, median 42) were randomised to physical fitness or control interventions in the 32 included clinical trials. The mean age of the patients was approximately 64 years. The mean time since onset of symptoms ranged from 8.8 days in trials assessing participants before discharge from hospital (Richards 1993) to 7.7 years in trials assessing participants after hospital discharge (Teixeira 1999).
One trial (Richards 1993) recruited non-ambulatory stroke survivors, three trials (Bateman 2001; Cooke 2010; Lennon 2008) recruited both ambulatory and non-ambulatory participants, two trials (Donaldson 2009; Winstein 2004) did not report this information, and all the remaining trials recruited ambulatory stroke survivors.
Participants were assessed at the end of the training period (end of intervention), or at any other defined point either within the trial duration or after completion of the training programme, or both (scheduled end of follow-up).

Interventions

Cardiorespiratory training

Fourteen trials with a total of 651 participants (range 15 to 92 individuals) (Aidar 2007; Bateman 2001; Cuviello-Palmer 1988; da Cunha 2002; Eich 2004; Glasser 1986; Katz-Leurer 2003; Lennon 2008; Moore 2010; Mudge 2009; Pohl 2002; Potempa 1995;

Salbach 2004; Smith 2008) examined cardiorespiratory training (details of these trials are summarised in Table 1). Two of these trials assessed circuit training (Mudge 2009; Salbach 2004), one trial assessed aquatic training (Aidar 2007), while the remaining trials employed different forms of ergometry (cycle, treadmill or Kinetron). The training programmes comprised regular weekly sessions of sufficient duration (usually greater than 20 minutes) but the exercise intensity was described in only half of the included trials. In eight trials (402 participants in total) the cardiorespiratory training started after usual care while in six trials (249 participants in total) it started during usual care. In two of these trials participants were recruited in the acute phase of stroke, less than one month post-stroke (Cuviello-Palmer 1988; da Cunha 2002).

Resistance training

Seven trials with a total of 246 participants (range 18 to 54 individuals) (Bale 2008; Flansbjer 2008; Inaba 1973; Kim 2001; Ouellette 2004; Sims 2009; Winstein 2004) assessed the effects of resistance training (details of these trials are summarised in Table 2). All employed muscle contractions resisted by weights, exercise machines, or elastic devices. Five trials limited the strength training to the lower limbs, one trial to the upper limbs (Winstein 2004), and one trial trained both the upper and lower limbs (Sims 2009). The training met or nearly met the ACSM 1998 criteria for strength training in five trials. All programmes were short (less than 12 weeks) apart from Ouellette 2004 (12 weeks). In four trials the resistance training started after usual care (Flansbjer 2008; Kim 2001; Ouellette 2004; Sims 2009), whilst in three trials it started during usual care (Bale 2008; Inaba 1973; Winstein 2004). In Winstein 2004 participants were recruited during the acute phase of stroke (less than one month post-onset).

Mixed training

Eleven trials with a total of 517 participants (range 13 to 100 individuals) (Cooke 2010; Donaldson 2009; Duncan 1998; Duncan 2003; James 2002; Langhammer 2007; Mead 2007; Richards 1993; Richards 2004; Teixeira 1999; Yang 2006) assessed the effects of mixed training (details of these trials are summarised in Table 3). The mode of exercise was rather diverse (for example circuit training, walking or treadmill training, and resistance training). Six trials focused on the training of the lower limbs, one trial on the training of the upper limbs and four trials on the training of both the lower and the upper limbs. All interventions contained one or more functionally relevant activities (such as walking). Intensity of exercise was reported sufficiently to classify the cardiorespiratory component of three trials (James 2002; Langhammer 2007; Teixeira 1999) and the strength component of four trials (Duncan 1998; Duncan 2003; Langhammer 2007; Teixeira 1999) as satisfying the ACSM 1998 criteria. In the majority of trials the duration of the intervention programme was less than 12 weeks. In seven trials training started after completion of usual care, whilst in four trials it started during usual care. Only one (Richards 1993) recruited participants in the acute phase of stroke (less than one month post-onset).

Adherence to training interventions

Adherence to the interventions was defined in terms of: (1) attendance at the planned training sessions, and (2) compliance with the planned content of the training sessions.

Attendance

Rate of attendance (%) could be clearly determined in 16 of the 32 included trials (Bateman 2001; Duncan 1998; Duncan 2003; Eich 2004; Flansbjer 2008; Langhammer 2007; Mead 2007; Mudge 2009; Ouellette 2004; Pohl 2002; Richards 1993; Richards 2004; Salbach 2004; Sims 2009; Winstein 2004; Yang 2006). The proportion of attended training sessions ranged from 65% up to 100%. Five trials measured attendance for the training and the control groups separately and showed similar rates between groups (Bateman 2001; Langhammer 2007; Mead 2007; Ouellette 2004; Salbach 2004). A few other trials described attempts to facilitate attendance and make up missed sessions, or reported that "attendance did not differ between intervention groups" but did not provide attendance rates (Bale 2008; Cooke 2010; Teixeira 1999). One trial (da Cunha 2002) specifically excluded those participants who attended fewer than nine training sessions from the statistical analyses (thus preventing an intention-to-treat assessment of results).

Compliance

Compliance with the scheduled exercise programme during training sessions was described in only six trials. For cardiorespiratory training interventions, Langhammer 2007 stated that the compliance with the individualised training levels was 'high', Pohl 2002 reported 'excellent tolerance' of treadmill training, and Salbach 2004 maintained that most of the participants completed nine out of 10 circuit training exercises. For mixed training, Duncan 1998 reported 'good compliance' with home-based training and Yang 2006 stated that mixed circuit training was 'performed as planned'. Mead 2007 reported 94% to 99% compliance with circuit training exercises 'tailored' to individual requirements. Information on compliance was not available for the remaining trials.

Risk of bias in included studies

Randomisation

One trial adopted a cross-over design with random allocation to the order of the treatment sequences (Moore 2010). For the purpose of this review we only analysed the results at the end of the first period, as deriving from parallel groups. All remaining trials adopted a parallel group design.

Methods of sequence generation were clearly reported in 16 out of the 32 included trials. These included methods such as drawing lots (Bale 2008), throwing dice (Langhammer 2007; Smith 2008), picking envelopes (Eich 2004; Pohl 2002; Yang 2006), random number tables (da Cunha 2002), or computer-generated lists (Bateman 2001; Cooke 2010; Donaldson 2009; James 2002; Lennon 2008; Mead 2007; Mudge 2009; Salbach 2004; Sims 2009). To balance the numbers of participants to be assigned to each intervention group block randomisation was used in 14 trials (Bateman 2001; Cooke 2010; Donaldson 2009; Duncan 1998; Duncan 2003; James 2002; Katz-Leurer 2003; Lennon 2008; Pohl 2002; Richards 1993; Richards 2004; Salbach 2004; Sims 2009; Teixeira 1999). To balance participant characteristics between intervention groups stratified randomisation was used in 11 trials. Allocation to intervention groups was stratified according to different participants' characteristics: by gait performance (Moore 2010; Pohl 2002; Salbach 2004); by gender (Sims 2009); by age and gender (Lennon 2008); by age, gender, and time since stroke (Kim 2001); by age, gender, and disability (Mead 2007); by gender and hemispheric lesion (Langhammer 2007); by functional ability (Donaldson 2009; Richards 1993); and by stroke severity (Winstein 2004). Six trials were described as randomised but did not provide information on the methods used for generating random assignments (Aidar 2007; Cuviello-Palmer 1988; Flansbjer 2008; Glasser 1986; Inaba 1973; Ouellette 2004; Potempa 1995).

Allocation concealment

Information on allocation concealment was available in less then half of the included trials (13/32). One trial reported the use of a central assignment (Mead 2007), another trial the use of a third party (Duncan 1998), and two trials the use of sequentially numbered sealed opaque envelopes (Cooke 2010; Donaldson 2009) as adequate mechanisms of allocation concealment. Most trials reported the use of 'sealed envelopes' but did not specify whether they were sequentially numbered or opaque (Bateman 2001; Duncan 2003; Eich 2004; James 2002; Lennon 2008; Moore 2010; Winstein 2004; Yang 2006), therefore we were unable to exclude potential selection bias with certainty.

Intention-to-treat (ITT) analysis

Fourteen trials reported the use of an ITT approach for their analyses (Bateman 2001; Donaldson 2009; Duncan 1998; Duncan 2003; Eich 2004; Flansbjer 2008; James 2002; Langhammer 2007; Mead 2007; Mudge 2009; Ouellette 2004; Potempa 1995; Richards 2004; Sims 2009) although one of these trials (Bateman 2001) did not analyse data for the participants who dropped out (where possible, we imputed these missing data).

Amongst the 18 trials that did not mention ITT, nine did not have any missing data (Bale 2008; Cuviello-Palmer 1988; Glasser 1986; Kim 2001; Moore 2010; Potempa 1995; Smith 2008; Teixeira 1999; Yang 2006).

Blinding

Participant blinding

Participants could not be blinded to physical training. In two trials, however, participants were informed that they would receive one of two different, potentially beneficial interventions (Kim 2001; Mead 2007) without being given information on the types of interventions. Similarly, in another trial (Donaldson 2009) participants allocated to the experimental group were advised that they were to be offered extra therapy but were not told which type of therapy.

Investigator blinding

The outcome assessors were reported to be blinded in 19 of the 32 included trials (Bale 2008; Bateman 2001; Cooke 2010; Donaldson 2009; Duncan 2003; Eich 2004; Flansbjer 2008; James 2002; Katz-Leurer 2003; Kim 2001; Langhammer 2007; Mead 2007; Mudge 2009; Ouellette 2004; Pohl 2002; Richards 1993; Richards 2004; Salbach 2004; Yang 2006). Some of these trials reported, however, that some degree of unmasking might have occurred (Eich 2004; Mudge 2009; Salbach 2004). Participants were instructed not to reveal group assignments in four trials (Bateman 2001; Duncan 2003; Flansbjer 2008; Mead 2007). Outcome assessment was not blinded in three trials (Moore 2010; Smith 2008; Winstein 2004). Details of blinding were not provided in the remaining trials.

Outcome measures

A variety of outcome measures were used in the included studies but only a few trials shared the same outcome measures. This limited the opportunity to combine outcome measures in meta-analyses.

Some outcome measures involved continuous data (for example assessment scales) with skewed distributions. Due to time and resources constraints we did not attempt to transform these data (Higgins 2008). We, therefore, combined continuous skewed data and continuous normal-distributed data.

Incomplete outcome data

The attrition rate at the end of intervention was relatively low, with 24 of the 32 included studies showing an attrition rate of 10% or less (Aidar 2007; Bateman 2001; Cooke 2010; Cuviello-Palmer 1988; Donaldson 2009; Duncan 1998; Duncan 2003; Eich 2004; Flansbjer 2008; Glasser 1986; James 2002; Katz-Leurer 2003; Kim 2001; Lennon 2008; Mead 2007; Mudge 2009; Ouellette 2004; Pohl 2002; Potempa 1995; Richards 2004; Salbach 2004; Teixeira 1999; Winstein 2004; Yang 2006), two trials an attrition rate of 13% (da Cunha 2002; Langhammer 2007), and one trial an attrition rate of 17% (Richards 1993). The attrition rate increased at the end of the scheduled follow-up for eight of the 13/24 trials which followed participants after completion of the intervention (Bateman 2001; Cooke 2010; Donaldson 2009; Duncan 2003; Katz-Leurer 2003; Mudge 2009; Richards 2004; Winstein 2004) and ranged from 14% to 40%. Overall the proportion of withdrawals was similar for the intervention and control groups.

In one trial (Inaba 1973) a large proportion of participants allocated to three intervention arms were lost either before or after randomisation (99/176 participants). The exact distribution of the withdrawals reported across the two arms included in this review and the excluded arm was not given. One reason given for the withdrawals was 'discharged before the end of the study'.

The remaining four trials did not report any dropouts.

Selection bias

Most of the included trials recruited participants during hospital or community stroke care. In a few trials, however, participants' recruitment involved media advertisements (Ouellette 2004; Teixeira 1999) or databases of potential volunteers (Kim 2001; Lennon 2008; Mudge 2009; Sims 2009; Yang 2006). These methods of recruitment render these trials more prone to self-selection bias and hamper the generalizability of their findings.

Comparisons

Training interventions were compared with control interventions in different ways in the included studies. We identified six different types of comparison, which has implications for establishing the effects of fitness training.

- Training plus % usual care versus usual care (seven out of 32 trials).
- Training plus usual care versus usual care (six out of 32 trials).
- Training plus usual care versus non-exercise intervention plus usual care (one out of 32 trials).
- Training versus non-exercise intervention after usual care (seven out of 32 trials).
- Training versus no intervention after usual care (seven out of 32 trials).
- Training versus usual outpatient care (four out of 32 trials).

In the first three comparisons both groups are exposed to an intervention: fitness training in the experimental group and usual care in the control group. This makes groups comparable in terms of exposure time (both groups are exposed to an intervention, the frequency and duration of which is similar between groups) and the 'attention' received by the therapists. Therefore, these comparisons allow one to separate the specific effects of fitness training from those of usual rehabilitation interventions.

In the last three comparisons the total intervention exposure time in the training group is greater than that in the control group. These comparisons will be described in this review as 'confounded by additional training time'. With regard to interventions involving physical exercise, a greater exposure to the intervention has a known effect on rehabilitation outcomes ('augmented therapy time') (Kwakkel 2004). Therefore, although these comparisons allow comment on the overall effect of training programmes, they make it difficult to attribute any benefits to the content of the exercise prescription itself.

Sample size

Of the 32 included trials, 12 had 20 participants or less (Bale 2008; Cuviello-Palmer 1988; da Cunha 2002; Donaldson 2009; Duncan 1998; Glasser 1986; James 2002; Kim 2001; Moore 2010; Richards 1993; Smith 2008; Teixeira 1999); two trials had between 21 and 40 participants (Aidar 2007; Flansbjer 2008); 10 trials had between 41 and 60 participants (Eich 2004; Inaba 1973; Lennon 2008; Mudge 2009; Ouellette 2004; Pohl 2002; Potempa 1995; Sims 2009; Winstein 2004; Yang 2006); four trials had between 61 and 80 participants (Cooke 2010; Langhammer 2007; Mead 2007; Richards 2004); and four trials had between 81 and 100 participants (Bateman 2001; Katz-Leurer 2003; Salbach 2004; Duncan 2003).

Effects of interventions

Effect of training on primary outcome measures

Case fatality

Number of deaths was reported in four trials.

In the Katz-Leurer 2003 trial one participant had died in the cardiorespiratory training group (1/42) compared with one participant in the control group (1/39) at the end of the scheduled follow-up period (Analysis 2.1). Fewer deaths were observed in the time between baseline assessment and the end of the intervention in the intensive mixed training group of the Langhammer 2007 trial (1/32) than in the usual rehabilitation group (4/35) (Analysis 5.1). Three trials reported the number of deaths that occurred between end of intervention and end of the scheduled follow-up

period in stroke survivors receiving mixed training (Cooke 2010; Duncan 2003; Langhammer 2007). Mixed training in stroke survivors compared with the usual rehabilitation programme did not increase the probability of death after completion of the training intervention (OR 0.27, 95% CI 0.05 to 1.37) (Analysis 6.1).

Death or dependence

The composite outcome of death or dependence was not reported by any trial.

Disability

Cardiorespiratory training

Few trials of cardiorespiratory training shared the same outcome measures and therefore few data were available for meta-analyses. Two trials with a total of 110 participants (Cuviello-Palmer 1988; Katz-Leurer 2003) used the Functional Independence Measure (FIM) to assess disability outcomes after usual care and found no significant difference between fitness training and standard rehabilitation at the end of the intervention (SMD 0.17, 95% CI -0.29 to 0.63) (Analysis 1.1). Similarly, Bateman 2001 did not find any improvement in the FIM score after training, at the end of the intervention during usual care (SMD 0.23, 95% CI -0.32 to 0.78) (Analysis 1.1). In the Bateman 2001 trial, however, the procedures for obtaining FIM data at end of intervention were not uniform and there was a high proportion of missing data (38%). Mudge 2009 assessed participants after usual care using the Physical Activity and Disability scale but found that cardiorespiratory training was not significantly better than a control 'non-exercise' intervention at the end of the training period (MD 19.90, 95% CI -17.58 to 57.38) (Analysis 2.4), but confidence intervals were wide.

At the end of follow-up three individual trials used different scales (Rivermead Mobility Index; Nottingham Extended ADLs; Physical Activity and Disability Scale; Frenchay Activities Index) to assess functional activities and disability outcomes during (Bateman 2001) and after usual care (Katz-Leurer 2003; Mudge 2009). We were not able to combine the results as the functional scales included in these trials cover slightly different domains and because one trial (Bateman 2001), which had a considerable proportion of missing data (21%), reported results from more than one single scale. No training effect was evident in each individual analysis.

Resistance training

Ouellette 2004 assessed participants' functional abilities and disability outcomes by means of the Late Life Function and Disability Instrument (LLFD). This scale, however, has not been validated in stroke survivors and we have not included it in the analyses. The remaining trials either did not measure disability outcomes or used subscales or specific dimensions of existing functional scales (Inaba 1973; Winstein 2004), which we did not deem suitable for inclusion.

Mixed training

Four trials (Duncan 1998; Duncan 2003; Langhammer 2007; Mead 2007) assessed the effects of mixed training at the end of the treatment phase or at follow-up using a variety of scales which measured disability outcomes (Lawton IADL, Barthel Index, FIM, Notthingham Extended ADLs, Rivermead Mobility Index, Stroke Impact Scale). We were able to pool only Lawton IADL results and Barthel Index and FIM scores in combination. There were no significant training effects at the end of intervention (Analysis 5.2; Analysis 5.4) or at follow-up (Analysis 6.3). It is worth noting that two trials included in the analyses (Duncan 1998; Duncan 2003) were confounded by increased training time and one trial by the fact that the Barthel Index scores reached ceiling level in five out of 20 participants at baseline and 10 out of 20 participants at follow-up (Duncan 1998).

Results of the remaining rating scales, reported by individual trials, did not show any significant effect of mixed training at either the end of intervention or at follow-up.

Effect of training on secondary outcomes

Adverse events

Adverse events were not reported systematically in the included trials.

Mead 2007 reported 11 falls in eight of 32 patients in the exercise group and five falls in four of 34 patients in the control group (P = ns). None of these falls occurred within training sessions.

Eight of the 32 included trials provided some comments on the patient tolerance of the training programme and did not report any adverse events such as falls, fractures, or injuries arising during the intervention.

Considering all included trials, four participants (three participants receiving the training intervention and one control) were reported to have suffered a cerebrovascular event between baseline and the end of the training intervention.

In the 15 trials which included a follow-up assessment, seven participants (three participants receiving the training intervention and four controls) were reported to have suffered a cerebrovascular event between the end of intervention and the end of follow-up.

Three participants (one participant receiving the training intervention and two controls) were also reported to have suffered a cardiovascular event between baseline and the end of the training intervention.

Vascular risk factors

Few data regarding modification of risk factors for cardiovascular and cerebrovascular events were available in the included trials. Four trials (da Cunha 2002; Katz-Leurer 2003; Lennon 2008; Potempa 1995) with a total of 267 participants measured systolic and diastolic blood pressure at the end of the cardiorespiratory training. There were no significant training effects on systolic (MD 0.40 mm Hg, 95% CI -8.38 to 9.18) (Analysis 1.4) or diastolic measures (MD -0.33 mm Hg, 95% CI -2.97 to 2.31) (Analysis 1.5).

Low values of peak VO_2 indicate poor cardiorespiratory fitness and are a risk factor for cardiovascular and cerebrovascular events. An improvement in peak VO_2 caused by cardiorespiratory training and to a lesser extent by mixed training therefore represents a risk reduction.

Physical fitness

Cardiorespiratory training (Comparisons 1 and 2)

Four trials with a total of 120 participants measured the peak VO_2 at the end of the training period during (da Cunha 2002) and after (Lennon 2008; Moore 2010; Potempa 1995) usual care. Cardiovascular fitness increased significantly in the training group (MD 2.14 ml/kg/minute, 95% CI 0.50 to 3.78) (Analysis 1.6). Similarly, in four trials that measured maximal cycling work rate at the end of intervention during (Bateman 2001; da Cunha 2002) and after (Katz-Leurer 2003; Potempa 1995) usual care, cardiorespiratory fitness improved significantly in participants who received the training intervention (SMD 0.60, 95% CI 0.18 to 1.02) (Analysis 1.8). Results from one individual trial (Bateman 2001) showed that the improvement measured by maximal cycling work rate was not maintained at follow-up (MD 5.11, 95% CI -18.93 to 29.15) (Analysis 2.7). The Bateman 2001 work rate data were transformed to normal distribution (Log_e) data with 8% missing values.

VO_2 cost assessed during the 12-minute walking test in the Moore 2010 trial did not show any significant training effect at the end of intervention (Analysis 1.7).

Resistance training (Comparisons 3 and 4)

Two trials with a total of 30 participants assessed the effects of resistance training on muscle strength at the end of intervention, during and after usual care (Kim 2001; Winstein 2004). Kim 2001 used a composite measure (that is the sum of the percentage change in six muscle groups) to assess the strength of the lower limbs while Winstein 2004 used a composite measure (that is the sum of the torque of the extensors and flexors of the wrist, elbow, and shoulder) to assess the strength of the upper limbs. The pooled estimate of effect was only marginally in favour of the resistance training group (SMD 0.58, 95% CI 0.06 to 1.10) (Analysis 3.1). However, the Winstein 2004 trial was biased by the lack of blinding and the use of a dynamometer which was hand-held by the investigator, and confounded by increased training time in the intervention group.

Two trials with a total of 42 participants assessed the effects of training on knee muscle strength measured with a dynamometer at the end of intervention during (Bale 2008) and after (Flansbjer 2008) usual care but did not detect any significant training effect (Analysis 3.2; Analysis 3.3). Follow-up data were available for only one of these two trials (Flansbjer 2008) and did not show any significant training effect over time (Analysis 4.1; Analysis 4.2).

Ouellette 2004 examined strength bilaterally in the lower limb extensors and unilaterally in the knee extensors and the ankle flexors (plantar and dorsi). All strength measures were reported to improve significantly after resistance training compared with the control group except for ankle dorsiflexion on the unaffected side. This study also suggested that peak power was improved during unilateral knee extensions but not during bilateral extension of the whole lower limb. However, as strength and power data were presented as graphs, we were not able to extrapolate them satisfactorily for further analyses.

Inaba 1973 reported that participants allocated to resistance training of the lower limbs achieved significantly greater gains in the 10-repetition maximum exercise compared with controls (12.18 versus 8.58 kg, $P < 0.02$) after one month of intervention. No significant differences were observed between groups after two months of training. No measures of variance were reported by this trial and therefore we were not able to include these data in our analyses.

Mixed training (Comparisons 5 and 6)

Based on the results of two individual trials a small significant difference was observed in VO_2 peak (Duncan 2003) and in gait economy (Mead 2007: net VO_2 mL/kg per metre) at the end of intervention in participants who received mixed training (Analysis 5.8; Analysis 5.9). The benefit in gait economy, however, disappeared after a three-month follow-up (Analysis 6.6).

Bateman 2001 reported a significant retention of maximum cycling workload at the scheduled three-month follow-up. However, we did not include these data in the analyses due to the high proportion of missing values (21%) in this trial.

Two trials with a total of 148 participants (Duncan 2003; Yang 2006) did not show any significant improvement in ankle dorsiflexion strength after mixed training (Analysis 5.10) but there was considerable heterogeneity between their results (Chi^2 17.67, df = 1) and both trials were confounded for increased training time. Yang 2006 also reported a range of lower limb strength improvements, but all measurements were potentially biased as they were obtained by means of a hand-held dynamometer, which is not a reliable, objective method of measurement.

The same two trials also assessed the effect of mixed training on knee extension strength. Data for knee extension strength were also available from the Cooke 2010 trial. The pooled SMD indicated a small effect size in favour of the mixed training group at the end of intervention (SMD 0.36, 95% CI -0.02 to 0.73) (Analysis 5.11). The Cooke 2010 trial showed that this training effect was not retained at the end of the scheduled follow-up (Analysis 6.8). Cooke 2010 also assessed knee flexion strength but no significant training effect was observed either at the end of intervention or at follow-up (Analysis 5.12; Analysis 6.7). Another trial (Mead 2007) assessed the extensor power of the lower affected limb at the end of the training period and at follow-up but found no differences between mixed training and a 'non-exercise' control intervention (Analysis 5.17; Analysis 6.9).

The pooled results of two trials assessing grip strength of the paretic hand (Duncan 2003; Langhammer 2007) did not show any significant improvement after mixed training at the end of the intervention phase (SMD -0.05, 95% CI -0.36 to 0.26). Langhammer 2007 also provided follow-up data for grip strength, which failed to demonstrate any training effect over time (Analysis 6.10).

One trial (Donaldson 2009) assessed the effect of mixed training on elbow extension, elbow flexion, and grip force at the end of intervention but did not detect any significant training effect (Analysis 5.13; Analysis 5.14; Analysis 5.16).

Mobility

Cardiorespiratory training (Comparisons 1 and 2)

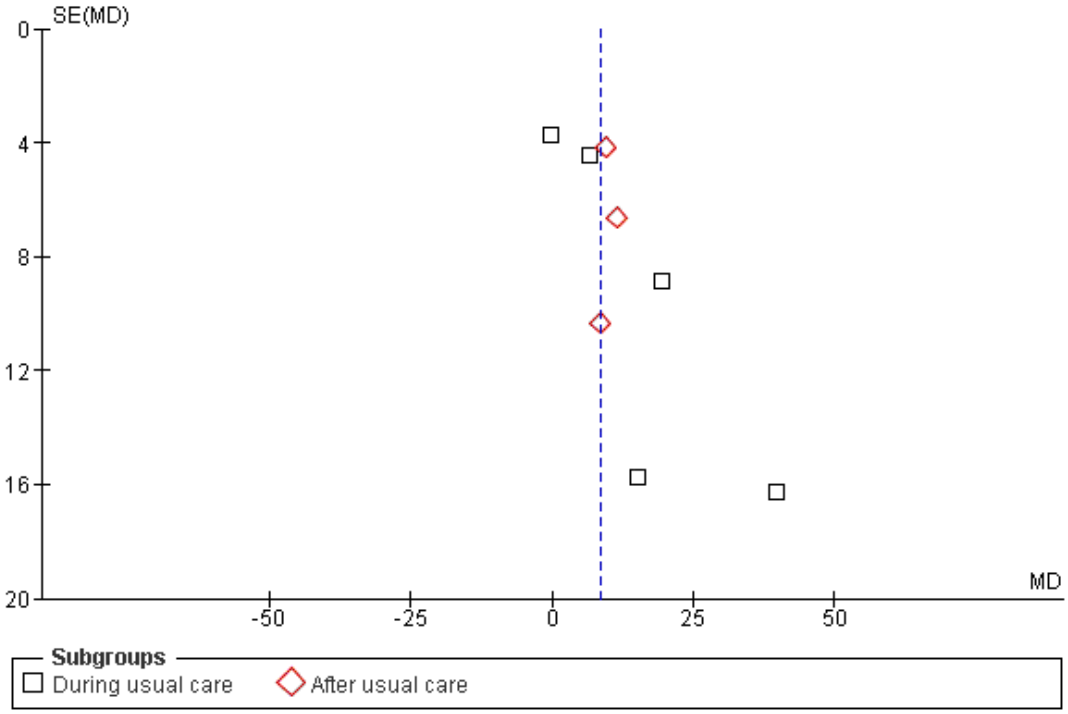
Two trials, which included three relevant comparisons and 73 participants, measured the effect of treadmill gait training using the Functional Ambulation Category (FAC) scale (da Cunha 2002; Pohl 2002). The pooled MD showed that the FAC score measured at the end of intervention was significant lower in stroke survivors who received cardiorespiratory training during usual care (MD 0.53, 95% CI 0.21 to 0.85; level of heterogeneity Chi^2 = 1.38, df = 2, P = 0.50) (Analysis 1.10).

Seven trials with a total of 365 participants measured maximum walking speed (metres per minute) at the end of the intervention period during (Bateman 2001; da Cunha 2002; Eich 2004; Pohl 2002) and after (Moore 2010; Mudge 2009; Salbach 2004) usual care. The cardiorespiratory training in all these trials was walking specific apart from two trials that used cycle ergometry (Bateman 2001) and circuit training (Mudge 2009) respectively. The pooled mean difference was significantly in favour of the training group (MD 8.66, 95% CI 2.98 to 14.34; level of heterogeneity Chi^2 = 10.89, df = 7, P = 0.14) (Analysis 1.11). We also analysed the results of these seven trials according to whether they met the ACSM criteria for cardiorespiratory training (Analysis 1.12). Surprisingly, the trials that met the ACSM criteria did not show any difference between intervention groups whilst those that did not meet the criteria (or in which the criteria were not clearly reported) showed a significant cardiorespiratory training effect.

Three trials also provided follow-up data on maximum walking speed (Bateman 2001; Eich 2004; Mudge 2009) and a significant training effect was observed at the end of follow-up, three months after training had finished (MD 8.21, 95% CI 3.38 to 13.05; level of heterogeneity Chi^2 = 0.70, df = 2, P = 0.70) (Analysis 2.9).

A funnel plot of the seven studies (including eight relevant comparisons) that measured maximum walking speed showed a tendency toward asymmetry, suggesting potential publication bias (Figure 1). However, there were too few data points to explore this further reliably.

Figure 1. Funnel plot of comparison: 1 Cardiorespiratory training versus control - end of intervention, outcome: 1.11 Mobility - maximal gait speed (m/min over 5 to 10 metres).



Four trials measured the preferred gait speed (metres per minute) in a total of 221 stroke survivors at the end of the training period during (Cuviello-Palmer 1988) and after (Katz-Leurer 2003; Moore 2010; Salbach 2004) usual care. The type of cardiorespiratory training in all these trials was walking specific apart from one trial (Katz-Leurer 2003) which used cycle ergometry. The pooled mean difference indicated a significant training effect (MD 4.68, 95% CI 1.40 to 7.96; level of heterogeneity Chi^2 = 1.04, df = 3, P = 0.79) (Analysis 1.13).

Four trials also assessed walking capacity (metres walked in six minutes: 6-MWT) in a total of 219 stroke survivors. Cardiorespiratory training significantly increased the walking capacity at the end of the training phase (MD 47.13, 95% CI 19.39 to 74.88; level of heterogeneity Chi^2 = 2.07, df = 3, P = 0.56) (Analysis 1.14). Follow-up data from two trials during (Eich 2004) and after (Mudge 2009) usual care demonstrated retention of the training effect over time (Analysis 2.10). Similarly, three trials measured walking endurance (metres per minute) in 154 stroke survivors at the end of intervention, during (da Cunha 2002; Eich 2004) and after (Salbach 2004) usual care. Walking capacity increased significantly in participants who received cardiorespiratory training (MD 8.87, 95% CI 1.35 to 16.40; level of heterogeneity Chi^2 = 3.47, df = 2, P = 0.18) (Analysis 1.15).

One trial (Glasser 1986) measured the time taken by stroke participants to walk a six metre distance and did not find any significant difference between participants who received Kinetron walking training and controls (Analysis 1.16).

Another trial (Mudge 2009) measured the number of steps per minute and the maximum step rate per minute in 58 stroke survivors. Significant effects of cardiorespiratory circuit training were observed in both outcome measures at the end of the training period (Analysis 1.18; Analysis 1.19) and at follow-up (Analysis 2.11; Analysis 2.12).

One trial (Smith 2008) assessed the effect of cardiorespiratory training using the mobility domain of the Stroke Impact Scale (SIS). SIS scores were similar between intervention groups at the end of the intervention and at follow-up (Analysis 1.17; Analysis 2.13).

It is worth noting that three trials (Katz-Leurer 2003; Moore 2010; Smith 2008), which assessed walking outcomes, were potentially confounded by additional training time.

Resistance training (Comparisons 3 and 4)

Four trials with a total of 104 participants measured maximal walking speed (metres per minute) during (Bale 2008) and after

(Flansbjer 2008; Kim 2001; Ouellette 2004) usual care. Overall, resistance training did not increase the walking velocity at the end of intervention (MD 1.92, 95% CI -3.50 to 7.35) (Analysis 3.4). There was, however, definite heterogeneity between trial results (Chi^2 = 7.76, df = 3, P = 0.05). The heterogeneity was mainly due to the results of one trial (Bale 2008) which involved specific walking-related exercises and, in contrast to the results of the other three trials, showed a significant training effect during usual care (MD 8.40, 95% CI 2.82 to 13.98). Follow-up data were available from one trial only (Flansbjer 2008) and did not show any significant training effect (Analysis 4.3).

Three trials with a total of 80 participants also measured preferred gait speed (metres per minute) during (Bale 2008) and after (Kim 2001; Ouellette 2004) usual care but failed to demonstrate any effect of resistance training on walking speed at the end of intervention (MD 2.34, 95% CI -6.77 to 11.45) (Analysis 3.5). Heterogeneity between results (Chi^2 = 9.18, df = 2, P = 0.01) was again attributable to the results of the Bale 2008 trial.

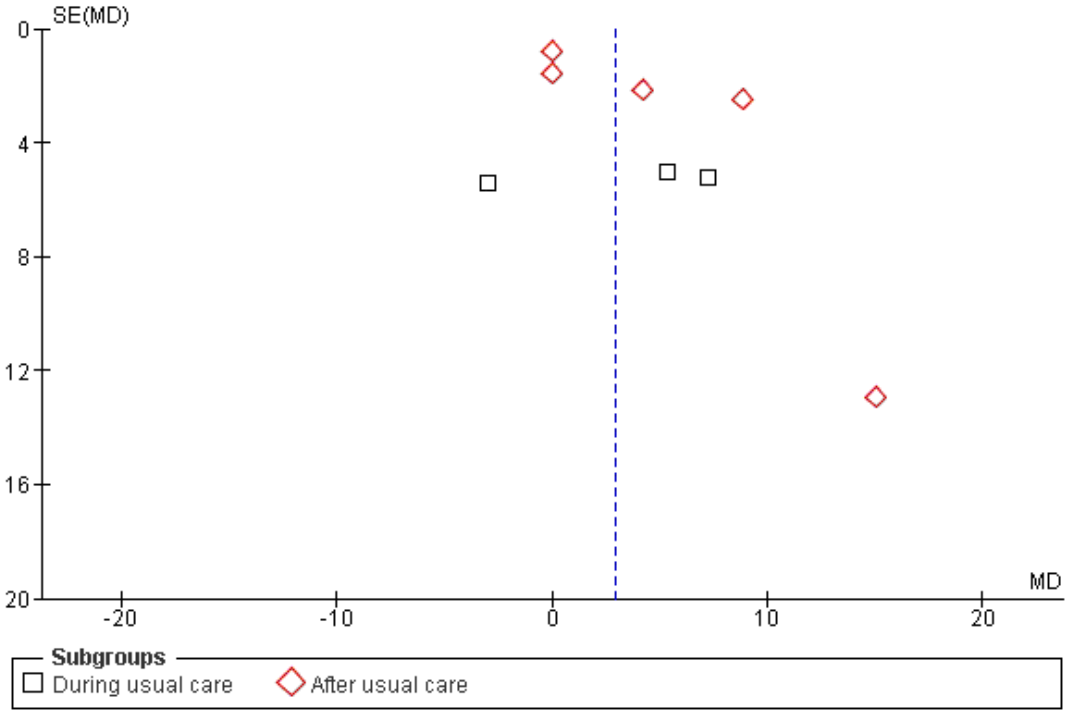
Two trials assessed the walking capacity (metres walked in six minutes) in a total of 66 stroke survivors (Flansbjer 2008; Ouellette 2004). Resistance training did not have any significant effect on walking capacity at the end of intervention (MD 3.78, 95% CI -68.56 to 76.11; level of heterogeneity Chi^2 = 0.00, df = 1, P = 0.99) (Analysis 3.6). One trial (Flansbjer 2008) provided follow-up data that confirmed the lack of training effect on walking capacity at the end of follow-up (Analysis 4.4).

Mixed training (Comparisons 5 and 6)

Eight studies with a total of 397 participants measured the effects of mixed training on preferred walking speed (metres per minute) during (Cooke 2010; Richards 1993; Richards 2004) and after (Duncan 1998; James 2002; Mead 2007; Teixeira 1999; Yang 2006) usual care. The walking speed increased (borderline statistical significance P = 0.05) at the end of intervention in stroke survivors who received mixed training (MD 2.93, 95% CI 0.02 to 5.84) (Analysis 5.18). The test for heterogeneity displayed moderate significance (Chi^2 = 17.92, df = 7, P = 0.01). Trials in which the experimental group was confounded by additional training time showed a non-significant difference in favour of mixed training (MD 4.43, 95% CI -0.13 to 8.99) whilst trials not confounded by additional training time did not (MD 0.49, 95% CI -2.96 to 3.94). The test of heterogeneity was significant in both subgroups (Analysis 5.19).

A funnel plot that was generated using continuous measures for preferred walking speed at the end of intervention did not suggest the presence of publication bias as its shape did not show gross asymmetry (Figure 2).

Figure 2. Funnel plot of comparison: 5 Mixed training versus control - end of intervention, outcome: 5.18 Mobility - preferred gait speed (m/min).



Three trials that provided follow-up data for preferred gait speed (Cooke 2010; Mead 2007; Richards 1993) did not show a significant training effect at the end of the scheduled follow-up (Analysis 6.11).

One study showed some indication of dose-response, where the improvement in preferred gait speed was positively associated with the amount of time spent on the gait training component (R^2 = 0.63) (Richards 1993).

Three trials measured the walking capacity (metres walked in six minutes) in a total of 168 participants after usual care (Duncan 1998; Duncan 2003; Yang 2006). Walking capacity increased significantly in the mixed training group (MD 30.59, 95% CI 8.90 to 52.28; level of heterogeneity Chi^2 = 0.84, df = 2, P = 0.66) (Analysis 5.20). It is worth noting, however, that in these trials the intervention group was potentially confounded by additional training time.

Three trials measured community ambulation speed (the ability to walk at 0.8 metres per second or more) in a total of 232 participants during (Cooke 2010) and after (Duncan 2003; Mead 2007) usual care. No significant training effects were observed either at the end of intervention or at follow-up (Analysis 5.21; Analysis 6.12).

Comparison of cardiorespiratory, resistance training, and mixed training (Comparison 7)

We performed a subgroup analysis to compare the effects of the different types of training (cardiorespiratory training versus mixed training versus resistance training). Walking speed increased significantly after cardiorespiratory training and showed a trend towards significance after mixed training. No significant training effect was observed on walking speed after resistance training (Analysis 7.1).

We repeated the analysis after removing the trials that were potentially confounded by additional training time. Only cardiorespiratory training showed a significant training effect (Analysis 7.2).

Physical function

The included trials assessed participants' physical function using a variety of different measures including rating scales (for example Berg Balance Scale) and specific measures of functional performance (for example functional reach, timed up and go test, stair climbing).

Cardiorespiratory training (Comparisons 1 and 2)

Three trials with a total of 188 participants assessed the effects of cardiorespiratory training on balance during (Bateman 2001) and after (Moore 2010; Salbach 2004) usual care using the Berg Balance Scale. Scores were not significantly different between intervention groups at the end of the training period (MD 1.52, 95% CI -1.80 to 4.84; level of heterogeneity Chi^2 = 0.82, df = 2, P = 0.66) (Analysis 1.20). One trial (Bateman 2001) also assessed participants at the end of the follow-up period but did not show any training effect over time (Analysis 2.14; Analysis 2.15).

Two trials (Moore 2010; Salbach 2004) that measured the performance of a total of 111 participants during the timed up and go test did not show any specific benefits of training at the end of the intervention after usual care (Analysis 1.21).

Resistance training (Comparisons 3 and 4)

One trial (Bale 2008) assessed the maximum weight-bearing on the affected leg (% body weight). A small training effect was observed in the resistance training group compared with the usual rehabilitation group (MD 11.80, 95% CI 0.89 to 22.71) (Analysis 3.7).

Two trials (Kim 2001; Ouellette 2004) did not find any significant differences between intervention groups in the time needed to ascend a 10-stair flight at the end of the training period (MD -0.04, 95% CI -0.86 to 0.77; level of heterogeneity Chi^2 = 2.30, df = 1, P = 0.13) (Analysis 3.8).

Another trial (Flansbjer 2008) measured the participants' performance of the timed up and go test but failed to demonstrate any significant training effect either at the end of intervention (Analysis 3.9) or at follow-up (Analysis 4.5).

Mixed training (Comparisons 5 and 6)

Four trials with a total of 199 participants assessed the participants' balance using the Berg Balance Scale during (Richards 1993; Richards 2004) and after (Duncan 1998; Duncan 2003) usual care. Berg Balance scores were not significantly different between intervention groups at the end of the training period (Analysis 5.22). Follow-up data from one trial (Richards 2004) did not show any significant training effect (Analysis 6.13).

Two trials (Duncan 2003; Mead 2007) with a total of 166 participants measured balance using the functional reach test but did not show any benefit of mixed training at the end of intervention (Analysis 5.23). One trial also provided follow-up data (Mead 2007), which did not show persistence of any training effect beyond the duration of intervention.

Three trials measured the time to complete the timed up and go test in a total of 176 participants (Mead 2007; Richards 2004; Yang 2006). Participants in the training group were slightly faster than those in the control group (MD -1.13, 95% CI -2.05 to -

0.21; level of heterogeneity Chi^2 = 0.08, df = 2, P = 0.96) (Analysis 5.26) at the end of the mixed training phase. The Yang 2006 data were, however, confounded by additional training time. After removal of these data from the analysis no significant training effect was evident (MD -1.13 seconds, 95% CI -2.91 to 0.65) (Analysis 5.27). Follow-up data from the two unconfounded trials (Mead 2007; Richards 2004) did not show a significant retention of mixed training benefits (Analysis 6.15).

One trial assessed upper extremity functional performance using the nine hole peg test (for fine motor coordination) and the Action Research Arm test (Donaldson 2009). No significant training effects were observed in either test at the end of intervention (Analysis 5.24; Analysis 5.25).

Health status and quality of life

Cardiorespiratory training (Comparisons 1 and 2)

Only one trial assessed the effects of cardiorespiratory training on measures of quality of life, in 28 participants (Aidar 2007). Both the SF-36 physical component score and the SF-36 emotion score were significantly better at the end of the training period in participants who underwent cardiorespiratory training (Analysis 1.22; Analysis 1.23).

Resistance training (Comparisons 3 and 4)

One small trial of 20 participants (Kim 2001) did not show any significant differences between the resistance training group and the control group in either the physical health or mental health component of the SF-36 at the end of intervention (Analysis 3.10; Analysis 3.11).

Mixed training (Comparisons 5 and 6)

One trial (Cooke 2010) measured the effects of mixed training on quality of life in 50 participants using two components of the EuroQuol scale. Scores were not significantly different between intervention groups at the end of the training phase (Analysis 5.28; Analysis 5.29) or at follow-up (Analysis 6.16; Analysis 6.17).

A few trials assessed the effects of mixed training on quality of life using different components of the SF-36 survey questionnaire. In two trials with a total of 112 participants (Duncan 2003; James 2002) significantly better scores were obtained in the SF-36 physical functioning component in the mixed training group at the end of intervention (SMD 0.48, 95% CI 0.10 to 0.85) (Analysis 5.30) but not in the social role functioning component (Analysis 5.31). Three trials with a total of 178 participants (Duncan 2003; James 2002; Mead 2007) showed significantly better scores in the SF-36 physical role functioning for the mixed training group at the end of intervention (SMD 0.56, 95% CI 0.26 to 0.86) (Analysis 5.32). This effect was retained at follow-up (Analysis 6.19).

One trial (Duncan 2003) showed that participants receiving mixed training had significantly better results in the emotional role functioning component of the SF-36 compared with controls at the end of the training period (Analysis 5.33) but not at follow-up (Analysis 6.20).

It is worth noting that in the Duncan 2003 and James 2002 trials the intervention group was potentially confounded by additional training time.

Mood

Cardiorespiratory training (Comparisons 1 and 2)

One trial (Smith 2008) assessed the potential benefits of cardiorespiratory training on depression symptoms using the Beck Depression Index. No significant differences were found between intervention groups at the end of intervention (Analysis 1.24) and at follow-up (Analysis 2.16).

One trial (Bateman 2001) assessed participants using the anxiety and depression components of the Hospital Anxiety and Depression Scale (HADS). The anxiety score decreased immediately after cardiorespiratory training (MD -1.94, 95% CI -3.80 to 0.08) (Analysis 1.25) but this small benefit was not retained at the follow-up assessment (Analysis 2.17). In contrast, the depression score was not significantly different between groups at the end of the training phase (Analysis 1.26) but decreased significantly in the cardiorespiratory group at the end of the follow-up period (MD -2.70, 95% CI -4.40 to -1.00) (Analysis 2.18). This trial had, however, substantial missing values at the end of intervention (29%) and end of follow up (37%) and therefore these findings should be interpreted with caution. Another trial (Lennon 2008), which measured participants' mood using the HADS, reported that the depression score improved in the intervention group but not in the control group. We were, however, unable to include these trial data in out analyses as they were presented in a format not suitable for RevMan.

Resistance training (Comparisons 3 and 4)

One trial (Sims 2009) assessed 88 participants using the Centre for Epidemiological Studies for Depression scale (CES-D). The mood in the resistance training group was significantly better at the end of intervention (MD -5.49, 95% CI -9.78 to -1.20) (Analysis 3.12) and at follow-up (MD -8.92, 95% CI -13.03 to -4.81) (Analysis 4.6).

Mixed training (Comparisons 5 and 6)

One trial (Duncan 2003) assessed participants' mood using both the emotion domain of the Stroke Impact Scale (SIS) and the Geriatric Depression Scale. SIS emotion scores were slightly significantly different between intervention groups at the end of the

training phase (Analysis 5.34) whilst the Geriatric Depression scale score significantly improved after mixed training (Analysis 5.35). Follow-up measurements did not show any significant training effect for both scales (Analysis 6.21; Analysis 6.22).

One trial (Mead 2007) assessed 66 participants using the anxiety and depression components of the Hospital Anxiety and Depression Scale (HADS). No immediate or retained training effects were observed on either HADS component at the end of the intervention (Analysis 5.36; Analysis 5.37) or at follow-up (Analysis 6.23; Analysis 6.24).

DISCUSSION

The included trials encompassed a variety of outcome measures. This has been a typical drawback of stroke rehabilitation trials for some time (Greener 2002) and continues to be a problem when summarising and combining data in a systematic review.

Effect of training on primary outcome measures

Case fatality

It is not known whether physical fitness training reduces case fatality. The observed numbers of deaths in this review may be low because the included participants were at lower risk of death compared with the wider stroke population. This may occur firstly because the inclusion criteria of the trials of exercise select participants with milder strokes (most were ambulatory) and reduced risk factors (such as blood pressure ceiling criteria). Secondly, there may be self-selection by participants who are physically active with increased fitness. Higher physical activity is known to be associated with reduced risk of stroke (Lee 2003; Wendel-Vos 2004) and higher VO_2 peak is associated with reduced risk of stroke (Kurl 2003) and mortality (Lee 2002). In addition, the majority of the training programmes in this review are all of very short duration (12 weeks or less). A Cochrane Review of the effect of exercise-only interventions showed that exercise reduced deaths in people with coronary heart disease (Jolliffe 2002), but the training programmes often lasted several years. Since many stroke patients have coexisting heart disease, training might influence post-stroke mortality provided it comprised cardiorespiratory training delivered over long periods of time. This requires investigation.

Although higher physical activity and cardiorespiratory fitness are linked to primary prevention of stroke, there is a lack of data on the role of fitness training in secondary prevention of stroke. This requires further investigation.

Death or dependence

There are no available data to draw conclusions about the influence of training on the composite outcome of death or dependence after stroke. Death is infrequent and measures of dependency such as those based on simple questions, a Barthel Index score of less than 20, or modified Rankin Scale score of 3, 4, or 5 are lacking (Lindley 1994). Both elements of this composite outcome are likely to be rare in stroke survivors who are eligible for physical fitness training.

Disability

We assessed a number of different global indices of disability. Limited data were suitable for meta-analysis and there was no good evidence of either an immediate or retained effect of fitness training on disability. There may be several reasons for this. Firstly, we identified a number of methodological issues which weaken and bias these limited data. Secondly, some measurement tools lacked sensitivity due to the recruitment of patients typically presenting with milder strokes. There was evidence of ceiling effects in the Barthel Index data from two trials (Bateman 2001; Duncan 1998). Similarly, the Functional Independence Instrument, which was assessed in some of the included studies, is known to be prone to ceiling effects, particularly in community living patients (Hall 1996). Thirdly, a lack of effect on disability measures despite functional benefits has been reported in trials of exercise for healthy elderly people (Keysor 2001).

It is worth pointing out that a lack of an immediate effect does not necessarily preclude longer-term benefits. An increased fitness reserve may ameliorate the deterioration of function which will occur with increasing age and thus postpone crossing thresholds of independence (Young 2001). Therefore, indicators of pre-clinical disability (Fried 1996) coupled with long-term follow-up may be a more useful approach for assessing outcomes in trials of fitness training after stroke.

On the whole, there were insufficient data to perform further statistical analyses and to draw reliable conclusions on the impact of physical fitness training on death, dependence, or disability after stroke.

Effect of training on secondary outcome measures

Adverse events

There was no evidence of any serious adverse event arising from training in patients who participated in physical fitness training programmes. However, this finding cannot be generalizable to the wider stroke population as only a few trials specifically recorded or reported adverse events. There is a clear need to improve the reporting of adverse events in physical fitness training trials.

Vascular risk factors

A few trials reported vascular risk factors. There was no effect on blood pressure but there was an increase in peak VO_2. As well as indicating poor cardiorespiratory fitness, low values of peak VO_2 peak are associated with an increased risk of stroke (Kurl 2003) and stroke mortality (Lee 2002). Limited data mean that no conclusions can be drawn.

Physical fitness

Cardiorespiratory fitness

Cardiorespiratory training, and to a smaller degree mixed training, significantly improved VO_2 peak and exercise tolerance during continuous exercise. This improvement may be beneficial because a low VO_2 peak is associated with functional limitation in elderly people (Young 2001). In people with stroke the functional benefits are however less clear (see for example the contradictory data by Patterson 2007 and Michael 2007).

Gait economy may improve in response to training that contains walking activity. A limited 'fitness reserve' caused by a low VO_2 peak coupled with poor walking economy is a common post-stroke problem (Macko 2001). Therefore, training to improve walking economy and increase the peak may be beneficial for walking performance and exercise tolerance after stroke. Only few, inconsistent data were available for the assessment of gait economy. Data from one individual trial (Mead 2007) suggest that mixed training may improve gait economy at the end of the training period even though this training effect seems to disappear at follow-up. On the whole, the data were insufficient to draw reliable conclusions on the effect of training on gait economy as well as on the post-training retention of cardiorespiratory fitness.

Musculoskeletal fitness

The few trials that assessed whether resistance training or mixed training improved muscle strength after stroke show inconsistent results. Most of the trials that showed positive training effects were either methodologically biased or confounded for additional training time.

One individual trial (Mead 2007) measured explosive lower limb extensor power but showed no immediate or retained effect of mixed training. Non-response could be due to a lack of explosive, fast movements during resistance training. In people with stroke, explosive power is associated with function and disability after stroke (Saunders 2008), and in elderly people explosive power output may be more important than strength for function and disability (Puthoff 2007). Interventions to improve explosive power after stroke remain under-researched (Evans 2000).

Mobility

Meta-analyses of the available data using a random-effects model demonstrated that cardiorespiratory training increased walking speed and walking capacity at the end of the training period (Analysis 1.11; Analysis 1.13; Analysis 1.14). This training effect was retained at follow-up, after the intervention had stopped (Analysis 2.9; Analysis 2.10). Gait improvements in stroke survivors after cardiorespiratory training may occur due to an increased fitness reserve (arising from an increased VO_2 peak or improved gait economy, or both). Cardiorespiratory walking training is, however, task-related and repetitive in nature. These elements by themselves may facilitate motor learning and benefit gait performance even in the absence of an obvious improvement in physical fitness parameters.

There is also evidence that walking speed and walking capacity may increase at the end of the training phase after mixed training (Analysis 5.18; Analysis 5.20). These findings are based, however, on trials which were heterogeneous and potentially confounded by additional training time. When we looked only at the results of the 'unconfounded' trials, we did not find any significant training effect (Analysis 5.19). Moreover, all trials except one (Yang 2006) included specific walking training. Therefore, benefits may be explained by the additional walking practice and treatment 'attention'.

Meta-analyses revealed no significant effects of resistance training on walking outcomes. It is worth noting that most of the resistance training interventions did not incorporate walking as a mode of exercise. Improvements in muscle strength may not necessarily produce functional benefits (Kim 2001), which translate into a better walking performance. The relationships between 'fitness' and 'function' is indeed very complex and may arise from factors such as non-linear associations (Buchner 1991) or the interaction of 'co-impairments' such as lack of balance and low muscle strength (Rantanen 2001).

On the whole, there is evidence that measures of walking performance improve after cardiorespiratory training and, to a lesser degree, after mixed training but not after resistance training (see Table 4).

Physical function

A variety of measures to assess functional limitations were used in the included trials. Only a few trials shared the same outcome measures. On the whole, no significant effects of cardiorespiratory, resistance, or mixed training were observed on physical function outcomes. The few trials that showed a small effect of mixed training on the timed up and go test were confounded by increased training time.

Health status and quality of life

Only a limited number of trials, with inconsistent results, included relevant quality of life measures. Therefore, few conclusions can

be drawn on whether training can improve self-perceived health status and quality of life after stroke.

One small trial (Aidar 2007) showed that both the physical functioning and the emotional role functioning of the SF-36 survey were significantly better after cardiorespiratory training.

Two trials, confounded by additional training time, showed better results on the physical functioning but not the social role functioning of the SF-36 survey after mixed training. Similarly, three trials demonstrated both immediate and long-term benefits of mixed training on the 'physical role functioning' of the SF-36 survey. The scoring of this domain is, however, problematic in people - such as stroke survivors - who are not engaged in employment (Johnson 1999). Furthermore, various elements of the SF-36 survey are prone to ceiling effects (Hobart 2002).

A small individual trial did not show any significant effect on the physical functioning and mental health components of the SF-36 health survey after resistance training.

Mood

Only data from individual trials of variable methodological quality were available to assess the effects of training on mood. Results were not consistent amongst trials and no conclusions can be drawn.

Factors influencing primary and secondary outcome measures

Dose of training

All the training interventions occurred regularly and were progressive in nature. The interventions differed in the dose of training, quantified in terms of (1) overall volume of training time, and (2) the intensity of the exercise used.

The ACSM 1998 criteria were used to define an effective overall 'dose' of fitness training as defined by the parameters of intensity, duration, and frequency. One of the few intended subgroup analyses which explored this showed that benefit was not clearly linked to those studies which met the criteria. This illustrates the problem of performing subgroup analyses when the number of trials is small; the consequences are reduced power and the influence of characteristics unrelated to the grouping factors, in this case the potentially powerful effect of the type of training. Some study interventions may have provided a sufficient dose of training but failure to record or report intensity meant they could not be assigned to a category. Conversely, interventions meeting the criteria may have provided a low dose of training because they were of short duration (for example Kwakkel 2004).

Underestimation of benefits may arise if interventions are poorly attended or complied with. Full attendance was found in few included trials, where interventions occurred partly or completely during inpatient care, were home-based, or were of very short duration (four weeks).

Overestimation of benefits may arise in trials where the intervention group is potentially confounded by increased training time compared with the control group. A further exaggeration of this simple 'dose' effect would also be expected for trials with long duration or large volumes of training, or both. In most confounded trials the total volume of training was 20 hours or more, whilst only few unconfounded trials exceeded 20 hours of training. Published meta-analyses have shown that augmented stroke rehabilitation may result in improvements in activities of daily living (Kwakkel 2004). This source of confounding may influence the outcome in trials of physical fitness training. For example, in the few instances when we excluded confounded trials in sensitivity analyses, the effect sizes became smaller. The data of Richards 1993 supported these observations, showing that longer gait training was associated with improved mobility outcomes (this may also be indicative of a dose-response effect).

Exercise programme intensity is one of the most important fitness training variables. Only the Pohl 2002 trial assessed intensity of training and demonstrated that higher intensity walking increased maximal walking speed compared with lower intensity walking. However, the training programme in the Pohl 2002 trial was also the most rapidly progressing. So it is somewhat difficult to disentangle the effect derived from an increase in progression from the effect due to the intensity of the intervention.

The findings of this review indicate that stroke survivors may successfully complete a variety of short-term training interventions. However, the optimal dose of training for people with stroke has yet to be established.

Type of training

None of the included trials directly compared cardiorespiratory, resistance, and mixed training. We were only able to compare the effects of the different types of training on one shared outcome, preferred gait speed. Walking speed increased significantly after cardiorespiratory training and to a lesser degree after mixed training, but not after resistance training. Both cardiorespiratory interventions and mixed interventions comprised specific gait-related training, which resulted in positive training effects.

Overall, the findings of this review show that benefits reflect the concept of the specificity of the training response. In particular, cardiorespiratory fitness (VO_2 peak) improved after cardiorespiratory training; muscle strength improved after resistance training; walking performance improved after training interventions based on walking or walking-like modes of exercise; walking and physical function outcomes did not improve after resistance training interventions, probably because functionally relevant movements are difficult to incorporate into resistance training interventions.

Timing of training

Due to limited data being available, we were unable to perform subgroup analyses to compare interventions during usual care with interventions after usual care.

Retention of benefits

Functional advantages observed at the end of rehabilitation interventions are known to be transient, disappearing at a later stage (Kwakkel 1999; Kwakkel 2002). This is probably due to continued improvements in the control group rather than deterioration in function (Langhorne 2002). Fitness improvements observed at the end of training interventions are also known to deteriorate.
Few trials included in this review assessed possible retention of benefits over time. Most of the functional improvements observed at the end of the training period were not sustained at later assessments. We found, however, that cardiorespiratory training effects on measures of walking performance were retained at the end of the follow-up period. This retention effect could have arisen from an increase in habitual levels of physical activity (including walking) facilitated by participation in a training intervention. The extent to which short-term fitness training influences longer-term habitual physical activity after stroke is still unknown. Currently, there are no data examining either long-term fitness training interventions or interventions to facilitate continued exercise after the training intervention is completed. Long-term assessments should be incorporated into future trials of physical fitness training.

Effect of physical activity performed by control groups

Training effects arising from physical activity in the control group could partly explain the lack of effect observed in some of the included trials.

Effect of trial quality

There are insufficient data to reliably examine the effects of trial quality on estimates of effect. Overall, the methodological quality of most of the 32 included trials was modest. Only four trials enrolled more than 80 participants, and 12 trials had 20 or fewer participants. Only 16 trials employed adequate methods of sequence generation and 19 trials had blinded outcome assessors (but some degree of unmasking occurred in three of these trials). The rate of attendance could only be determined in half of the included trials.

Summary of review findings

- Most available data relate to ambulatory people in the chronic phase (more than one month) post-stroke.
- It is feasible for stroke survivors to participate in a variety of short-term fitness training regimens presented in a range of settings, either during usual stroke care or after hospital discharge.
- There are insufficient data to assess death and dependence outcomes reliably.
- From the limited data reported in the included trials, there is an indication that participation in fitness training programmes is safe and does not result in serious adverse events.
- Global indices of disability are not consistently reported in trials of fitness training. No conclusions can be drawn from the available data.
- There is some evidence that cardiorespiratory training may improve physical fitness outcomes.
- There is clear evidence that cardiorespiratory training improves measures of walking performance (e.g. walking speed and walking capacity) and reduces dependence during usual care. These training effects are retained at follow-up.
- There are insufficient data to assess reliably the effects of resistance training.
- There is a suggestion that mixed training may improve measures of walking performance.
- There is an indication that the training effect may be greater when fitness training is specific or 'task-related'.
- There are few data relating to physical function, quality of life, and mood outcomes.
- There are insufficient data to conduct meaningful subgroup analyses to explore the effects of the type, 'dose', and timing of training on outcome measures.
- Limited methodological quality of included trials and relatively small sample sizes hamper the generalizability of findings.

Issues for research

Control groups

In terms of trial design, there should be a concerted effort to balance total contact time across all arms in order to avoid confounded results. Preferably, the control intervention should contain minimal or no physical activity since even performing activities of daily living may be sufficient to cause training effects in elderly people (Young 2001). One robust way of clarifying whether the content of the training itself is beneficial would be, for example, to compare and assess two doses of training.

Interventions

Currently there are few well-controlled trials examining interventions to improve muscle force production. Trials of resistance training often focus on pre-specified movements that bear little resemblance to those relevant to everyday life and, even though muscle strength may improve, no functional benefits arise. The nature

of the association between physical fitness and functional benefits is complex, and this suggests that training interventions should address other co-impairments such as balance.

Outcome measures

To measure disability and dependence in stroke is problematic. A variety of disability and assessment scales are usually reported in trials of physical rehabilitation and fitness training. These scales do not always assess the same functional domain and therefore pose the problem of the validity and reliability of combining their results in a meta-analysis. Furthermore, some of these scales are not validated in stroke survivors and, therefore, may lack specificity. Rating scales are also prone to 'ceiling effect' and to skewed distributions. It would be useful if only well-known, validated scales are used in future trials for the assessment of participants' functional performance and if trial investigators would clearly address the problems related to the use of these assessment scales.

Stroke survivors who are eligible for fitness training have typically mild levels of disability. Mild impairments may be difficult to assess and many of the existing disability scales may fail to detect them. However, functional decline over time that is simply due to increasing age and inactivity could mean that mild disability may progress quickly to more serious levels. Therefore, it would be useful to assess long-term outcomes in mild stroke survivors using pre-clinical disability measures (for example Fried 1996).

Long-term studies

Both improvements in physical fitness after training and improvements in physical function after rehabilitation are transient. Since physical fitness may be linked to functional status, the long-term retention of benefit should be routinely examined in trials of fitness training. Fitness and function parameters are known to deteriorate with physical inactivity and to decrease with increasing age. Therefore, it is plausible that short-term effects of training only emerge as being beneficial after a period of functional decline.

There is a need to examine strategies aimed at promoting physical activity and maintaining physical fitness in the long-term after stroke.

In conclusion, there is a clear need for larger well-designed trials of physical fitness training. Future trials should include participants with a greater spectrum of stroke severity that includes non-ambulatory patients, have adequate control interventions, and use relevant outcome measures.

AUTHORS' CONCLUSIONS

Implications for practice

Cardiorespiratory walking training during usual stroke care is effective in increasing walking speed and walking capacity in stroke survivors. It is likely that improvements in fitness, mobility, and physical function outcomes are associated with 'task-related' training. Services for exercise after stroke are developing throughout the UK, based on existing evidence about the benefits of exercise after stroke and the needs of stroke survivors to have ongoing access to rehabilitation after discharge from hospital. The findings of this review will inform the content of such services.

Implications for research

Larger, well-designed clinical trials are needed to assess the effects of physical fitness training after stroke and to determine the optimal regimen for improving fitness.

Future trials should:

- comply with the current CONSORT guidelines for reporting of randomised clinical trials (CONSORT 2010);
- include a broader population of stroke survivors (including non-ambulatory stroke survivors) to allow stratification by gender, level of impairment, and functional ability;
- assess the effects of physical fitness training in people with specific post-stroke problems, such as people with depression or post-stroke fatigue;
- be of longer duration (12 weeks or longer);
- comprise a long-term follow-up.

The training intervention and the control intervention should be comparable in terms of duration to prevent overestimation of training effects. The content of an attention control intervention should be chosen carefully to prevent underestimation of treatment effects caused by confounded physical activity in the control group.

Implications for future updates

The literature on physical fitness training interventions is constantly growing. This poses the question whether it would be more useful to split this review according to the different types of training and to revise some of the inclusion criteria to allow more potentially relevant comparisons to be assessed.

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* *Indicates the major publication for the study*

CHARACTERISTICS OF STUDIES

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

Aidar 2007

Methods	Design: randomised trial of cardiorespiratory training (aquatic physical exercises) versus no intervention after usual care Randomisation: stated 'random' but not further details provided Allocation concealment: not reported Blinding: not reported Intention-to-treat: no Measurements: at the end of intervention (12 weeks) Withdrawals: 1 participant in the intervention group refused the training - at the beginning of the programme; 2 participants in the control group were not assessed at the end of the intervention
Participants	Randomised: 31 participants, assessed 28 (15 participants in the intervention group and 13 in the control group) Intervention: 15 participants: 10 males and 5 females; mean age 50.3 years (SD 9.1) Control: 13 participants; 9 males and 4 females; mean age 52.5 years (SD 7.7) Inclusion criteria: ischaemic cerebrovascular accident; hemiplegia or hemiparesis Exclusion criteria: cognitive impairment; significant co-morbidities
Interventions	Intervention group: aquatic physical sessions (e.g. walking activity and physical exercises in the water; swimming) 45 to 60 minutes each session; 2 times/week for 12 weeks Control group: no intervention - delayed started of the same programme Setting: community setting
Outcomes	Included outcome: SF-36
Notes	Content of the intervention not very detailed. Unclear whether the trial met the ACSM criteria for fitness training

Risk of bias

Bias	**Authors' judgement**	**Support for judgement**
Allocation concealment (selection bias)	Unclear risk	Not reported

Bale 2008

Methods	Design: randomised trial of resistance training plus % usual care versus usual care - during usual care. Sample size calculation reported Randomisation: drawing lots - not clearly described Allocation concealment: unclear Blinding: outcome assessors blinded Intention-to-treat: planned but no withdrawals Measurements: at the end of intervention (4 weeks) Withdrawals: none
Participants	Randomised:18 participants Intervention: 8 participants; 3 males and 5 females; mean age 68.0 years (SD 13); time since stroke 49.4 (SD 22.1) days Control:10 participants 4 males and 6 females; mean age 64.9 years (SD 8.8); time since stroke 32.0 (SD 18.5) days Inclusion criteria: first onset of stroke with reduced muscle strength in the affected leg; ability to understand verbal information; ability to sit without support Exclusion criteria: significant sensory or cognitive sequels; arrhythmia; uncontrolled angina pectoris or hypertension; co-morbidities that could mask the sequels from the stroke; lack of motor control of the affected leg
Interventions	Intervention group: resistance training 50 minutes a day 3 days per week for 4 weeks. 8 individually tailored exercises for the affected lower limb involving weight bearing, stepping, sit-to-stand, heel/toe raising, and bridging. Tailored progression included using weights, reducing speed, adding more sets, etc. Other functional activities sometimes included too (walking, stair climbing, sit-to-stand). One set of 10 to 15 repetitions to moderate fatigue Control group: usual care (Bobath) 50 minutes a day 3 days per week for 4 weeks, plus usual care (other) 50 minutes/day, 2 days per week for 4 weeks. Total training: 50 minutes a day 5 days per week for 4 weeks Setting: 2 rehabilitation units
Outcomes	Included outcomes: isometric muscle strength; preferred walking speed; maximal walking speed Other outcomes: maximum weight bearing; 2 items of the MAS; Patient Global Impression of Change tool
Notes	Very small sample size Poor external validity

Risk of bias

Bias	**Authors' judgement**	**Support for judgement**
Allocation concealment (selection bias)	Unclear risk	Poorly reported

Bateman 2001

Methods	Design: randomised trial of cardiorespiratory training plus usual care versus non-exercise intervention plus usual care - during usual care Randomisation: mechanism - computer; method - blocks size of 10 participants Allocation concealment: sealed envelopes Blinding: investigator blinded; participants encouraged to maintain blinding; efficacy unknown Intention-to-treat: yes, but participants were excluded after recruitment and baseline assessments due to discharge Measurements: end of intervention (12 weeks) and at follow-up Withdrawals: intervention group (12 participants: 4 before and 8 after the 12-week assessment); control group (12 participants: 2 before and 10 after the 12-week assessment) Reasons unclear but included early discharge
Participants	Randomised: 84 participants Intervention: 40 participants; males 20, females 20; age 47.0 years (SD 13.1); 144 days (SD 84) post-stroke Control: 44 participants; males 29, females 14; age 50.3 years (SD 10.1); 184 days (SD 127) day post-stroke Inclusion criteria: single stroke; could comply with planned interventions; could sit on a cycle ergometer Exclusion criteria: likely to be inpatient for < 3 months; impairments severe enough to limit training compliance and participation; cardiac disease; co-morbidities contraindicated for exercise
Interventions	Intervention: cardiorespiratory training; cycle ergometry at 60% to 80% of age-related heart rate maximum for up to 30 minutes per day 3 days per week for 12 weeks Control: relaxation - programme individualised: included breathing exercises, progressive muscle relaxation, autogenic exercises, visualisation techniques Setting: multicentre, 4 rehabilitation units
Outcomes	Included outcomes: FIM; BI (0 to 20 scale); NEADL; RMI; HADS; BBS; gait maximum speed; maximum cycling workload (data transformed to Log base e); BMI Other outcomes: fatigue questionnaire
Notes	Mixed brain injury data provided by authors; stroke-only data retained and re-analysed. High rate of missing data made statistical analyses difficult

Risk of bias

Bias	**Authors' judgement**	**Support for judgement**
Allocation concealment (selection bias)	Low risk	Sealed envelopes

Cooke 2010

Methods	Design: phase I multicenter trial; 4 centres; mixed training plus usual care versus usual care - during usual care - i.e. functional strength training (FST) plus conventional physiotherapy (CPT) versus conventional physiotherapy alone and versus conventional physiotherapy plus conventional physiotherapy (CPT + CPT) Randomisation: computer-generated random allocation in blocks of 9 per trial centre (stratified allocation by baseline scores for visual spatial neglect) Allocation concealment: sequentially numbered sealed opaque envelopes Blinding: assessor blinded to group allocation Intention-to-treat: attempt to measure participants at outcome and follow-up even if they withdraw but analyses were not performed according to intention-to-treat principle Measurements: at the end of intervention (6 weeks) and 12 weeks later (follow-up) Withdrawals: at outcome 10 (9%) had withdrawn. 7 participants were lost at outcome in the control CPT group (3 unwell, 3 withdrew, 1 moved abroad) and 3 in the CPT + CPT group (2 unwell, 1 sectioned). At follow-up, a further 18 participants had withdrawn (26%). 14 participants were lost in the CPT group (5 unwell, 4 withdrew, 1 moved abroad, 2 housebound, 2 died); 7 in the CPT + CPT group (5 unwell, 1 sectioned, 1 withdrew); and 7 in the CPT + FST group (5 unwell, 2 withdrew)
Participants	Randomised: total 109 participants. 38 participants were randomised to CPT, 35 to CPT + CPT, and 36 to FST + CPT (only the results from the CPT and the CPT + FST groups were included in this review) Intervention: FST + CPT = 36 participants: 22 males (61%) and 14 females (39%); mean age: 71.17 (SD 10.6); 33.86 (SD 16.50) days after stroke Control: CPT = 38 participants: 21 males (55%) and 17 females (45%); mean age: 66.37 (SD 13.7); 36.76 (SD 22.41) days after stroke Inclusion criteria: inpatients between 1 and 13 weeks after anterior circulation stroke (ischaemic and haemorrhagic); independently mobile; some voluntary contraction in the lower affected limb; no orthopaedic surgery or trauma affecting the lower limb in the last 8 weeks; no previous history of neurological diseases; able to follow a 1-stage command Exclusion criteria: not reported
Interventions	Intervention: FST/mixed training plus CPT. FST consisted of increasing the amount of bodyweight the patients needed to move; increasing movements resistance; reducing amount of bodyweight support during treadmill training. Frequency of intervention: 1 hour for 4 days/week for 6 weeks Control: CPT included soft issue mobilisation, facilitation of muscle activity, facilitation of co-ordinated multi-joint movement; tactile and proprioceptive input, resistive exercise, and functional retraining. Frequency of intervention: 1 hour for 4 days/week for 6 weeks Setting: hospital
Outcomes	Included outcomes: walking speed; health related quality of life measures (e.g. EuroQuol) Other outcomes: gait parameters; paretic knee torque force analysis; modified RMI
Notes	Trial authors stated 'strength training' but intervention was actually mixed training

Risk of bias

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

Allocation concealment (selection bias)	Low risk	Sequentially numbered sealed opaque envelopes

Cuviello-Palmer 1988

Methods	Design: randomised trial of cardiorespiratory training plus % usual care versus usual care - after usual care Randomisation: unknown Allocation concealment: unknown Blinding: unknown Intention-to-treat: no Measurements: end of intervention (3 weeks) Withdrawals: none
Participants	Randomised: 20 participants Intervention: 10 participants; 6 males and 4 females; age 69.5 years (SD 14.1); 20.7 days post-stroke (SD 13.2) Control: 10 participants; 7 males and 3 females; age 71.8 years (SD 12.0); 12.0 days post-stroke (SD 16.8) Inclusion criteria: unknown Exclusion criteria: unknown
Interventions	Intervention: cardiorespiratory training: isokinetic ergometer allowing resisted reciprocal leg movements (Kinetron II); commencing at 2 x 7 minutes/day for 5 days/week and 1 x 7 minutes/day for 1 day/week (total 6 days/week) for 3 weeks progressing to 10 minutes per session in week 2 and 12 minutes in week 3 Exercise intensity maintained at a heart rate of < 20 beats/minute above resting Control: usual care: 2 x 45 minutes/day for 5 days/week and 1 x 45 minutes/day for 1 day/week (total 6 days/week) for 3 weeks Gait training, mat exercises, and transfer training achieved via strengthening exercises, post neuromuscular facilitation (PNF), functional electrical stimulation (FES), Brunnstum, Rood and neurodevelopment techniques Setting: rehabilitation centre
Outcomes	Included outcomes: FIM (old version); preferred gait speed (7 seconds) Other outcomes: stance symmetry; contact time (seconds); stride cadence steps/minute and other biomechanical gait parameters
Notes	

Risk of bias

Bias	**Authors' judgement**	**Support for judgement**
Allocation concealment (selection bias)	Unclear risk	Not reported

da Cunha 2002

Methods	Design: randomised trial of cardiorespiratory training plus % usual care versus usual care - during usual care Randomisation mechanism: random number table Allocation concealment: unknown Blinding: unknown Intention-to-treat: no Measurements: end of intervention (2/3 weeks - until discharge) Withdrawals: none
Participants	Randomised: 15 participants Intervention: 7 participants; 6 males and 1 females; age 57.8 years (SD 5.5); 15.7 days post-stroke (SD 7.7) Control: 8 participants; 7 males and 1 female; age 58.9 years (SD 12.9); 19.0 days post-stroke (SD 12.7) Inclusion criteria: recent stroke (onset < 6 weeks); significant gait deficit (< 36 metres/minute; FAC score of 0, 1 or 2); sufficient cognition to participate in training (Mini Mental State Examination - MMSE $\geq$ 21); able to stand and take 1 or more steps without assistance Exclusion criteria: co-morbidity or disability other than hemiparesis; recent myocardial infarct; any uncontrolled health condition; joint disease or rheumatoid arthritis; obesity (> 110 kg); cognitive impairment (MMSE < 21)
Interventions	Intervention: cardiorespiratory training: treadmill walking with body weight support 20 minutes/day 6 days/week for 2 to 3 weeks (until discharge); intensity unknown but rapid progression imposed by increasing speed and reducing body weight support; the 20-minute training replaced the 20-minute gait training component of the control Control: usual care 3 hours per day for 6 days per week for 2 to 3 weeks until discharge; included kinesitherapy (1 hour per day), occupational therapy (1 hour per day) and physical therapy (1 hour per day): the physical therapist included 20 minutes of gait training comprising stepping, standing, turning, etc, but not continuous walking Setting: rehabilitation centre
Outcomes	Included outcomes: cycle performance work rate (Watts); VO_2 peak; blood pressure; FAC; FIM (lower limb); gait speed maximal (5 metres); gait endurance (5 minutes); gait economy Other outcomes: stance symmetry; contact time (seconds); stride cadence steps/minute and other biomechanical gait parameters
Notes	

Risk of bias

Bias	Authors' judgement	Support for judgement
Allocation concealment (selection bias)	Unclear risk	Not reported

Donaldson 2009

Methods	Design: phase II randomised multicentre trial; 3 centres; mixed training plus usual care versus usual care - during usual care - i.e. functional strength training (FST) plus conventional physiotherapy (CPT) versus CPT alone and versus CPT plus CPT Randomisation: computer-generated random allocation. Allocation was stratified by baseline Action Research Arm Test score in blocks of 3 within each stratum Allocation concealment: sequentially numbered sealed opaque envelopes held by an independent investigator Blinding: assessor blinded to group allocation Intention-to-treat: yes Measurements: at the end of intervention (6 weeks) and 12 weeks after (follow-up) Withdrawals: two participants were lost at outcome in the CPT group (new stroke = 1; bail = 1). A further 11 participants were lost at follow-up. 5 participants in the CPT group (3 unwell, 1 moved abroad, 1 bail); 4 in the CPT + CPT group (1 unwell, 2 died, 1 moved house); and 2 in the CPT + FST group (1 unwell, 1 moved abroad)
Participants	Randomised: total 30 participants. 10 participants were randomised to CPT, 10 to CPT + CPT, and 10 to CPT + FST (only the results from the CPT and the CPT + FST groups were included in this review) Intervention: CPT + FST = 10 participants, 3 males and 7 females; mean age: 72.6 Control: CPT = 10 participants, 5 males and 5 females; mean age: 72.6 Inclusion criteria: inpatients; infarction of the anterior cerebral circulation between 1 weeks and 3 months after stroke; some voluntary contraction in the upper affected limb; no obvious unilateral visuospatial neglect; ability, prior to the stroke, to use the paretic upper limb to lift a cup and drink; ability to follow a 1-stage command Exclusion criteria: not reported
Interventions	Intervention: CPT + FST. FST = repetition and goal directed functional activity of the upper limb; hand positioning; hand grip activities; hand manipulation involving objects; improving power of shoulder/elbow muscles to enable appropriate hand position. Frequency of intervention: 1 hour for 4 days/week for 6 weeks Control: CPT included soft issue mobilisation, facilitation of muscle activity/movement, positioning; joint alignment; tactile and proprioceptive input. Frequency of intervention: 1 hour for 4 days/week for 6 weeks Setting: hospital setting
Outcomes	Included outcomes: upper limb strength (hand grip force, pinch grip force; isometric elbow flexion and extension force); upper limb function (ARAT); dexterity (i.e. 9HPT)
Notes	

Risk of bias

Bias	**Authors' judgement**	**Support for judgement**
Allocation concealment (selection bias)	Low risk	Sequentially numbered sealed opaque envelopes held by an independent investigator

Duncan 1998

Methods	Design: randomised trial of mix training versus usual care - after usual care (outpatient) Randomisation mechanism: unknown; method: blocks of 10 Allocation concealment: third-party involvement Blinding: unclear Intention-to-treat: yes Measurements: end of intervention (12 weeks) Withdrawals: none
Participants	Randomised: 20 participants Intervention: 10 participants; number of males and females unknown; age 67.3 years (SD 9.6); 66 days post-stroke Control: 10 participants; number of males and females unknown; age 67.8 years (SD 7.2) ; 56 days post-stroke Inclusion criteria: 30 to 90 days post-stroke; minimal/moderately impaired sensorimotor function; available to attend all training sessions; ambulatory with or without supervision or walking aids; living at home within 50 miles Exclusion criteria: medical condition which compromised outcome assessment or prevented fitness training; MMSE score < 18 or receptive aphasia
Interventions	Intervention: mixed training, performed approximately 90 minutes/day 3 days/week for 12 weeks (8 weeks supervised 1:1 with therapist and 4 weeks alone), functional exercises comprising assistive/resistive exercise, balance exercises, upper limb functional activities, walking or cycling; apart from some resisted exercise the training intensity was not quantified Control: usual outpatient care, physical and occupational therapy as advised by the patient's physician, averaging 44 minutes per day, 3.25 days per week for 12 weeks, therapeutic interventions were during home or outpatient visits and comprised balance training (60%) , strength training (40%), bimanual activities (50%) and facilitative exercise (30%); cardiorespiratory training was not provided (0%) Setting: home-based, therapist-supervised for first 8 weeks
Outcomes	Included outcomes: BI; Lawton Activities of Daily Living; gait endurance (6MWT); BBS; gait preferred speed (data lack variance measures) Other outcomes: SF-36 (non-standard pooling of data), Jebsen Hand Test; Fugl Meyer (upper and lower extremity)
Notes	

Risk of bias

Bias	Authors' judgement	Support for judgement
Allocation concealment (selection bias)	Low risk	Third-party involvement

Duncan 2003

Methods	Design: randomised trial of mixed training versus usual care - after usual care (outpatient) Randomisation mechanism: unknown; method: blocks of 6 Allocation concealment: sealed envelopes Blinding: investigator; participants asked to maintain blinding Intention-to-treat: yes Measurements: end of intervention (12/14 weeks) and 6-month follow-up Withdrawals: intervention (10 participants: 6 before (1 renal insufficiency, 1 subclavian steal syndrome, 1 chose withdrawal, 3 recurrent stroke) 4 after the 3-months follow up (1 died, 1 hospital, 2 recurrent stroke); control (11 participants: 2 before (1 withdrew, 1 non-return), 9 after 3-months follow-up (2 died, 2 hospital, 5 withdrew)
Participants	Randomised: 100 participants Intervention: 50 participants; 23 males and 27 females; age 68.5 years (SD 9.0); 77.5 days post-stroke (SD 28.7) Control: 50 participants; males and 27 females 23; age 70.2 years (SD 11.4); 73.5 days post-stroke (SD 27.1) Inclusion criteria: 30 to 150 days post-stroke; independent ambulation for 25 feet; Fugl-Meyer scores 27 to 90; Orpington Prognostic Scale 2.0 to 5.2); Folstein Mini-Mental State score 16 Exclusion criteria: serious cardiac condition; oxygen dependence; severe weight bearing pain; serious organ system disease; life expectancy < 1 year
Interventions	Intervention: mixed training, performed approximately 90 minutes per day 3 days per week for 12 to 14 weeks (36 sessions); training included range of motion and flexibility, strength training, balance, functional upper extremity practice, endurance training via interval training on cycle ergometer. All elements progressive but intensity not quantified Control: usual outpatient care including physiotherapy and occupational therapy for participants who needed. All controls received 30-minute visit every 2 weeks including provision of health promotion information Setting: home-based, therapist-supervised for first 8 weeks
Outcomes	Included outcomes: cognitive and motor subscales of the FIM; SF-36 subscales; ankle dorsiflexion and knee extension isometric strength (Nm); isometric grip strength (N); BBS; functional reach; VO_2 peak; gait speed preferred (10-metre); 6MWT; community ambulation (> 0.8 metres/second) Other outcomes: Stroke Impact scale; cycle duration; Fugl Meyer scores
Notes	Some outcomes reported as change from baseline scores. Others reported as means at end of 6-month follow-up

Risk of bias

Bias	**Authors' judgement**	**Support for judgement**
Allocation concealment (selection bias)	Low risk	Sealed envelopes

Eich 2004

Methods	Design: randomised trial of cardiorespiratory training plus usual care versus usual care - during usual care Randomisation mechanism: picking envelopes; method: restricted Allocation concealment: sealed envelopes Blinding: investigator; efficacy was compromised Intention-to-treat: yes Measurements: end of intervention (6 weeks) and 3-month follow-up Withdrawals: intervention 1 participant (refusal) after the 6-week training
Participants	Randomised: 50 participants Intervention: 25 participants;17 males and 8 females; age 62.4 years (SD 4.8); 43 days post-stroke (SD 15) Control: 25 participants; 16 males and 9 females; age 64 years (SD 9); 44 days post-stroke (SD 18) Inclusion criteria: aged 50 to 75 years; first stroke; time since stroke < 6 weeks; walk 12 metres with/without assistance; Barthel score 50 to 80; participating in 12-week comprehensive rehabilitation programme; stable cardiovascular responses; no non-stroke walking impairments; able to understand purpose and content of study
Interventions	Intervention: cardiorespiratory training, performed 30 minutes per day 5 days per week for 6 weeks; progressive treadmill training with either no or minimal support of bodyweight; intensity was 60% of heart rate reserve Control: both groups received usual care comprising individual physiotherapy based on Bobath concept plus occupational and speech therapy, and neuropsychology as required Setting: rehabilitation unit - inpatient care
Outcomes	Included outcomes: gait speed maximal (10 metres); gait endurance (6MWT) Other outcomes: RMA (non-normal data); walking quality scale (non-normal data)
Notes	

Risk of bias

Bias	**Authors' judgement**	**Support for judgement**
Allocation concealment (selection bias)	Low risk	Sealed envelopes

Flansbjer 2008

Methods	Design: randomised trial of resistance training versus no training - after usual care Randomisation: stratified unequal randomisation (2:1) Allocation concealment: non-sealed envelopes Blinding: physiotherapists who assessed isokinetic strength and gait performance outcomes were blinded to group assignment but the physiotherapist who assessed dynamic strength and muscle tone outcomes was not blinded; patient were not blinded but were told not to disclose group assignment Intention-to-treat: yes Measurements: at the end of intervention (10 weeks) and 5-month follow-up Withdrawals: 1 participant dropped out from the intervention group due to an accident unrelated to strength training
Participants	Randomised: total 25 participants Intervention: 15 participants, 9 males and 6 females; mean age 61 (SD 5) years; time since stroke 18.9 (SD 7.9) months Control: 9 participants, 5 males and 4 females; mean age 60 (SD 5) years; time since stroke 20.0 (SD 11.6) months Inclusion criteria: age 40 to 70 years; 6 months post-stroke; able to perform isolated extension and flexion movements of the knee; at least 15% reduction in muscle strength in the paretic limb (mean isokinetic peak torque at 60º/sec); walk unsupervised for 200 metres with or without walking aid; no medication, physical, cognitive or mental dysfunction that could impact upon knee muscle strength, gait performance or perceived participation; able to understand verbal and written information Exclusion criteria: not reported
Interventions	Intervention group: 10 weeks of dynamic and isokinetic knee muscle strength training. Each training session started with a warm-up of 5 minutes of stationary cycling, 5 repetitions without resistance and 5 repetitions at 25% of maximum load. The participants then performed 6 to 8 repetitions at about 80% of their maximum load with a 2-minute rest between each set. The participants performed as many repetitions as possible. The load was adjusted every two weeks to remain at 80% of their maximum load. Each training session lasted about 90 minutes but the actual progressive strength training time was less than 6 minutes. Control group: participants were encouraged to continue daily activities and training but not to engage in any progressive strength training Setting: community dwelling; training in hospital
Outcomes	Included outcomes: dynamic and isokinetic muscle strength; 3-metre TUG; maximum walking speed; 6MWT; SIS - Swedish version; muscle tone assessed with the mAS Other outcomes: none
Notes	Maximum walking speed data obtained from authors. The physiotherapist that supervised the resistance training was the same that assessed dynamic strength and muscle tone outcomes

Risk of bias

Bias	Authors' judgement	Support for judgement

Flansbjer 2008 (*Continued*)

Allocation concealment (selection bias)	High risk	Non-sealed envelopes

Glasser 1986

Methods	Design: randomised trial of cardiorespiratory training plus % usual care versus usual care - during usual care Randomisation: unknown Allocation concealment: unknown Blinding: unknown Intention-to-treat: no withdrawals Measurements: end of intervention (10 weeks) Withdrawals: none
Participants	Randomised: 20 participants Intervention: 10 participants; 4 males and 6 females Control: 10 participants; 6 males and 4 females All participants age 40 to 75 years and were 3 to 6 months post-stroke; all participants exhibited hemiparesis with upper and lower extremity motor dysfunction; some showed sensory deficits and mild expressive or receptive aphasia Inclusion criteria: unknown Exclusion criteria: unknown
Interventions	Intervention: cardiorespiratory training: isokinetic ergometer (Kinetron) training twice a day 5 days per week for 10 weeks; the intensity was maintained at 50 to 100 psi and duration of each session progressed from 10 to 30 minutes over the first 5 weeks Control: therapeutic exercise and gait training 1 hour per session 2 sessions per day, 5 days per week for 5 weeks Setting: physical therapy department
Outcomes	Included outcomes: gait speed maximal (6 metres) Other outcomes: FAPS
Notes	

Risk of bias

Bias	**Authors' judgement**	**Support for judgement**
Allocation concealment (selection bias)	Unclear risk	Not reported

Inaba 1973

Methods	Design: randomised trial of resistance training plus usual care versus usual care - during usual care Randomisation: unknown Allocation concealment: unknown Blinding: outcome assessor - unclear Intention-to-treat: no Measurements: end of intervention (4 to 8 weeks) and 2-month follow-up Withdrawals: unclear: 101/177 patients lost to follow-up across the control and both intervention groups; 54 patients completed the control versus strength training comparison; estimated dropouts approximately 60 1 reason given for dropouts was discharge before end of the study
Participants	Randomised: 54 participants Intervention: 28 participants; 11 males and 17 females; age 55.6 years; < 3 months post-stroke Control: 26 participants; 15 males and 11 females; age 56.9 years; < 3 months post-stroke All participants had hemiparesis Inclusion criteria: hemiparesis arising from cerebrovascular accident secondary to thrombosis; embolus or haemorrhage; able to follow verbal or demonstrated directions; extend the involved lower limb against a load of 1.1 kg; independent ambulation Exclusion criteria: aetiology of aneurysm or trauma
Interventions	Intervention: progressive resistive exercise once per day for 4 to 8 weeks; extension of the affected lower limb from 90º to full-knee extension whilst in the supine position on an Elgin table (machine weights), 5 repetitions at 50% maximum weight, and 10 at maximum Control: usual care: conventional functional training, including stretching, 4 to 8 weeks until discharge Setting: rehabilitation centre
Outcomes	Included outcomes: leg strength (10 repetition maximum) lacked variance measures number of participants able to perform 10 activities of daily living
Notes	

Risk of bias

Bias	**Authors' judgement**	**Support for judgement**
Allocation concealment (selection bias)	Unclear risk	Not reported

James 2002

Methods	Design: randomised trial of mixed training versus no intervention - after usual care Randomisation mechanism: computer; method: blocks of 4 Allocation concealment: sealed envelopes Blinding: investigator Intention-to-treat: yes Measuremetns: end of intervention (4 weeks) Withdrawals: control group 2 dropped out (neurological problems)	
Participants	Randomised: 20 participants Intervention: 10 participants; 4 males and 6 females; age 76.1 years (SD 12.33); 1826 days post-stroke Control: 10 participants; 2 males and 8 females; age 80.8 years (SD 9.0); 1845 days post-stroke Inclusion criteria: stroke with hemiplegia; ability to give informed consent Exclusion criteria: no complicating medical history (cardiac, pulmonary or neurological) ; no severe deficits in communication, memory or understanding; no painful orthopaedic conditions which could limit participation	
Interventions	Intervention: mixed training, performed 90 to 120 minutes per day 3 days per week for 4 weeks Warm up followed by half squats; chair squats; small knee bends; standing on affected leg; single-leg half squat on affected leg; standing on unaffected leg and bending affected hip and knee; stair stepping; stepping on spot; walking indoors and outdoors; stepping forwards, backwards and sideways; opening and closing doors; walking and placing/lifting objects; placing objects on shelves. Finished with a cool down; progression achieved increasing pulse rate from 50% (first 2 weeks) to 60% (last 2 weeks) of heart rate reserve, increasing total distance walked, and increasing step height and repetition number Control: no intervention Setting: patients' homes	
Outcomes	Included outcomes: gait speed preferred (5 metres with mixed surfaces and a dead turn at 2.5 metres) Other outcomes: functional walking ability questionnaire; upright motor control test; SF-36 - older version	
Notes	Unpublished thesis	
Risk of bias		
Bias	**Authors' judgement**	**Support for judgement**
Allocation concealment (selection bias)	Low risk	Sealed envelopes

Katz-Leurer 2003

Methods	Design: randomised trial of cardiorespiratory training plus usual care versus usual care - during usual care Randomisation mechanism: unknown; method: blocks based on side of lesion Allocation concealment: sealed envelopes Blinding: investigator; efficacy unknown Intention-to-treat: unknown Measurements: end of intervention and 6-month post stroke follow-up Withdrawals: intervention: no losses at end of intervention, 5 losses at 6-month follow-up (4 not located, 1 died); control: 2 discontinued intervention (1 acute myocardial infarction, 1 deep vein thrombosis), 6 losses to follow-up (3 not located, 1 died, 2 recurrent stroke)
Participants	Randomised: 92 participants Intervention: 46 participants; 26 males and 20 females; age 62 years (SD 11); time since stroke unknown Control: 46 participants; 23 males and 23 females; age 65 years (SD 11); time since stroke unknown Inclusion criteria: age > 50 years; > 6 months after first ever stroke; walk 40 metres with +/- rest, +/- assistive device; ≥ stage 3 of Chedoke-McMaster Stroke Assessment: tolerate 45 minutes of exercise with rest intervals; non-participation in other therapy programmes Exclusion criteria: comprehensive aphasia; not medically stable; musculoskeletal problems not associated with stroke
Interventions	Intervention: cardiorespiratory training: cycle ergometer; 8-week programme: (1) 20 minutes per day 5 days per week for 2 weeks of intermittent (10 x 1 minute) exercise progressing to 20 minutes continuous exercise by end of week 2; (2) 30 minutes per day 3 days per week for 6 weeks not exceeding 60% hear rate reserve; ACSM criteria for cardiorespiratory training met Control: usual physiotherapy, occupational therapy, speech therapy and group activity/ exercise Setting: rehabilitation centre
Outcomes	Included outcomes: FIM; blood pressure; maximum cycle workload (Watts); comfortable walking speed (10-metre) gait endurance; distance until fatigue; FAI; stair climbing Other outcomes: SSS
Notes	

Risk of bias

Bias	**Authors' judgement**	**Support for judgement**
Allocation concealment (selection bias)	Low risk	Sealed envelopes

Kim 2001

Methods	Design: randomised trial of resistance training versus non-exercise intervention - after usual care Randomisation mechanism: unknown; method: stratified based on gender, age (50 to 59 or 60+ years) and time since onset of stroke (6 months to 2 years/2+ years) Allocation concealment: unknown Blinding: investigator; participants blinded to purpose of interventions Intention-to-treat: unknown Measurements: end of intervention (6 weeks) Withdrawals: none
Participants	Randomised: 20 participants Intervention: 10 participants; 7 males and 3 females; age 60.4 years (SD 9.5); 4.9 years post-stroke (SD 3.3) Control: 10 participants; 7 males and 3 females; age 61.9 years (SD 7.5); 3.2 years post-stroke (SD 1.2) All participants had hemiparesis Inclusion criteria: age > 50 years; > 6 months after first ever stroke; walk 40 metres with +/- rest, +/- assistive device; stage 3 of Chedoke-McMaster Stroke Assessment; tolerate 45 minutes of exercise with rest intervals; non-participation in other therapy programmes Exclusion criteria: comprehensive aphasia; not medically stable; musculoskeletal problems not associated with stroke
Interventions	Intervention: isokinetic dynamometer (Kin-Com); 45 minutes per day 3 days per week for 6 weeks; after a warm up this comprised 30 minutes of 3 x 10 resisted repetitions of maximal effort concentric hip flexion/extension, knee flexion/extension and ankle dorsi-flexion/plantarflexion of the affected lower limb; progression in the resistance was achieved by increasing the preload on the Kin-Com device; ACSM criteria for resistance training met Control: exactly the same as intervention except the resisted contractions replaced with passive range of motion movements Setting: rehabilitation centre
Outcomes	Included outcomes: gait preferred speed (metres/minute over 8 metres); gait maximum speed (metres/minute); stair climbing speed (stairs/second); composite strength score for the affected (trained) lower limb Other outcomes: stair walking performance (4 x 18 cm steps) self selected and maximal; physical functioning and mental health components of the SF-36; composite strength score for the affected (trained) lower limb
Notes	Data reported as change scores

Risk of bias

Bias	**Authors' judgement**	**Support for judgement**
Allocation concealment (selection bias)	Unclear risk	Not reported

Langhammer 2007

Methods	Design: randomised trial of mixed training versus usual care - after usual care - i.e. intensive exercise (with emphasis on endurance, strength and balance) versus regular exercise (no specific treatment was recommended) at discharge. Sample size calculation reported Randomisation: stratified randomisation according to gender and hemisphere lesion (minimisation). Method of randomisation: dice (uneven numbers versus even numbers). Randomisation was performed by an investigator not involved with the patients or the treatment Allocation concealment: unclear. protocol was sealed for 1.5 years from the start of the study Blinding procedure: outcome assessor blinded Intention-to-treat: planned but not performed Measurements: 3, 6, and 12 months Withdrawals: 3 participants in the intensive group at discharge (1 dead and 2 withdrawals) and 5 (3 dead and 2 withdrawals) in the regular exercise group at discharge. 1 dead and 1 withdrawal at 3 months and 2 dead at 6 months in the regular exercise group
Participants	Randomised: 75 participants Intervention: 35 participants, gender not reported; mean age 76 years (SD 12.7) Control: 40 participants, gender not reported; mean age 72 years (SD 13.6) Inclusion criteria: first-time stroke, confirmed by CT and voluntary participation Exclusion criteria: more than one stroke event, subarachnoid bleeding, tumour, other serious illness, brainstem or cerebellar stroke
Interventions	Intervention: intensive individualised training programme supervised by physiotherapists. Endurance = walking indoors and outdoors, stationary bicycling, stair walking, treadmill, etc, at 70% to 80% maximal pulse. Strength = push-ups, sit-ups, weight lifting, pulley, etc, at 50% to 60% calculated from 1 repetition maximum. Patients were also encouraged to maintain high activity level apart from that in the training sessions. Frequency: 2/3 times per week (daily in rehabilitation ward); minimum 20 hours every third month, in the first year after stroke Control: rehabilitation and follow-up treatments according to participants' needs but not on regular basis. No specific treatment was recommended. Participants were however encouraged to maintain high activity level Setting: general hospital, patients homes and community service centres
Outcomes	Included outcomes: MAS; BI; grip strength measured with a Martin Vigorimeter; occurrences of falls and pain Other outcomes: none
Notes	

Risk of bias

Bias	**Authors' judgement**	**Support for judgement**
Allocation concealment (selection bias)	Unclear risk	Unclear; protocol was sealed for 1.5 years from the start of the study

Lennon 2008

Methods	Design: pilot randomised study of cardiorespiratory training versus usual care - after usual care. Sample size calculation reported Randomisation: stratified randomisation (by age and sex) into 4 blocks of 6 using a sequence generator by an independent party Allocation concealment: opaque envelopes Blinding: single-blinded. Unclear who was blinded. Intention-to-treat: no but only 1 participant dropped out in the control group Measurements: end of intervention (10 weeks) Withdrawals: 1 participant (refusal) in the control group
Participants	Randomised: total 48 participants. Participants were recruited from the Stroke Rehabilitation Database (Dublin). Volunteers contacted the research team for initial screening Intervention: 24 participants, 14 males (58%) and 10 females (42%); mean age 59.0 years (SD 10.3); mean number of weeks from stroke 237.3 (SD 110.7) Control: 24 participants; 14 males (58%) and 10 females (42%); mean age 60.5 years (SD 10.0), mean number of weeks from stroke 245.3 (SD 169.8) Inclusion criteria: > 1 year post ischaemic stroke and over 18 years of age; participants were recruited irrespective of their ability to ambulate independently Exclusion criteria: O_2 dependence, angina, unstable cardiac conditions, uncontrolled diabetes mellitus, major medical conditions, claudication, cognitive impairment or beta blocker medication
Interventions	Intervention: the Cardiac Rehabilitation Programme consisted of cycle ergometry training using either the upper or lower limbs. Exercise load was set at 50% to 60% of the participants' maximal heart rate. Resistance and speed were adjusted daily to ensure progression. Frequency: participants trained twice weekly for 30 minutes each time, for 10 weeks. Measurements performed at week 1 and re-assessment at week 10. All sessions were supervised by a physiotherapist Control: conventional physiotherapy and occupational therapy; no therapy contained an aerobic exercise component; measurements at week 1 and re-assessment at week 10. No further details provided Setting: outpatient rehabilitation
Outcomes	Included outcomes: VO_2; BMI; maximum cycle workload; resting systolic blood pressure; resting diastolic blood pressure; total cholesterol; FAI; HADS Other outcomes: resting heart rate; cardiac risk score; rate of perceived exertion
Notes	The trial authors maintained that their pilot study was too small for detecting functional benefits (a minimum of 120 participants in each group would have been required to show expected change in all primary outcomes) ; possible Hawthorn effect due to the fact that the control group did not receive the comparable non-exercise related attention to the intervention group

Risk of bias

Bias	**Authors' judgement**	**Support for judgement**
Allocation concealment (selection bias)	Unclear risk	Opaque envelopes (sealed?)

Mead 2007

Methods	Design: explanatory randomised trial of mixed training versus non-exercise intervention - after usual care Randomisation mechanism: Internet application; minimisation dichotomised on sex; FIM score (120); age (70 years) Allocation concealment: sequence generation and allocation occurred simultaneously Blinding: investigator; participants encouraged to maintain blinding Intention-to-treat: yes Measurements: end of intervention (12 to 14 weeks) and 4-month follow-up Withdrawals: intervention 0; control 4: 1 withdrew before intervention; 3 after end of intervention follow-up (1 stroke-related illness, 1 fall, 1 recurrent stroke)
Participants	Randomised: 66 participants Intervention: 32 participants; 18 males and 14 females; age 72.0 years (SD 10.4); median 171 (IQR 55 to 287) days post-stroke Control: 34 participants; 18 males and 16 females; age 71.7 years (SD 9.6); median 147. 5 (IQR 78.8 to 235.5) days post-stroke Inclusion criteria: independently ambulatory; living within central or south Edinburgh Exclusion criteria: dysphasia or confusion severe enough to prevent informed consent or impair safety in exercise classes; medical contraindications to exercise training
Interventions	Intervention: mixed training: group circuit training performed 40 to 75 minutes per day 3 days per week for 12 to 14 weeks (36 sessions); after a warm-up the training comprised 2 components: (1) a cardiorespiratory circuit (cycle ergometry, raising and lowering an exercise ball, shuttle walking, standing chest press, and stair climbing and descending); (2) resistance training circuit (upper back exercise and tricep extension using Thera-Band, lifting a weighted pole, a sit-to-stand exercise); progression in duration, repetition number, speed, mass of objects and resistance of Thera-Band whilst maintaining a rate of perceived exertion (6 to 20 scale) of 13 to 60 Control: non-exercise intervention; seated relaxation involving deep breathing and progressive muscular relaxation; no muscle contractions were involved Setting: rehabilitation hospital
Outcomes	Included outcomes: FIM; NEADL; RMI; functional reach; TUG; sit-to-stand time; SF-36 - version 2; HADS; gait preferred speed; gait economy (VO_2 ml/kg/m); lower limb extensor explosive power (W/kg) Other outcomes: EMS (ceiling effect); FAC (ceiling effect)
Notes	

Risk of bias

Bias	**Authors' judgement**	**Support for judgement**
Allocation concealment (selection bias)	Low risk	Sequence generation and allocation occurred simultaneously

Moore 2010

Methods	Design: randomised cross-over trial of cardiorespiratory training versus no intervention - after usual care - (i.e. intensive locomotor training - including treadmill training - versus delayed cardiovascular training) Randomisation: stratified randomisation according to severity of gait impairment Allocation concealment: sealed envelopes Blinding: investigators were not blinded Intention-to-treat: not reported Measurements: end of intervention (4 weeks) Withdrawals: none reported
Participants	Randomised: 20 participants; mean age 50 years (SD 15); males 14, females 6; duration of post-stroke symptoms 13 months (SD 8); moderate/severe gait limitations 13/7 Intervention: the number of participants randomised to the immediate locomotor training group was not clearly reported Control: the number of participants randomised to the delayed locomotor training group was not clearly reported Inclusion criteria: patients with hemiparesis of > 6 months duration who were attending physical therapy after unilateral supratentorial stroke; all patients were required to walk > 10 metres overground without physical assistance and medical clearance Exclusion criteria: lower extremity contractures; significant osteoporosis; cardiovascular instability; previous history of peripheral or central nervous system injury, cognitive or communication impairment; inability to adhere to study requirements
Interventions	Intervention: the immediate locomotor training group received 4 weeks of intensive locomotor training after discharge from clinical physical therapy, which consisted of high intensity stepping practice on a motorized treadmill while wearing an overhead harness attached to a safety system. Frequency: 2 to 5 days per week for 4 weeks. Intensity: highest tolerable speed with velocity increased in 0.5 kmph increments until participants reached 80% to 85% of predicted maximum heart rate or until the participants Rating of Perceived Exertion increased to 17 on the Borg scale. Partial weighted support was reduced in 10% increments as tolerated by participants who needed partial weighted support. Measurements were performed: 4 weeks before termination of usual physical therapy; soon after termination of usual physical therapy; after completion of the 4-week locomotor training; and again after a delay of 4 weeks after termination of locomotor training Control: delayed locomotor training group. The delayed group was also assessed 4 weeks before and after termination of usual physical therapy, but did not receive locomotor training or any other interventions for 4 weeks after termination of usual physical therapy. After this 4 week delay the participants received locomotor training as described above Setting: rehabilitation centre
Outcomes	Included outcomes: preferred gait speed; fastest gait speed; 12MWT; O_2 cost; peak treadmill speed; VO_2 peak, TUG; BBS
Notes	Only data at the end of the first cross-over period were used for analyses

Risk of bias

Bias	Authors' judgement	Support for judgement

Allocation concealment (selection bias)	Low risk	Sealed envelopes.

Mudge 2009

Methods	Design: randomised trial of cardiorespiratory training versus non-exercise intervention training - after usual care (circuit-based rehabilitation versus social and educational sessions) ; power calculation reported Randomisation: computer-generated random numbers by an individual not associated with the trial Allocation concealment: not reported Blinding: assessor blinded (unmasking of the independent assessor occurred in three cases who inadvertently stated or implied their group allocation) Intention-to-treat: yes Measurements: end of intervention (4 weeks) and 3-month follow-up Withdrawals: 1 participant in the intervention group (disinterest) and 2 participants in the control group (too busy) withdrew at the end of intervention. 3 further participants withdrew from the intervention group (health problems = 2; another stroke = 1) and 2 from the control group (health problems = 1; another stroke = 1) before the end of follow-up
Participants	Randomised: 58 participants; median age 71.5 years (range 39.0 to 89.0 years); median 3.9 years after stroke (range 0.5 to 18.7 years); participants were recruited through the Stroke Foundation of New Zealand, stroke clubs, and the local hospital stroke service. Potential candidates were invited to contact the investigators if they wished to participate. All participants walked independently and 26 (45%) used an assistive device. 55 participants completed the trial Intervention: 31 participants were randomised to circuit training; 19 males and 12 females; median age 76.0 (range 39.0 to 89.0); median onset of stroke 3.33 years (range 0.6 to 13. 3) Control: 27 participants were randomised to social and educational sessions; 13 males and 14 females; median age 71.0 (range 44.0 to 86.0); median onset of stroke 5.8 years (range 0.5 to 18.7) Inclusion criteria: participants with 1 or more strokes more than 6 months earlier, had been discharged from rehabilitation and were able to walk independently (with an aid if necessary). Some residual gait difficulty was required, as defined by a score of less than 2 on at least 1 of the walking items of the physical functioning scale of the SF-36 Exclusion criteria: participants were excluded if they had progressive neurological diseases or significant health problems, more than 2 falls in the previous 6 months, unstable cardiac conditions, uncontrolled hypertension, or congestive heart failure
Interventions	Intervention: participants in the intervention group attended 12 group circuit sessions 3 times per week for 4 weeks. Groups were led by 1 of the principal investigators assisted by 2 physiotherapist students. There were 15 stations in the circuit which were graded to each participant's ability and progressed as tolerated. Each station contained either a task-oriented gait or standing balance activity (e.g. step-ups, balance beam, marching in place) or strengthening of a lower extremity muscle with the purpose to improve gait (e.g. lunges, Swiss ball squats, side leg lifts). Total exercise time was 30 minutes including stretching. Measurements performed post-intervention and at 3-month follow-up

Mudge 2009 (*Continued*)

	Control: participants in the control group attended 8 sessions - 4 social and 4 educational sessions (e.g. provide participants with relevant and useful information for everyday activities; provide intellectual stimulation and enjoyment sessions; play a game; cafe' outing). Each session lasted 90 minutes. The control group was led by an occupational therapist. Measurements performed post-intervention and at 3-month follow-up Setting: rehabilitation clinic
Outcomes	Included outcomes: mean number of steps a day measured by the StepWatch Activity Monitor; walking speed and walking endurance Other Outcomes: self-reported confidence during activity of daily living and self-reported mobility assessed by the ABCS, the RMI, and the PADS
Notes	Randomisation was revealed to each participant by the principal investigator after the second baseline assessment. The trial was limited by the small number of participants. Participants volunteered to participate and were likely to be highly motivated. The sample appeared in fact to be higher functioning in terms of gait speed. A gait endurance component was not included in the training circuit

Risk of bias

Bias	**Authors' judgement**	**Support for judgement**
Allocation concealment (selection bias)	Unclear risk	Not reported

Ouellette 2004

Methods	Design: randomised trial of resistance training versus non-exercise intervention - after usual care Randomisation: unknown Allocation concealment: unknown Blinding: investigator Intention-to-treat: yes Measurements: end of intervention (12 weeks) Withdrawals: intervention: 1 withdrew (cardiac problem), and 1 was lost at follow-up (hernia); control: 2 withdrew during intervention, 1 was lost at follow-up (abnormal ECG)
Participants	Randomised: 42 participants Intervention: 21 participants; number of males and females unknown; age 65.8 years (SD 11.5); 968 days post-stroke (SD 460) Control: 21 participants; number of males and females unknown; age 66.1 years (SD 9. 62); 779 days post-stroke (SD 558) Inclusion criteria: age $\geq$ 50 years; 6 months to 6 years after single unilateral mild/moderate stroke with residual lower extremity hemiparesis; community dwelling; independently ambulatory +/- walking aids; report of ?2 limitations on the physical function subscale of the SF-36; ability to travel to the exercise laboratory; willing to be randomised

Interventions	Intervention: progressive resistance training of both lower limbs performed 3 days/week for 12 weeks comprising 3 sets of 8 to 10 repetitions at 70% of 1 repetition maximum (1-RM); exercises were (1) seated bilateral leg press, and (2) unilateral knee extension, both using pneumatic resistance, and unilateral ankle; dorsiflexion; plantarflexion, both using weights; progression achieved via weekly assessment of 1-RM; warm up for each exercise was 4 repetitions of 25% 1-RM Control: non-exercise: bilateral range of motion and upper body flexibility exercises 3 days/week for 12 weeks Setting: exercise laboratory
Outcomes	Included outcomes: muscle strength (bilateral lower limb extension force); muscle strength (unilateral knee extension, ankle dorsiflexion and ankle plantarflexion); gait endurance (6MWT), preferred speed (10 metres) and maximal speed (10 metres); chair rise time (5 repetitions); stair climb time (10 steps); late life function and disability instrument scale; SF-36 physical function subscale Other outcomes: muscle power - bilateral lower limb extension and unilateral knee extension; geriatric depression scale (data not reported); sickness impact profile; Ewarts self-efficacy scale
Notes	Variance reported as standard error and converted to standard deviation

Risk of bias

Bias	**Authors' judgement**	**Support for judgement**
Allocation concealment (selection bias)	Unclear risk	Not reported

Pohl 2002

Methods	Design: randomised trial of cardiorespiratory training plus % usual care versus usual care - during usual care Randomisation mechanism: unknown; method: equal block based on gait speed Allocation concealment: unknown Blinding: investigator; efficacy unknown Intention-to-treat: no Measurements: end of intervention (4 weeks) Withdrawals: none
Participants	Randomised: 60 participants. 20 participants were randomised to the speed-dependent treadmill training group (STT); 20 participants to the limited progressive treadmill training group (LTT) and 20 participants to a conventional gait training group (CGT). Intervention: STT group = 20 participants; 14 males, 6 females; age 57.1 years (SD 13.9) ; 16.8 (20.5) weeks post-stroke. LTT group = 20 participants; 16 males, 4 females; age 58. 2 years (SD 10.5); 16.2 (16.4) weeks post-stroke. Control: 20 participants; 13 males, 7 females; age 61.6 years (SD 10.6); 16.10 (SD 18.5) weeks post-stroke Inclusion criteria: left or right hemiparesis for > 4 weeks; impaired gait; no or slight abnormal muscle tone (Ashworth Score 0 and 1); walk without assistance (FAC = 3); 10-metre walk

	time > 5 seconds and < 60 seconds; class B exercise risk (ACSM 1998); absence of known heart disease; no evidence of heart failure, ischaemia or angina at rest or exercise; appropriate rise in systolic blood pressure and absence of ventricular tachycardia during exercise Exclusion criteria: previous treadmill training; class C or D exercise risk (ACSM 1998); cognitive deficits (MMSE < 26 of 30); movement disorders; orthopaedic or gait-influencing diseases
Interventions	Intervention: STT (structured speed-dependent treadmill training); 30 minutes per day 3 days per week for 4 weeks; minimal body weight support (10%) for first 3 sessions; speed was increased progressively to the highest speed at which the patient could walk safely. The maximum-achieved speed was held for 10 seconds followed by a recovery period. Each time the patient successfully completed 10 seconds of walking at the set speed, the speed was increased during the next phase by 10%. Treadmill was run at 0% incline LTT (limited progressive treadmill training group); 30 minutes per day 3 days per week for 4 weeks; minimal body weight support for first 3 sessions; speed was increased by no more than 5% of the maximum initial speed each week (20% over 4 weeks); treadmill was run at 0% incline Both intervention groups also received conventional physiotherapy 45 minutes/day 2 days/week for 4 weeks (included some gait training); total 12 hours of treatment Control: conventional gait training that comprised post neuromuscular facilitation and Bobath techniques; 30 minutes/day 3 days/week for 4 weeks. The control group also received conventional physiotherapy 45 minutes per day 2 days per week for 4 weeks (included some gait training); total 15 hours of treatment Setting: rehabilitation centre
Outcomes	Included outcomes: gait maximum speed; FAC Other outcomes: stride cadence (steps/minute); stride length (metres)
Notes	The control group (20 participants) was divided between the 2 relevant comparisons to avoid exaggeration of overall participant numbers in the analyses

Risk of bias

Bias	**Authors' judgement**	**Support for judgement**
Allocation concealment (selection bias)	Unclear risk	Not reported

Potempa 1995

Methods	Design: randomised trial of cardiorespiratory training versus non-exercise intervention - after usual care Randomisation: unknown Allocation concealment: unknown Blinding: unknown Intention-to-treat: no Measurements: end of intervention (10 weeks) Withdrawals: none
Participants	Randomised: 42 participants Intervention: 19 participants; 8 males and 11 females Control: 23 participants; 15 males and 8 females All participants aged 43 to 70 years and were 216 days post-stroke (SD 43) All participants had upper and lower limb hemiparesis Inclusion criteria: medically stable; at least 6 months post-stroke; completed formal rehabilitation Exclusion criteria: patients with brain stem lesions; any clinical evidence that would preclude maximal exercise testing
Interventions	Intervention: cardiorespiratory training: cycle ergometer training for 30 minutes per day 3 days per week for 10 weeks; intensity 30% to 50% of maximal effort increasing to maximum sustainable over first 4 weeks Control: non-exercise intervention: passive range of motion exercises for 30 minutes per day 3 days per week for 10 weeks Setting: unknown
Outcomes	Included outcomes: blood pressure; maximum cycling work rate (Watts) Other outcomes: BMI; heart rate at rest and during maximal exercise; respiratory exchange rate and other respiratory variables; exercise duration; Fugl Meyer score
Notes	Variance reported as standard error and converted to standard deviation

Risk of bias

Bias	**Authors' judgement**	**Support for judgement**
Allocation concealment (selection bias)	Unclear risk	Not reported

Richards 1993

Methods	Design: randomised trial of mixed training plus usual care versus usual care - during usual care Randomisation mechanism: unknown; method: stratified on BI scores Allocation concealment: unknown Blinding: investigator; efficacy unknown Intention-to-treat: no Measurements: end of intervention (5 weeks) Withdrawals: control group 3 (1 refusal, 2 unknown)
Participants	Randomised: 18 participants Intervention: 10 participants; 5 males and 5 females; age 69.6 years (SD 7.4 years); 8.3 days post-stroke (SD 1.4) Control: 8 participants; 2 males and 6 females; age 67.3 years (SD 11.2); 8.8 days post-stroke (SD 1.5) Inclusion criteria: within 50 km of treatment centre; males and females aged 40 to 80 years; 0 to 7 days after first stroke; middle cerebral artery syndrome identified by CT; under care of neurologist involved in study; willing to sign informed consent Exclusion criteria: other major medical conditions that would interfere with functional capacity or interfere with rehabilitation; patients who were independently ambulatory 1 week after stroke; patients who were unconscious at onset
Interventions	Intervention: mixed training: task-oriented gait training programme which used a tilt table, resisted exercises using a Kinetron, and treadmill walking, 104 minutes/day 5 days per week for 5 weeks; progression achieved via velocity and resistance (Kinetron) increments Control: traditional neurophysical techniques 109 minutes/day 5 days per week for 5 weeks Setting: hospital
Outcomes	Included outcomes: Barthel Ambulation scores; BBS; gait velocity Other outcomes: Fugl-Meyer balance; Fugl-Meyer upper and lower extremity scores
Notes	A second control group of early conventional therapy was not used for comparison since it differed from the institution usual care; it commenced earlier than usual during hospital care and had substantially longer contact time

Risk of bias

Bias	**Authors' judgement**	**Support for judgement**
Allocation concealment (selection bias)	Unclear risk	Not reported

Richards 2004

Methods	Design: randomised trial of mixed training plus % usual care versus usual care - during usual care Randomisation mechanism: unknown; method: variable blocks stratified on time since stroke, disability, and age Allocation concealment: unknown Blinding: investigator; efficacy unknown Intention-to-treat: yes Measurements: end of intervention (8 weeks) and 3-month follow-up Withdrawals: intervention: 9 (2 discontinued intervention: 1 hip fracture, 1 cardiac problem), 5 unavailable for follow-up; control: 8 (1 withdrew from intervention, 7 unavailable for follow-up)
Participants	Randomised: 63 participants Intervention: 32 participants; 22 males and 10 females; age 62.9 years (SD 12); 52 days post-stroke (SD 22) Control: 31 participants; 21 males and 10 females; age 60.7 years (SD 12); 52.8 days post-stroke (SD 18) Inclusion criteria: first or second stroke; men or women aged 30 to 89 years; impaired walking; follow verbal instructions; Barthel ambulation score ?10; gait speed of 10 to 60 cm/second Exclusion criteria: cerebral and subarachnoid haemorrhage; major medical problems (cancer, heart conditions, diabetes); receptive or expressive aphasia; lower extremity musculoskeletal disorders affecting gait
Interventions	Intervention: mixed training: task-oriented gait training programme which used a limb-load monitor, resisted exercises using a Kinetron, and treadmill walking, intervention occurred during physiotherapy sessions of 60 minutes per day 5 days per week for 8 weeks, progression achieved via velocity and resistance (Kinetron) increments Control: physiotherapy sessions of 60 minutes per day 5 days per week for 8 weeks not including the task-oriented gait training content above Setting: 2 rehabilitation units
Outcomes	Included outcomes: preferred walking speed; TUG; BI (ambulation subscore); BBS Other outcomes: kinematic gait analysis weakened by missing data in 50% participants; Fugl-Meyer leg and arm scores
Notes	A second control group of conventional therapy was not used for comparison since (1) it was much shorter in duration, and (2) started later than the training intervention. Outcome data imputed from graphs in publication

Risk of bias

Bias	**Authors' judgement**	**Support for judgement**
Allocation concealment (selection bias)	Unclear risk	Not reported

Salbach 2004

Methods	Design: randomised trial of cardiorespiratory training versus non-exercise intervention - after usual care Randomisation mechanism: computer; method: stratified on gait speed Allocation concealment: unknown Blinding: investigator blinded (unblinded during assessment of intervention group 18/42 and control group 16/43) Intention-to-treat: yes Measurements: end of intervention (6 weeks) Withdrawals: intervention: 3 discontinued (refused to travel, wanted both interventions, groin pain) with 2 of these lost to follow-up; control: 4 discontinued (MI, prostate cancer, fall + fracture, wanted other intervention) with 3 of these lost to follow-up
Participants	Randomised: 91 participants Intervention: 44 participants; 26 males and 18 females; age 71 years (SD 12); 239 days post-stroke (SD 83) Control: 47 participants; 30 males and 17 females; age 73 years (SD 8); 217 days post-stroke (SD 73) Inclusion criteria: first or recurrent stroke; gait deficit from recent stroke; mental competency; independently ambulatory for 10-metres +/- aids or supervision; ability to comprehend instructions; resident in community; discharged from rehabilitation; recent stroke 1 year or less Exclusion criteria: neurological deficit caused by metastatic disease; gait function (6MWT) equivalent to healthy norms; discharged to permanent care; comorbidity preventing participation in either intervention
Interventions	Intervention: cardiorespiratory training: task-oriented circuit training, performed 55 minutes per day 3 days per week for 6 weeks, comprising a warm up followed by 10 walking-related tasks (step ups, balance beam, kicking ball, stand up and walk, obstacle course, treadmill, walk and carry, speed walk, backward walking, stairs); progression of speed, load and degree of assistance Control: functional practice, whilst seated, of writing, keyboard use, and manipulating cards; some practice encouraged at home Setting: 2 rehabilitation centres or hospitals
Outcomes	Included outcomes: gait endurance 6MWT; gait comfortable speed; gait maximal speed; TUG; BBS Other outcomes: activity-specific balance confidence scale
Notes	

Risk of bias

Bias	**Authors' judgement**	**Support for judgement**
Allocation concealment (selection bias)	Unclear risk	Not reported

Sims 2009

Methods	Design: pilot randomised study of resistance training versus no intervention (i.e. a waiting-list comparison group) - after usual care. Sample size calculation reported Randomisation: computer generated block randomisation by an independent investigator - blocks of 6 stratified by gender Allocation concealment: unclear Blinding:unclear Intention-to-treat: yes Measurements: at the end of the training programme (10 weeks) and at 6-month follow-up Withdrawals: 1 participant did not complete the 10-week assessment; 5 participants (3 intervention, 2 control) did not complete the physical assessment at 10 weeks due to health reasons unrelated to the programme or time commitments. 43 participants completed the 6-month survey assessment
Participants	Randomised: 45 participants; 27 males and 18 females; mean age 67.13 years (SD 15.23) , average time since stroke 13.2 months (SD 4.95) Intervention: 23 participants were allocated to the progressive resistance training group. 21 participants completed the 10-week programme (2 people became medically ineligible) Control: 22 participants were allocated to the waiting-list control group Inclusion criteria: stroke survivors with depressive symptoms Exclusion criteria: under 18 years; stroke < 6 months ago; inability to walk a distance of at least 20 metres independently with or without a gait assistive device; Prime-MD Patients Health Questionnaire (PHQ-9) score < 5; depression with psychotic features; alcohol or drug-related depression, schizophrenia; bipolar disorder; other psychiatric diagnoses; suicidal ideation; dementia; terminally ill; uncontrolled hypertension; unstable angina; and unstable insulin dependent diabetes
Interventions	Intervention: participants in the intervention group attended a community gymnasium twice/week for 10 weeks and trained under the supervision of an accredited fitness trainer. The training programme entailed moderate strengthening exercises (3 sets of 8/10 repetitions at a resistance of 80% of 1-RM) using machine weights for the major upper and lower limb muscle groups. Resistence was increased when participants were able to complete 3 sets of 10 repetitions of an exercise Control: the wait-list controls received usual care and were asked not to do any resistance-type exercise (content of the 'usual care' intervention not specified) Setting: community-based setting
Outcomes	Included outcomes: CES-D; AQoL, SF-12 Other outcomes: SIS; SWLS; LOT-R; Self-Esteem Scale; RLOC
Notes	Sample size calculation performed but sample obtained was smaller than that of the calculation (45 participants instead of 60). Small sample size. At baseline the intervention group had significantly lower depression scores than the comparison group. Impact of social interaction was not assessed The participants in the control group received more attention than simply usual care as they received a 10-week strength assessment
Risk of bias	

Sims 2009 (*Continued*)

Bias	Authors' judgement	Support for judgement
Allocation concealment (selection bias)	Unclear risk	Not reported

Smith 2008

Methods	Design: randomised trial of cardiorespiratory training versus non-exercise intervention - after usual care (i.e. treadmill gait training versus weekly telephone calls - the main purpose of the trial was to explore the potential additional benefits of treadmill training) Randomisation: random matched-pair assignment. The investigator assigned a number to suitable participants and placed them in 1 of the intervention groups by 'the roll of a dice' (odd control, even treatment), or systematically allocated a participant to match a randomly assigned participant in the alternate group (minimisation?) Allocation concealment: unclear Blinding: clinical assessor not blinded Intention-to-treat: not reported, but no withdrawals Measurements: at the end of the intervention (4 weeks) and then 6 weeks later Withdrawals: none
Participants	Randomised: 20 participants; age range 42 to 72 years Intervention: 10 participants, 8 males and 2 females; mean age 57.8 years (SD 7.0); time from stroke : 8 participants < 1 year and 2 participants $\geq$ 1 year < 2 years Control: 10 participants, 4 males and 6 females; mean age 56 years (SD 8.3); time from stroke : 8 participants < 1 year and 2 participants $\geq$ 1 year < 2 years Inclusion criteria: stroke in the middle cerebral artery territory more than 3 months but less than 2 years prior to enrolling in the trial; walking slower than pre-stroke Exclusion criteria: cognitive impairment; unable to ambulate; concomitant pathology that prevented walking on a treadmill
Interventions	Intervention: participants in the intervention group received 12 sessions of treadmill training (20 minutes each session) over 4 weeks plus weekly calls from the investigator enquiring about the quality of their week and encouraging them to keep a quality-of-life log. They wore a standard gait belt on the treadmill and had a practice session prior to the start of the trial. The starting speed on the treadmill was the speed at which the participant could walk during the practice session for 5 minutes with a rate of perceived exertion (RPE) $\leq$ 13. The speed was increased by 0.2 mph each time the participant walked for 10 consecutive minutes with a RPE $\leq$ 13 Control: participants in the control group received weekly calls from the investigator enquiring about the quality of their week and encouraging them to keep a quality-of-life log only Setting: community-based setting
Outcomes	Included outcomes: none Other outcomes: specific domains of the SIP
Notes	Very small sample size. Fitness outcomes not considered.

Risk of bias

Smith 2008 (*Continued*)

Bias	Authors' judgement	Support for judgement
Allocation concealment (selection bias)	Unclear risk	Not reported

Teixeira 1999

Methods	Design: randomised trial of mixed training versus no intervention - after usual care First iteration only of a lag control design; participants randomly allocated to immediate or delayed - participants allocated delayed intervention initially received no intervention Randomisation mechanism: unknown; method: unclear ('balanced blocks') Allocation concealment: unknown Blinding: unknown Intention-to-treat: no Measurements: end of intervention (10 weeks) Withdrawals: none
Participants	Randomised: 13 participants Intervention: 6 participants; 1 male and 5 females; age 65.9 years (SD 10.2); 9.15 years post-stroke (SD 12.7) Control: 7 participants; 1 male and 6 females; age 69.4 years (SD 8.85); 6.4 years post-stroke (SD 6.2) All participants had unilateral stroke resulting in residual weakness or abnormal muscle tone or both Inclusion criteria: at least 9 months post-stroke; independently ambulatory with or without walking aids; no comprehensive aphasia Exclusion criteria: non-stroke related disability
Interventions	Intervention: mixed training: cardiorespiratory and lower extremity strength training 60 to 90 minutes per day 3 days per week for 10 weeks; cardiorespiratory training: graded walking plus stepping or cycling progressing from 10 to 20 minutes per day and from 50% to 70% of maximal cycling work rate over first 5 weeks; strength training: 7 exercises involving use of body weight and progressive resistive exercise using different masses and elastic bands (Thera-Band), each performed as 3 x 10 repetitions and progressing from 50% to 80% of 1 repetition maximum; warm up and warm down 10 to 20 minutes per day Control: no intervention Setting: unclear
Outcomes	Included outcomes: gait preferred speed (22-metre); Adjusted Activity Score; NHP Other outcomes: insufficient data to compare lower limb muscle strength (peak torque Nm); muscle tone assessment; and stair climbing
Notes	

Risk of bias

Bias	Authors' judgement	Support for judgement

Teixeira 1999 (*Continued*)

Allocation concealment (selection bias)	Unclear risk	Not reported

Winstein 2004

Methods	Design: randomised trial of resistance training plus usual care versus usual care - during and after usual care Randomisation mechanism: unknown; method: stratified on Orpington Prognostic Scale (1.6 to 1.4 and 4.2 to 6.8) Allocation concealment: sealed envelopes Blinding: principal investigator but not outcome assessor Intention-to-treat: no Measurements: end of intervention (4 to 6 weeks) and 9-month post stroke follow-up Withdrawals: before end of intervention: 1 (treatment group, medical complications), 1 (control group, lost interest); before end of follow-up: 9 (treatment group 4, control group 5 - moved away or lost contact)
Participants	Randomised: 42 participants Intervention: 21 participants; 12 males and 8 females; time since stroke 17.3 days (SD 10. 6) Control: 20 participants; 2 males and 8 females; time since stroke 15.4 days (SD 5.5) Age: 29 to 76 years, most 35 to 75 years Inclusion criteria: first stroke; 2 to 35 days post-stroke; FIM score Exclusion criteria: peripheral nerve or orthopaedic condition limiting arm movement; function limited by cardiac disease; subarachnoid haemorrhage without infarction; progressive hydrocephalus; history of brain injury; severe aphasia, neglect, agitation or depression which could limit participation
Interventions	Intervention: upper limb movements resisted by gravity, free weights, Thera-Band and grip devices for fingers, 60 minutes/day 5 days per week for 4 to 6 weeks, high intensity for 3 days per week and low intensity higher velocity for 2 days/week, training target 20 hours total Control: standard care delivered by occupational therapy, included muscle facilitation exercises using neuro-developmental approach, electrical stimulation, stretching, ADL and caregiver training; activities included use of upper limbs Setting: inpatient rehabilitation hospital and outpatient clinic
Outcomes	Included outcomes: FIM (mobility and self care scores); FTHUE; composite measure of strength (sum of torque from extension and flexion of the wrist elbow and shoulder); grip and pinch force Other outcomes: Fugl-Meyer scores
Notes	Change from baseline scores reported and analysed.

Risk of bias

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

Winstein 2004 (*Continued*)

Allocation concealment (selection bias)	Low risk	Sealed envelopes

Yang 2006

Methods	Design: randomised trial of mixed training versus no intervention - after usual care Randomisation mechanism: picking envelopes Allocation concealment: sealed envelopes Blinding: investigator Intention-to-treat: unknown Measurements: end of intervention (4 weeks) Withdrawals: none
Participants	Randomised: 48 participants Intervention: 24 participants; 16 males and 8 females; age 56.8 years (SD 10.2); time since stroke > 1 year Control: 24 participants; 18 males and 8 females; age 60 years (SD 10.4); time since stroke > 1 year Inclusion criteria: first stroke < 1 year ago; not receiving rehabilitation; ambulatory, independent with no aids; medically stable to participate; able to understand instructions and follow commands Exclusion criteria: medical condition preventing participation; uncontrolled health condition for which exercise was contraindicated
Interventions	Intervention: mixed training performed as a circuit 30 minutes per day 3 days per week for 4 weeks; circuit comprised 6 x 5-minute lower extremity workstations (standing and reaching, sit-to-stand from chair, stepping forwards and backwards onto blocks, stepping sideways onto blocks, forward step-up onto blocks), participants encouraged to work hard, progression achieved by increasing number of repetitions in each 5-minute block, and increasing step and chair height, and the complexity of task; extended periods (5-minute) warrant acknowledgement of a cardiorespiratory component despite the author's title (progressive resistance strength training) Control: no intervention
Outcomes	Included outcomes: gait endurance (6MWT - outcome assessor not blinded); gait speed preferred (10-metres); 3-metre TUG; step test; isometric strength of knee and hip ankle extension and flexion; and ankle dorsi-flexion and plantar-flexion (using handheld dynamometer) Other outcomes: gait cadence and stride length
Notes	Trial authors stated 'strength training' but intervention was actually mixed training. Data reported as absolute and change scores

Risk of bias

Bias	**Authors' judgement**	**Support for judgement**
Allocation concealment (selection bias)	Low risk	Sealed envelopes

6MWT: 6-Metre Walking Test
9HPT: 9-Hole Peg Test
12MWT: 12-minute walk test
ABCS: Activities-Specific Balance Confidence Scale
ACSM: American College of Sports Medicine
ADL: activities of daily living
AQoL: Assessment of Quality of Life Instrument
ARAT: Action Research Arm Test
BBS: Berg Balance scale
BI: Bathel Index
BMI: Body Mass Index
CES-D: Centre for Epidemiological Studies for Depression scale
CT: computerised tomography
ECG: electrocardiogram
EMS: Elderly Mobility Scale
FAC: Functional Ambulation Classification
FAI: Frenchay Activity Index
FAPS: Functional Ambulation Profile Score
FIM: Functional Independence Measure
FTHUE: Functional Test of the Hemiparetic Upper Extremity
HADS: Hospital Anxiety and Depression Scale
LOT-R: Life Orientation Test - Revised
mAS: modified Ashworth Scale
MAS: Motor Assessment Scale
MI: myocardial infarction
MMSE: Mini Mental State Examination
NEADL: Nottingham Extended Activities of Daily Living
NHP: Nottingham Health Profile
PADS: Peripheral Arterial Diseases Walking Impairment questionnaire
RLOC: Recovery Locus of Control Scale
RMA: Rivermead Motor Assessment
RMI: Rivermead Mobility Index
SD: standard deviation
SF-12: Short Form-12 Health Survey Questionnaire
SF-36: Short Form 36 Health Survey
SIP: Stroke Impact Scale
SIS: Stroke Impact Scale
SSS: Scandinavian Stroke Scale
SWLS: Satisfaction with Life sSale
TUG: Timed Up and Go test

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

Study	Reason for exclusion
Ada 2003	Control intervention was described as training and included prescribed walking which confounds this walking study
Ada 2010	Not valid comparison (treadmill gait training with body weight support versus overground gait training)
Akbari 2006	Not valid control group
Au-Yeung 2009	Intervention not physical fitness training (short-form Tai Chi). Not valid control
Barreca 2007	Not progressive physical fitness training
Baskett 1999	Intervention not physical fitness training: it is described as exercise and activities but no evidence of progressive cardiorespiratory or strength elements, or both
Batchelor 2009	Intervention not physical fitness training (falls prevention programme)
Blennerhassett 2004	Control group perform upper limb training intervention - this could theoretically influence lower limb outcome measures
Bourbonnais 2002	Comparison of upper and lower body exercise
Brown 2002	Comparison of 2 exercise regimens
Butefisch 1995	Non-random, alternate allocation on admission method
Carr 2003	No relevant comparisons: comparison of cardiorespiratory training and mixed training
Chanruengvanich 2006	Intervention does not meet the criteria for physical fitness training (self-regulated exercise programme). Control not specified
Chu 2004	Control group perform upper limb training intervention - this could theoretically influence lower limb outcome measures
Davis 2003	No relevant comparisons: comparison of cardiorespiratory training and strength training
Davis 2006	Control group included physical activity: comprised 30 minutes 'sham' aerobic training (which was motorised and passive) and 30 minutes of 'sham' resistance training; resistance training was not passive as it involved movement of legs against gravity and it included some stretching
Dean 1997	Intervention not physical fitness training: although an element of progression is present the intervention is more 'practice' than training as defined in this review
Dean 2000	Not valid comparison (upper body versus lower body)
Desrosiers 2005	Not a valid comparison: control contained additional dose of 'usual arm therapy'. Intervention not physical fitness training: repetition and practice

(*Continued*)

Di Lauro 2003	Not a valid comparison. It is 'training' versus usual care, the intervention is also not physical fitness training
Dias 2007	Not valid control (not usual care)
Dickstein 1986	Intervention not physical fitness training: although post neuromuscular facilitation and Bobath approaches may contain resistive exercises. Patient allocation not randomised: based on hospital administration procedures
Dickstein 1997	Intervention not physical fitness training: muscle contractions not resisted and not progressive. Patient allocation not randomised: patients were sequentially assigned
Dobkin 2010	Not valid comparison. Both groups received physiotherapy plus 10-metre walk. The experimental group received feedback about walking speed
Dromerick 2005	Intervention not physical fitness training: constraint induced movement therapy
Drummond 1996	Interventions not physical fitness training: 2 interventions: (1) leisure therapy, and (2) conventional occupational therapy
Feys 1998	Intervention not physical fitness training: the physical activity (rocking movements) showed no progression of intensity
Fletcher 1994	Mixed population (35% of sample were not stroke)
Foley 2004	Mixed population. Only 15 of 338 participants (4%) had stroke
Franceschini 2009	Not valid comparison (treadmill gait training versus overground gait training)
Gelber 1995	Intervention not physical fitness training: comparison of traditional functional retraining and neurodevelopmental techniques. No relevant comparisons
Gilbertson 1998	Intervention not physical fitness training: home-based occupational therapy
Gregson 2006	Intervention was not fitness training, it was repetitive practice with no progression of exercise load except for some participants initially unable to complete the target number of repetitions (10)
Harrington 2010	Not valid comparison (exercise and education programme versus standard care)
Harris 2009	Intervention does not meet the criteria for physical fitness training (upper limb supplementary programme)
Hart 2004	Control intervention not a valid comparison: not usual care, not non-exercise, and balance exercises confound
Helbostad 2004	Only 16 of 77 participants with stroke. Not a valid comparison, both groups receiving home training
Hidler 2007	No a valid comparison: comparison of 2 types of training

(*Continued*)

Higgins 2006	Intervention not fitness training: experimental group dexterity practice. Control group not valid: included physical activity (walking)
Howe 2005	Intervention not physical fitness training
Hu 2003	Intervention (Bobath) not physical fitness training
Hu 2006	Intervention not physical fitness training
Ishida 2001	Regular rehabilitation was suspended in some participants during a period of usual care Not an exercise intervention
Jeong 2007	Intervention not physical fitness training (rhythmic music and specialised rehabilitation movements)
Jongbloed 1989	No relevant control group: comparison of 2 occupational therapy interventions. Interventions not physical fitness training
Jongbloed 1991	Intervention not physical fitness training: occupational therapy related to leisure activities
Kamps 2005	Not relevant control group: participants recruited after usual care yet were exposed to physiotherapy and 'ergotherapeutic' interventions
Klassen 2005	Not a valid control group: low intensity upper body exercise
Kwakkel 1999	Intervention not physical fitness training: investigation of rehabilitation of functional tasks. The principal author clarified that there was no progression of training intensity, the content of training was variable, and the treadmill training volume comprised only approximately 10% of patients
Langhammer 2009	Not valid comparison (physiotherapy versus self-initiated exercise)
Langhammer 2010	Not valid comparison (treadmill gait training versus walking outdoors)
Laufer 2001	Intervention not physical fitness training: comparison of treadmill ambulation and overground walking. No relevant comparisons
LEAPS	No relevant comparisons
Lee 2008	Not valid control
Lennon 2009	Not valid comparison (aerobic exercises plus lifestyle counselling and risk reduction programme versus risk reduction programme)
Leveille 1998	Contained few people with stroke: intervention (8%), control (9%). Not a valid intervention - other healthy living interventions included. Not a valid control - provided access to training facilities of intervention group
Lin 2004	Intervention not physical fitness training

(*Continued*)

Lincoln 1999	Interventions not physical fitness training: comprised additional physiotherapy
Lincoln 2003	Comparison of 2 physiotherapy approaches
Lindsley 1994	This was published as an abstract only, the numerical data were not included and could not be recovered from the authors This intervention may have been training although the abstract contained no mention of progression
Liston 2000	Intervention not physical fitness training
Logan 2003	Intervention not physical fitness training: comprised leisure activities, although sport was included
Logigian 1983	No relevant comparisons: comparison of traditional and facilitation techniques. Intervention not physical fitness training: although training elements may have been included it would be difficult to separate the effect of training from therapy
Lord 2008	Not valid comparison (functional gait activities in community environments versus physiotherapy including treadmill gait training)
Luft 2004	Intervention not physical fitness training. Control group contained physical activity not linked to usual care
Luft 2008	Not valid comparison (treadmill gait training versus stretching exercises)
Macko 2005	Control group is not non-exercise, or conventional treatment
Maeshima 2003	Not a relevant comparison: 2 exercise groups, with and without family members present
Marigold 2005	Not a relevant comparison: comparison of agility and stretching/weight shifting; neither is physical fitness training
Mayr 2007	Not valid comparison (Lokomat automatised gait training versus Bobath exercises)
McClellan 2004	Control group not non-exercise
Mehrholz 2008	Not valid comparison (automated locomotor gait training with physiotherapist assistance versus physical therapy)
Michaelsen 2006	Control group is not non-exercise
Miller 2000	Intervention not physical fitness training
Moreland 2003	Control group not non-exercise
Nelles 2001	Not a valid comparison. Intervention not physical fitness training. Included non-stroke healthy controls

(*Continued*)

Nilsson 2001	Comparison not relevant: comparison of treadmill training with a physiotherapy approach to gait training (motor relearning programme) during usual care
Noh 2008	Not valid comparison. Active control. Experimental group received aquatic therapy - Ai Chi - whilst control group performed gym exercises
Olney 2006	Not a valid comparison: trial of supervised versus unsupervised exercise
Outermans 2010	Not valid comparison (high intensity training programme versus low-intensity circuit rehabilitation programme)
Pan 2004	Not a valid comparison: trial of training versus unsupervised training
Pang 2006	Control group not non-exercise
Pang 2008	Not valid comparison (leg exercise programme versus arm exercise programme)
Parker 2001	Intervention not physical fitness training: leisure therapy and occupational therapy
Parry 1999	Intervention not physical fitness training: physiotherapy using Bobath and movement science approaches
Partridge 2000	Intervention not physical fitness training: comparison of amount of physiotherapy
Peng 2002	Intervention not physical fitness training
Peurala 2005	Not a valid comparison (control group physical activity)
Peurala 2009	Not valid comparison (electromechanical gait training with physio assistance versus conventional physiotherapy)
Pitsch 2006	Intervention not physical fitness training
Platz 2001	Intervention not physical fitness training: arm ability training comprised simple functional and manipulative tasks
Platz 2005	2 interventions, neither were physical fitness training
Pohl 2007	Not valid comparison (electromechanical gait training with body support)
Pomeroy 2001	Intervention not physical fitness training: weighted garments may offer increased resistance to muscle contraction but physical activity was neither controlled nor accurately monitored (patients log book)
Quaney 2009	Not valid comparison (bicycle training versus strength training)
Rimmer 2000	Patient allocation not randomised: influenced by geographical location. The intervention was physical fitness training and comprised elements of cardiorespiratory, strength and flexibility training

(*Continued*)

Rimmer 2009	Not valid comparison (moderate short duration exercise programme versus long-intensity longer duration exercise programme versus rehabilitation programme including walking training and strength exercises). No valid control
Shatil 2005	Intervention not physical fitness training. Control involved some strengthening
Sherrington 2008	Mixed population (results are not provided separately for stroke participants)
Shimada 2003	Only 25% of cohort were people with stroke (only 1 with stroke in control group)
Shimizu 2002	Non-random allocation (order of admission). Only 11 of 16 participants were people with stroke
Sivenius 2007	Comparison not relevant: comparison of 2 therapies
Smith 1981	Intervention not physical fitness training: intensive and conventional physiotherapy and occupational therapy
Sullivan 2002	Comparison not relevant: participants allocated 3 different treadmill training speeds
Sullivan 2007	Not valid comparison (treadmill gait training with body weight support versus leg cycling versus upper-extremity ergometry)
Sunderland 1994	Intervention not physical fitness training: comparison of orthodox and enhanced physiotherapy
Suputtitada 2004	Control is active walking
Thielman 2004	Not a relevant comparison: resistance training versus task-related training
Thielman 2005	Not a relevant comparison: resistance training versus task-related training
Van der Lee 1999	Intervention not physical fitness training. Comparison not relevant: comparison between forced use of affected arm and use of both arms
Walker 1999	Intervention not physical fitness training: occupational therapy
Werner 1996	Intervention not physical fitness training: physical and occupational therapy
Werner 2002	Not a valid comparison: comparison of 2 forms of training
Widén Holmqvist 1998	Intervention not physical fitness training: home-based physical and occupational therapy
Wing 2006	Control group exposed to exercise (upper body)
Wolfe 2000	Intervention not physical fitness training: community-based physical and occupational therapy
Xiao 2002	Not a valid comparison

(*Continued*)

Yang 2005	Not a valid comparison: control intervention included strengthening, function, mobility and gait training after completion of usual care
Yang 2007	Intervention not physical training (ball exercise programme versus rehabilitation training)
Yen 2008	Not valid control (not usual care)
Yokokawa 1999	Ongoing rehabilitation classes were randomised, not individuals; this is biased

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

AMBULATE

Trial name or title	AMBULATE
Methods	Prospective randomised clinical trial; blinded assessment
Participants	122 participants Inclusion criteria: > 18 years old; < 5 years of first stroke; able to walk 10 metres unaided or with a single-point stick; 10 metre walk time > 9 seconds; finished formal rehabilitation; able to gain medical clearance to participate Exclusion criteria: any barriers to taking part in a physical rehabilitation program; insufficient cognition/ language
Interventions	Intervention: Group 1 - treadmill and overground walking program 30 minutes/day 3 days/week for 4 months; Group 2 - treadmill and overground walking program 30 minutes/day 3 days/week for 2 months Control: no intervention
Outcomes	Primary outcome measures: 10-metre walk speed, 6-minute walk distance Secondary outcome measures: falls, self-efficacy of community ambulation, Adelaide Activites Profile, Euro-QOL Timepoint: measured at baseline, 2 months, 4 months, 6 months and 12 months
Starting date	Start: 27 April 2007
Contact information	Associate Professor Louise Ada, Discipline of Physiotherapy Faculty of Health Sciences, University of Sydney, PO Box 170, Lidcombe NSW 1825, Australia Tel: +61 2 93519544, Fax: +61 2 93519278, Email: L.Ada@usyd.edu.au
Notes	ACTRN12607000227493

Askim

Trial name or title	Does intensive task specific training improve balance after acute stroke?
Methods	Randomised clinical trial
Participants	62 participants Inclusion criteria: admitted to the stroke unit with a diagnosis of stroke; living in the city of Trondheim; included 4 to 14 days after first sign of symptoms; Modified Rankin Scale > 3 before admission to hospital; Scandinavian Stroke Scale (SSS) less than 58 points and more than 14 points; SSS leg item less than 6 points or SSS movement item less than 12 points; discharged to home or a rehabilitation clinic; Mini Mental State Examination score more than 20 points; able and willing to provide informed consent Exclusion criteria: serious heart and lung diseases; other diseases which makes it difficult to evaluate the function; already included in the trial
Interventions	Intervention: intensive task specific balance training (physical therapy technique and exercises) 3 days/week for 4 weeks then 1 day/week for 8 weeks plus usual physical therapy Control: usual physical therapy alone
Outcomes	Primary outcome measures: Berg Balance Scale Secondary outcome measures: Mini Mental State Examination; Scandinavian Stroke Scale (SSS); Motor Assessment Scale; Timed Up and Go Step Test; walking speed; Barthel Index; Modified Rankin Scale; Fall Efficacy Scale; Stroke Impact Scale Time frame: inclusion 1, 3 and 6 months follow up
Starting date	Start: April 2004 Completion: April 2008
Contact information	Associate Professor Bent Indredavik, Department of Neuroscience, Faculty of Medicine, Norwegian University of Science and Technology, Trondheim, Norway
Notes	Norwegian University of Science and Technology

Eng

Trial name or title	The effect of a supplementary exercise program for upper extremity function in stroke rehabilitation
Methods	Randomised clinical trial; parallel assignment; single blind (participants)
Participants	250 stroke patients Inclusion criteria: 19 years of age or older; arm recovery as a rehabilitation goal; have palpable movement of wrist extension; able to follow 3-step verbal commands Exclusion criteria: unstable cardiovascular status (congestive heart failure, uncontrolled hypertension, uncontrolled atrial fibrillation, or left ventricular failure); significant musculoskeletal problems (e.g., rheumatoid arthritis) or neurological conditions (e.g. Parkinson's disease) due to conditions other than stroke; receptive aphasia
Interventions	Intervention: usual care + arm and hand exercise (muscle strengthening and stretching, repetitive reaching, folding, stacking, pushing and pulling tasks, picking up objects, and activities that use speed and accuracy) 60 minutes per day for 4 weeks during inpatient care

Eng (*Continued*)

	Control: usual care only
Outcomes	Primary outcome measures: the primary outcome is the ability to use the paretic arm in activities of daily living Secondary outcome measures: amount of use and quality of movement of the paretic arm; motor recovery; strength; tone; and health-related quality of life Measures will be evaluated pre and post program
Starting date	Start: July 2006 Completion: June 2008
Contact information	Jocelyn Harris, GF Strong Rehab Center, Vancouver, British Columbia, Canada Tel: +1 604 737 6310, Email: jocelyn.harris@vch.ca
Notes	NCT00359255

FAME

Trial name or title	A RCT of FAmily Mediated Exercises (FAME) following stroke
Methods	Randomised clinical trial; single group assignment; single blind (outcomes assessor)
Participants	40 stroke patients Age > 18 years Inclusion criteria: diagnosis of first unilateral stroke; patients who score between 3.2 and 5.2 on the Orpington Prognostic Scale; patients participating in a physiotherapy programme; patients willing to give informed written consent; patients with family willing to participate in their assigned physiotherapy intervention programme Exclusion criteria: hemiplegia of a non-vascular origin; discharged from hospital less than 2 weeks following stroke; pre-existing neurological disorder; any lower limb orthopaedic condition that may limit exercise capacity; aphasia; cognitive impairment; not willing to give written consent
Interventions	Intervention: routine therapy plus additional 'family mediated exercise therapy' (repetitive sit-to-stand exercises, weight bearing exercises during standing, bridging, straight leg raises, quadriceps strengthening exercises, active/active assisted range of movement exercises for the lower limb and walking; total > 1200 minutes over 8 weeks) Control: routine therapy only
Outcomes	Fugl Meyer Assessment, Berg Balance Scale, Motor Assessment Scale, 6-Minute Walk Test, Barthel Index, re-integration into Normal Living Index; Nottingham Extended Activities of Daily Living Baseline, post-intervention and 3-month follow-up
Starting date	Start: April 2008 Completion: March 2009
Contact information	Dr Emma Stokes, Principal Investigator, University of Dublin, Trinity College, Dublin, Ireland Tel: 00 353 1 896 2127, Email: estokes@tcd.ie

FAME (*Continued*)

Notes	NCT00666744

Ivey (A)

Trial name or title	Effects of exercise on endothelial function in stroke patients
Methods	Randomised clinical trial; parallel assignment; open label
Participants	140 participants Inclusion criteria: ischaemic stroke greater than 6 months prior in men or women ages 40 to 85 years; residual hemiparetic gait deficits; already completed all conventional inpatient and outpatient physical therapy; adequate language and neurocognitive function to participate in exercise testing and training
Interventions	Intervention: cardiorespiratory treadmill training Control: stretching and range of motion
Outcomes	Peak aerobic capacity, mobility
Starting date	Start: August 2003 Completion: May 2008
Contact information	Frederick M Ivey, Baltimore VA Medical Center/ University of Maryland School of Medicine Baltimore, Maryland, USA
Notes	NCT00891514

Ivey (B)

Trial name or title	Strength training for skeletal muscle adaptation after stroke
Methods	Randomised clinical trial; parallel assignment; open label
Participants	52 participants Inclusion criteria: men and women aged 40 to 85 years, ?6 months post stroke Completion of rehabilitation
Interventions	Intervention: lower extremity strength training (leg extension, press and curl), 45 to 60 minutes per day, 3 days per week for 3 months Control: active and passive upper and lower body stretching and range of motion, 45 to 60 minutes per day, 3 days per week for 3 months
Outcomes	VO_2 peak; bilateral single limb strength testing (leg extension and leg press); bilateral single limb muscle endurance (static and dynamic); mobility (timed 10-metre and 6-minute walks); Berg Balance Scale
Starting date	Start: April 2009 Completion: March 2012

Ivey (B) (*Continued*)

Contact information	Fred Ivey, VA Maryland Health Care System, Baltimore, USA
Notes	NCT00827827

Luft

Trial name or title	Structural neuroplasticity associated with aerobic treadmill training in geriatric chronic stroke survivors
Methods	Randomised clinical trial; parallel assignment; open label
Participants	40 patients aged over 60 years with lower extremity paresis after a first-ever clinical stroke longer than 6 months prior to study inclusion will be recruited Inclusion criteria: women and men aged > 60 years; first-ever ischaemic stroke at least prior 6 months; all conventional inpatient and outpatient physical therapy completed; residual hemiparetic gait disturbance adequate language and neurocognitive function to participate in exercise training and testing Exclusion criteria: already performing > 20 minutes aerobic exercise 3 times a week; alcohol consumption > 2 oz liquor, or 2 x 4 oz glasses of wine, or 2 x 12 oz cans of beer per day; cardiac history of unstable angina, recent (< 3 months) myocardial infarction, congestive heart failure (New York Heart Association category II) , haemodynamically significant valvular dysfunction; medical history of recent hospitalisation (< 3 months) for severe medical disease: symptomatic peripheral arterial occlusive disease, orthopaedic or chronic pain conditions restricting exercise, pulmonary or renal failure, active cancer,poorly controlled hypertension (> 160/100) or diabetes mellitis (fasting glucose >180 mg/dl, HbA1C > 10%); neurological history of dementia, receptive or global aphasia that confounds testing and training (operationally defined as unable to follow 2-point commands), cognitive deficits (other than dementia and aphasia, as above), non-stroke neuromuscular disorder restricting exercise (e.g. Parkinson's syndrome), untreated major depression; exclusion criteria for magnetic resonance imaging scanning (metal implants such as pacemakers, claustrophobia, etc)
Interventions	Intervention: 3 months progressive graded aerobic treadmill exercise training (3 times/week, duration 10 to 45 minutes) Control: attention control
Outcomes	Aerobic capacity (VO_2 peak) Gait velocity
Starting date	Start: January 2008 Completion: July 2009
Contact information	Dr Andreas Luft, Department of Neurology, University Hospital Tuebingen
Notes	NCT00614224

Olsson

Trial name or title	Evaluation of an intervention program targeted at improving balance and functional skills after stroke: a randomised controlled study
Methods	Randomised clinical trial; parallel assignment; double blind (participants, outcomes assessor)
Participants	50 stroke patients Age ≥ 55 years; 3 to 6 months post stroke; ambulatory ≥ 10 metres with or without assistive device; ability to understand simple instructions Exclusion criteria: TIA; independent in walking outdoors; serious visual or hearing impairment; long distance to intervention station
Interventions	Intervention: high intensity functional exercise plus theory session Control: theory session
Outcomes	Balance, incidence of falls, self-efficacy, Activities of Daily Living, walking ability
Starting date	Start: September 2006 Completion: February 2008
Contact information	Eva Olsson, Umeå University and The Vårdal Institute Tel: +46 90 786 91 37, Email: eva.olsson@physiother.umu.se
Notes	NCT00377689

Protas

Trial name or title	Stroke rehabilitation outcomes with supported treadmill ambulation training
Methods	Randomised efficacy trial, single group assignment; open label
Participants	48 recent unilateral stroke patients expected Adults, males and females, aged 18 years or older
Interventions	Intervention: supported treadmill ambulation training + usual care Control: usual care
Outcomes	FIM, oxygen consumption, BMCA
Starting date	Start: January 2001 Completion: December 2003
Contact information	Dr Elizabth Protas, VAMC, Houston, Texas, USA Tel: +1 713 794 7117, E-mail: lim.peter@houston.va.gov
Notes	NCT00037895

REHAB

Trial name or title	Reshaping Exercise Habits And Beliefs (REHAB): pilot testing of a behavioural intervention to improve mobility after stroke
Methods	Randomised clinical trial; parallel assignment; open label
Participants	90 stroke patients aged 40 to 85 years Inclusion criteria: 40 to 85 years old ischaemic stroke patients; stroke onset < 90 days at enrolment; hemiparetic gait disorder; patients able to walk 30 feet with or without assistive device; sufficient English comprehension to understand instructions, provide consent, and answer questions; live within 30 miles of the Greater Baltimore area Exclusion criteria: dementia (extended MMSE < 85 or < 80 if education level below 9th grade); untreated major clinical depression (CES-D > 16); heavy alcohol use (< 3 oz liquor, 3 x 4-oz glasses of wine, or 3 x 12-oz beers daily); active cancer, or any illness with a life expectancy of less than 6 months; any condition in which exercise activity would be contraindicated including, but not limited to: unstable angina, cardiac ischaemic event within the past 6 months, congestive heart failure (Stage III or IV), major orthopedic chronic pain or non-stroke neuromuscular disorders restricting exercise, oxygen-dependent COPD or peripheral neuropathy
Interventions	Intervention: home-based exercise prescriptions with weekly motivational telephone calls Control: stroke education program with matched attention phone calls
Outcomes	Ambulatory Activity Profile
Starting date	Start: October 2006 Completion: June 2010
Contact information	Alyssa D Stookey, PhD MS, VA Maryland Health Care System, Baltimore, Maryland, USA Tel: +1 410 605 7000 ext 5431; Email: alyssa.mealey@va.gov
Notes	NCT00431821

Ryan

Trial name or title	Inflammation and exercise in stroke
Methods	Randomised clinical trial; parallel assignment; open label
Participants	150 participants expected Ischaemic or haemorrhagic stroke greater than or equal to 6 months prior with stable residual hemiparetic gait deficits Already completed all conventional inpatient and outpatient physical therapy
Interventions	Intervention: cardiorespiratory training Control: stretching
Outcomes	Body composition, VO_2 peak
Starting date	Start: May 2009 Completion: April 2014

Ryan (*Continued*)

Contact information	Dr Alice S. Ryan, University of Maryland, VA Research Service, USA Tel 410-605-7851, Email aryan@grecc.umaryland.edu
Notes	NCT00891514 (same as Ivey (A)?)

Suskin 2007

Trial name or title	Cardiac rehabilitation for TIA patients (CR-TIA)
Methods	Randomised clinical trial, parallel assignment; single blind (outcomes assessor)
Participants	200 participants Inclusion criteria: age > 20 years; documented TIA or mild non-disabling stroke within the previous 3 months; at least 1 of the following vascular risk factors: hypertension, ischaemic heart disease, diabetes mellitus, dyslipidaemia or cigarette smoking Exclusion criteria: inability to speak or understand English or provide informed consent; severe aphasia that renders communication difficult or impossible; Modified Rankin Scale score of greater than or equal to 3; Mini Mental State Examination score $\leq$ 20; evidence of intracranial haemorrhage confirmed by CT scan or MRI study; anticipated or recent (< 30 days) carotid endarterectomy, angioplasty and/or stenting; resides > 1 hour travel time from London or Ottawa; prior participation in a CCR program; inability to perform expected exercise training of CCR program; evidence of cardioembolic source for TIA/stroke such as atrial fibrillation, valvular disease, septal defect or left ventricular wall motion abnormality; participation in another clinical trial that could interfere with the intervention or outcomes of the current study
Interventions	Intervention: comprehensive CCR program plus usual care (include home-based exercise 2 days/week for 6 months) Control: usual care alone
Outcomes	Primary outcome measures: functional capacity; lipid profile; depression symptoms; cognition Secondary outcome measures: cerebrovascular and cardiovascular events; physiological, anthropometric and behavioral vascular risk factors; neurocognitive measure; quality of life Time frame: 6 months
Starting date	Start: September 2007 Completion: March 2010
Contact information	Neville G. Suskin, MBChB, MSc, University of Western Ontario and London Health Sciences Centre, London, Ontario, Canada, N6A 5A5 Tel: + 1 519 663 3488, Email: neville.suskin@lhsc.on.ca
Notes	NCT00536562

Tørhaug

Trial name or title	Strength training for chronic stroke patients
Methods	Randomised cross-over trial; single group assignment; open label
Participants	Stroke patients, males and females, under 67 years old (from 18 to 67 years) who had suffered from a stroke at least 6 months previously, able to walk, living in the Trondheim area such that travel costs can be covered by 1500 NOK
Interventions	Intervention: Maximal Strength Training (MST) involving weights of up to 90% of the participants 1 repetition maximum. Unilateral leg press and plantarflexion exercises
Outcomes	Primary outcome: unilateral 1 repetition maximum for leg press and plantarflexion Secondary outcomes: rate of force development in unilateral leg press and plantarflexion; maximal oxygen uptake and walking economy; Timed Up and Go Test; 4 Step Balance Test; V-Wave (using surface electromyography - SEMG) of soleus during static plantarflexion; blood lipid profile; 6-Minute Walk Test; Jump Height of a counter movement jump; SF-36 Quality of life questionnaire, Norwegian version
Starting date	Start: November 2009 Completion date March 2010
Contact information	Study Completion Date:
Notes	NCT01003353. Trial has been completed but not yet published

Van der Port

Trial name or title	Cost-effectiveness of a structured progressive task-oriented circuit class training programme to enhance walking competency after stroke: The protocol of the FIT-Stroke trial
Methods	Multicentre single-blinded randomised trial stratified by rehabilitation centre
Participants	220 stroke patients discharge to the community from inpatient rehabilitation who are able to communicate and walk at least 10 meters without physical assistance
Interventions	Intervention: progressive task-oriented circuit class training (CCT) two times per week for 12 weeks Control: usual individual face-to-face physiotherapy
Outcomes	Primary outcomes: mobility component of the Stroke Impact Scale (SIS-3.0); EuroQol Secondary outcomes: other domains of the SIS-3.0, lower limb muscle strength, walking endurance, gait speed, balance, instrumental activities of daily living, fatigue, anxiety, depression, and health related quality of life measures
Starting date	2009
Contact information	Van der Port, Centre of Excellence for Rehabilitation Medicine, Utrech, The Netherlands Email: i.v.d.port@dehoogstraat.nl

Van der Port (*Continued*)

Notes	Dutch Trial Register NTR1534

Vanroy

Trial name or title	The effect of an aerobic exercise programme in stroke patients
Methods	Randomised clinical trial; parallel assignment; double blind
Participants	50 participants Inclusion criteria: 3 to 6 weeks after first stroke. Ability to follow simple verbal instructions and cycle for ? 1 minute at 20 Watt (at 50 revolution/minute)
Interventions	Intervention: regular rehabilitation plus cardiorespiratory training; 30 minutes per day, 3 days per week for 12 weeks. Cycle ergometry. After 12 weeks the experimental group is randomised to receive either feedback on how to continue training or no feedback Control: regular rehabilitation plus passive mobilisation
Outcomes	VO_2 peak, strength, walking, activities of daily living, post-stroke fatigue, depression, lifestyle, cardiovascular risk factors
Starting date	Start: February 2010 Completion: December 2011
Contact information	Vanroy Christel, University College Antwerp
Notes	NCT01070459

Wolff

Trial name or title	Effects of strength training on upper-limb function in post-stroke hemiparesis
Methods	Randomised clinical trial; single group assignment; double blind
Participants	60 adults, males and females, 18 years of older
Interventions	Intervention: standard functional rehabilitation (SFR) combined with high-intensity resistance exercise (strength training) Control: SFR
Outcomes	Outcome measures will include strength (maximal voluntary isovelocity joint torque), hypertonia (onset threshold of the stretch reflex, Modified Ashworth Scale), standard clinical assessment of activities of daily living (Barthel Index, Functional Independence Measure), and upper extremity motor function (Fugl-Meyer exam, Functional Test of the Hemiparetic Upper Extremity)
Starting date	Start: October 2000 Completion date September 2003

Wolff (*Continued*)

Contact information	David Wolff, Veterans Affairs Rehabilitation Research and Development Service, Palo Alto, California, USA
Notes	NCT00037908. The trial has been completed but not yet published

BMCA: brain motor control assessment
CCR: Circulatory, Cardiac and Respiratory Research Program
CES-D: Center for Epidemiologic Studies Depression Scale
COPD: chronic obstructive pulmonary disease
FAC: Functional Ambulation Classification
FIM: Functional Independence Measure
TIA: transient ischaemic attack
TMS: transcranial magnetic stimulation

DATA AND ANALYSES

Comparison 1. Cardiorespiratory training versus control - end of intervention

Outcome or subgroup title	No. of studies	No. of participants	Statistical method	Effect size
1 Disability - Functional Independence Measure	3	162	Std. Mean Difference (IV, Random, 95% CI)	0.21 [-0.10, 0.52]
1.1 During usual care	1	52	Std. Mean Difference (IV, Random, 95% CI)	0.23 [-0.32, 0.78]
1.2 After usual care	2	110	Std. Mean Difference (IV, Random, 95% CI)	0.17 [-0.29, 0.63]
2 Disability - Rivermead Mobility Index	1		Mean Difference (IV, Random, 95% CI)	Subtotals only
2.1 During usual care	1	77	Mean Difference (IV, Random, 95% CI)	0.16 [-1.46, 1.78]
2.2 During usual care - LOCF	1	83	Mean Difference (IV, Random, 95% CI)	0.05 [-1.50, 1.60]
2.3 After usual care	0	0	Mean Difference (IV, Random, 95% CI)	0.0 [0.0, 0.0]
3 Disability - Physical Activity and Disability Scale	1	58	Mean Difference (IV, Random, 95% CI)	16.9 [-15.15, 48.95]
3.1 During usual care	0	0	Mean Difference (IV, Random, 95% CI)	0.0 [0.0, 0.0]
3.2 After usual care	1	58	Mean Difference (IV, Random, 95% CI)	16.9 [-15.15, 48.95]
4 Risk factors - blood pressure, systolic	4	190	Mean Difference (IV, Random, 95% CI)	0.40 [-8.38, 9.18]
4.1 During usual care	1	12	Mean Difference (IV, Random, 95% CI)	26.33 [1.95, 50.71]
4.2 After usual care	3	178	Mean Difference (IV, Random, 95% CI)	-2.69 [-8.03, 2.66]
5 Risk factors - blood pressure, diastolic	4	190	Mean Difference (IV, Random, 95% CI)	-0.33 [-2.97, 2.31]
5.1 During usual care	1	12	Mean Difference (IV, Random, 95% CI)	1.0 [-10.46, 12.46]
5.2 After usual care	3	178	Mean Difference (IV, Random, 95% CI)	-0.41 [-3.12, 2.31]
6 Physical fitness - peak VO2 (ml/kg/min)	4	120	Mean Difference (IV, Random, 95% CI)	2.14 [0.50, 3.78]
6.1 During usual care	1	12	Mean Difference (IV, Random, 95% CI)	3.43 [0.56, 6.30]
6.2 After usual care	3	108	Mean Difference (IV, Random, 95% CI)	1.78 [-0.06, 3.62]
7 Physical fitness - gait economy, VO2 (ml/kg/metre)	1	20	Mean Difference (IV, Random, 95% CI)	-0.08 [-0.28, 0.12]
7.1 During usual care	0	0	Mean Difference (IV, Random, 95% CI)	0.0 [0.0, 0.0]
7.2 After usual care	1	20	Mean Difference (IV, Random, 95% CI)	-0.08 [-0.28, 0.12]
8 Physical fitness - maximum cycling work rate (Watts)	4	221	Std. Mean Difference (IV, Random, 95% CI)	0.60 [0.18, 1.02]
8.1 During usual care	2	89	Std. Mean Difference (IV, Random, 95% CI)	0.32 [-0.34, 0.98]
8.2 After usual care	2	132	Std. Mean Difference (IV, Random, 95% CI)	0.83 [0.47, 1.18]
9 Physical fitness - Body Mass (Kg)	1	72	Mean Difference (IV, Random, 95% CI)	5.38 [-1.69, 12.45]
9.1 During usual care	1	72	Mean Difference (IV, Random, 95% CI)	5.38 [-1.69, 12.45]
9.2 After usual care	0	0	Mean Difference (IV, Random, 95% CI)	0.0 [0.0, 0.0]
10 Mobility - functional ambulation categories	2	73	Mean Difference (IV, Random, 95% CI)	0.53 [0.21, 0.85]
10.1 During usual care	2	73	Mean Difference (IV, Random, 95% CI)	0.53 [0.21, 0.85]
10.2 After usual care	0	0	Mean Difference (IV, Random, 95% CI)	0.0 [0.0, 0.0]
11 Mobility - maximal gait speed (m/min over 5 to 10 metres)	7	365	Mean Difference (IV, Random, 95% CI)	8.66 [2.98, 14.34]
11.1 During usual care	4	196	Mean Difference (IV, Random, 95% CI)	10.00 [-0.05, 20.05]

11.2 After usual care	3	169	Mean Difference (IV, Random, 95% CI)	9.93 [3.38, 16.48]
12 Mobility - maximal gait speed (m/min over 5 to 10 metres); subgroup: ACSM	7	365	Mean Difference (IV, Random, 95% CI)	8.66 [2.98, 14.34]
12.1 ACSM criteria met	3	143	Mean Difference (IV, Random, 95% CI)	2.97 [-2.41, 8.35]
12.2 ACSM criteria unknown	2	118	Mean Difference (IV, Random, 95% CI)	16.24 [0.40, 32.07]
12.3 ACSM criteria not met	2	104	Mean Difference (IV, Random, 95% CI)	14.22 [3.83, 24.61]
13 Mobility - preferred gait speed (m/min)	4	221	Mean Difference (IV, Random, 95% CI)	4.68 [1.40, 7.96]
13.1 During usual care	1	20	Mean Difference (IV, Random, 95% CI)	6.04 [-0.92, 13.00]
13.2 After usual care	3	201	Mean Difference (IV, Random, 95% CI)	4.29 [0.57, 8.01]
14 Mobility - gait endurance (6-MWT metres)	4	219	Mean Difference (IV, Random, 95% CI)	47.13 [19.39, 74.88]
14.1 During usual care	1	50	Mean Difference (IV, Random, 95% CI)	34.40 [-7.42, 76.22]
14.2 After usual care	3	169	Mean Difference (IV, Random, 95% CI)	57.14 [20.06, 94.22]
15 Mobility - gait endurance (m/min)	3	154	Mean Difference (IV, Random, 95% CI)	8.87 [1.35, 16.40]
15.1 During usual care	2	63	Mean Difference (IV, Random, 95% CI)	12.24 [-3.41, 27.89]
15.2 After usual care	1	91	Mean Difference (IV, Random, 95% CI)	6.60 [-2.66, 15.86]
16 Mobility - 6-metre walking time (sec)	1	20	Mean Difference (IV, Random, 95% CI)	-3.32 [-8.52, 1.88]
16.1 During usual care	1	20	Mean Difference (IV, Random, 95% CI)	-3.32 [-8.52, 1.88]
16.2 After usual care	0	0	Mean Difference (IV, Random, 95% CI)	0.0 [0.0, 0.0]
17 Mobility - Stroke Impact Scale (mobility domain)	1	20	Mean Difference (IV, Random, 95% CI)	-3.20 [-17.14, 10.74]
17.1 During usual care	0	0	Mean Difference (IV, Random, 95% CI)	0.0 [0.0, 0.0]
17.2 After usual care	1	20	Mean Difference (IV, Random, 95% CI)	-3.20 [-17.14, 10.74]
18 Mobility - peak activity index (steps/min)	1	58	Mean Difference (IV, Random, 95% CI)	18.10 [7.71, 28.49]
18.1 During usual care	0	0	Mean Difference (IV, Random, 95% CI)	0.0 [0.0, 0.0]
18.2 After usual care	1	58	Mean Difference (IV, Random, 95% CI)	18.10 [7.71, 28.49]
19 Mobility - max step rate in 1 min	1	58	Mean Difference (IV, Random, 95% CI)	15.5 [4.58, 26.42]
19.1 During usual care	0	0	Mean Difference (IV, Random, 95% CI)	0.0 [0.0, 0.0]
19.2 After usual care	1	58	Mean Difference (IV, Random, 95% CI)	15.5 [4.58, 26.42]
20 Physical function - Berg Balance scale	3	188	Mean Difference (IV, Random, 95% CI)	1.52 [-1.80, 4.84]
20.1 During usual care	1	77	Mean Difference (IV, Random, 95% CI)	-0.30 [-5.52, 4.92]
20.2 After usual care	2	111	Mean Difference (IV, Random, 95% CI)	2.76 [-1.54, 7.06]
21 Physical function - Timed Up and Go (sec)	2	111	Mean Difference (IV, Random, 95% CI)	-3.94 [-11.65, 3.77]
21.1 During usual care	0	0	Mean Difference (IV, Random, 95% CI)	0.0 [0.0, 0.0]
21.2 After usual care	2	111	Mean Difference (IV, Random, 95% CI)	-3.94 [-11.65, 3.77]
22 Health related QoL - SF-36 physical functioning	1	28	Mean Difference (IV, Random, 95% CI)	10.60 [6.51, 14.69]
22.1 During usual care	0	0	Mean Difference (IV, Random, 95% CI)	0.0 [0.0, 0.0]
22.2 After usual care	1	28	Mean Difference (IV, Random, 95% CI)	10.60 [6.51, 14.69]
23 Health related QoL - SF-36 emotional role functioning	1	28	Mean Difference (IV, Random, 95% CI)	11.0 [6.15, 15.85]
23.1 During usual care	0	0	Mean Difference (IV, Random, 95% CI)	0.0 [0.0, 0.0]

23.2 After usual care	1	28	Mean Difference (IV, Random, 95% CI)	11.0 [6.15, 15.85]
24 Mood - Beck Depression Index	1	20	Mean Difference (IV, Random, 95% CI)	0.60 [-1.60, 2.80]
24.1 During usual care	0	0	Mean Difference (IV, Random, 95% CI)	0.0 [0.0, 0.0]
24.2 After usual care	1	20	Mean Difference (IV, Random, 95% CI)	0.60 [-1.60, 2.80]
25 Mood - Hospital Anxiety and Depression Scale (HADS) - anxiety score	1	60	Mean Difference (IV, Random, 95% CI)	-1.94 [-3.80, -0.08]
25.1 During usual care	1	60	Mean Difference (IV, Random, 95% CI)	-1.94 [-3.80, -0.08]
25.2 After usual care	0	0	Mean Difference (IV, Random, 95% CI)	0.0 [0.0, 0.0]
26 Mood - Hospital Anxiety and Depression Scale (HADS) - depression score	1	60	Mean Difference (IV, Random, 95% CI)	-1.40 [-3.21, 0.41]
26.1 During usual care	1	60	Mean Difference (IV, Random, 95% CI)	-1.40 [-3.21, 0.41]
26.2 After usual care	0	0	Mean Difference (IV, Random, 95% CI)	0.0 [0.0, 0.0]

Comparison 2. Cardiorespiratory training versus control - end of retention follow-up

Outcome or subgroup title	No. of studies	No. of participants	Statistical method	Effect size
1 Case fatality	1	81	Odds Ratio (M-H, Random, 95% CI)	0.45 [0.04, 5.18]
2 Disability - Rivermead Mobility Index	1		Mean Difference (IV, Random, 95% CI)	Subtotals only
2.1 During usual care	1	66	Mean Difference (IV, Random, 95% CI)	-0.25 [-1.85, 1.35]
2.2 During usual care - ITT analysis using 'last observation carried forward' approach	1	84	Mean Difference (IV, Random, 95% CI)	0.04 [-1.47, 1.55]
2.3 After usual care	0	0	Mean Difference (IV, Random, 95% CI)	0.0 [0.0, 0.0]
3 Disability - Nottinghan Extended ADLs	1	147	Mean Difference (IV, Random, 95% CI)	2.90 [-2.68, 8.48]
3.1 During usual care	1	64	Mean Difference (IV, Random, 95% CI)	2.64 [-5.57, 10.85]
3.2 After usual care	0	0	Mean Difference (IV, Random, 95% CI)	0.0 [0.0, 0.0]
3.3 During usual care - ITT analysis using 'last observation carried forward' approach	1	83	Mean Difference (IV, Random, 95% CI)	3.13 [-4.48, 10.74]
4 Disability - Physical Activity and Disability Scale	1	58	Mean Difference (IV, Random, 95% CI)	19.90 [-17.58, 57.38]
4.1 During usual care	0	0	Mean Difference (IV, Random, 95% CI)	0.0 [0.0, 0.0]
4.2 After usual care	1	58	Mean Difference (IV, Random, 95% CI)	19.90 [-17.58, 57.38]
5 Disability - Frenchay Activities Index (FAI)	1	79	Mean Difference (IV, Random, 95% CI)	1.0 [-1.55, 3.55]
5.1 During usual care	0	0	Mean Difference (IV, Random, 95% CI)	0.0 [0.0, 0.0]
5.2 After usual care	1	79	Mean Difference (IV, Random, 95% CI)	1.0 [-1.55, 3.55]
6 Physical fitness - maximum cycling work rate (Watts)	1	66	Mean Difference (IV, Random, 95% CI)	6.12 [-24.06, 36.30]
6.1 During usual care	1	66	Mean Difference (IV, Random, 95% CI)	6.12 [-24.06, 36.30]
6.2 After usual care	0	0	Mean Difference (IV, Random, 95% CI)	0.0 [0.0, 0.0]

7 Physical fitness - maximum cycling work rate (Watts) - ITT analysis using 'last observation carried forward' approach	1	84	Mean Difference (IV, Random, 95% CI)	5.11 [-18.93, 29.15]
7.1 During usual care	1	84	Mean Difference (IV, Random, 95% CI)	5.11 [-18.93, 29.15]
7.2 After usual care	0	0	Mean Difference (IV, Random, 95% CI)	0.0 [0.0, 0.0]
8 Physical fitness - Body Mass (Kg)	1	64	Mean Difference (IV, Random, 95% CI)	2.81 [-4.63, 10.25]
8.1 During usual care	1	64	Mean Difference (IV, Random, 95% CI)	2.81 [-4.63, 10.25]
8.2 After usual care	0	0	Mean Difference (IV, Random, 95% CI)	0.0 [0.0, 0.0]
9 Mobility - maximal gait speed (m/min)	3	186	Mean Difference (IV, Random, 95% CI)	8.21 [3.38, 13.05]
9.1 During usual care	2	128	Mean Difference (IV, Random, 95% CI)	8.10 [1.98, 14.22]
9.2 After usual care	1	58	Mean Difference (IV, Random, 95% CI)	8.40 [0.52, 16.28]
10 Mobility - gait endurance (6-MWT metres)	2	107	Mean Difference (IV, Random, 95% CI)	69.30 [33.38, 105.23]
10.1 During usual care	1	49	Mean Difference (IV, Random, 95% CI)	61.80 [16.48, 107.12]
10.2 After usual care	1	58	Mean Difference (IV, Random, 95% CI)	82.0 [23.05, 140.95]
11 Mobility - peak activity index (steps/min)	1	58	Mean Difference (IV, Random, 95% CI)	12.20 [1.38, 23.02]
11.1 During usual care	0	0	Mean Difference (IV, Random, 95% CI)	0.0 [0.0, 0.0]
11.2 After usual care	1	58	Mean Difference (IV, Random, 95% CI)	12.20 [1.38, 23.02]
12 Mobility - max step rate in 1 min	1	58	Mean Difference (IV, Random, 95% CI)	12.10 [0.93, 23.27]
12.1 During usual care	0	0	Mean Difference (IV, Random, 95% CI)	0.0 [0.0, 0.0]
12.2 After usual care	1	58	Mean Difference (IV, Random, 95% CI)	12.10 [0.93, 23.27]
13 Mobility - Stroke Impact Scale (mobility domain)	1	20	Mean Difference (IV, Random, 95% CI)	5.90 [-7.97, 19.77]
13.1 During usual care	0	0	Mean Difference (IV, Random, 95% CI)	0.0 [0.0, 0.0]
13.2 After usual care	1	20	Mean Difference (IV, Random, 95% CI)	5.90 [-7.97, 19.77]
14 Physical function - Berg Balance scale	1	66	Mean Difference (IV, Random, 95% CI)	-2.93 [-7.91, 2.05]
14.1 During usual care	1	66	Mean Difference (IV, Random, 95% CI)	-2.93 [-7.91, 2.05]
14.2 After usual care	0	0	Mean Difference (IV, Random, 95% CI)	0.0 [0.0, 0.0]
15 Physical function - Berg Balance scale - ITT analysis using 'last observation carried forward' approach	1	84	Mean Difference (IV, Random, 95% CI)	-0.79 [-5.93, 4.35]
15.1 During usual care	1	84	Mean Difference (IV, Random, 95% CI)	-0.79 [-5.93, 4.35]
15.2 After usual care	0	0	Mean Difference (IV, Random, 95% CI)	0.0 [0.0, 0.0]
16 Mood - Beck Depression Index	1	20	Mean Difference (IV, Random, 95% CI)	-1.30 [-3.67, 1.07]
16.1 During usual care	0	0	Mean Difference (IV, Random, 95% CI)	0.0 [0.0, 0.0]
16.2 After usual care	1	20	Mean Difference (IV, Random, 95% CI)	-1.30 [-3.67, 1.07]
17 Mood - Hospital Anxiety and Depression Scale (HADS) - anxiety score	1	53	Mean Difference (IV, Random, 95% CI)	-1.6 [-3.58, 0.38]
17.1 During usual care	1	53	Mean Difference (IV, Random, 95% CI)	-1.6 [-3.58, 0.38]
17.2 After usual care	0	0	Mean Difference (IV, Random, 95% CI)	0.0 [0.0, 0.0]
18 Mood - Hospital Anxiety and Depression Scale (HADS) - depression score	1	53	Mean Difference (IV, Random, 95% CI)	-2.7 [-4.40, 1.00]
18.1 During usual care	1	53	Mean Difference (IV, Random, 95% CI)	-2.7 [-4.40, 1.00]

18.2 After usual care	0	0	Mean Difference (IV, Random, 95% CI)	0.0 [0.0, 0.0]

Comparison 3. Resistence training versus control - end of intervention

Outcome or subgroup title	No. of studies	No. of participants	Statistical method	Effect size
1 Physical fitness - composite measure of muscle strength	2	60	Std. Mean Difference (IV, Random, 95% CI)	0.58 [0.06, 1.10]
1.1 During usual care	0	0	Std. Mean Difference (IV, Random, 95% CI)	0.0 [0.0, 0.0]
1.2 During and after usual care	1	40	Std. Mean Difference (IV, Random, 95% CI)	0.47 [-0.16, 1.10]
1.3 After usual care	1	20	Std. Mean Difference (IV, Random, 95% CI)	0.84 [-0.09, 1.76]
2 Physical fitness - muscle strength, knee extension (Nm)	2	42	Mean Difference (IV, Random, 95% CI)	12.01 [-4.46, 28.47]
2.1 During usual care	1	18	Mean Difference (IV, Random, 95% CI)	4.80 [-5.98, 15.58]
2.2 After usual care	1	24	Mean Difference (IV, Random, 95% CI)	21.80 [4.92, 38.68]
3 Physical fitness - muscle strength, knee flexion (Nm)	2	42	Mean Difference (IV, Random, 95% CI)	9.61 [-5.01, 24.24]
3.1 During usual care	1	18	Mean Difference (IV, Random, 95% CI)	4.5 [-1.13, 10.13]
3.2 After usual care	1	24	Mean Difference (IV, Random, 95% CI)	20.5 [0.84, 40.16]
4 Mobility - maximal gait speed (m/min)	4	104	Mean Difference (IV, Random, 95% CI)	1.92 [-3.50, 7.35]
4.1 During usual care	1	18	Mean Difference (IV, Random, 95% CI)	8.40 [2.82, 13.98]
4.2 After usual care	3	86	Mean Difference (IV, Random, 95% CI)	1.00 [-4.57, 2.57]
5 Mobility - preferred gait speed (m/min)	3	80	Mean Difference (IV, Random, 95% CI)	2.34 [-6.77, 11.45]
5.1 During usual care	1	18	Mean Difference (IV, Random, 95% CI)	9.0 [3.42, 14.58]
5.2 After usual care	2	62	Mean Difference (IV, Random, 95% CI)	-2.61 [-7.73, 2.51]
6 Mobility - gait endurance (6-MWT metres)	2	66	Mean Difference (IV, Random, 95% CI)	3.78 [-68.56, 76.11]
6.1 During usual care	0	0	Mean Difference (IV, Random, 95% CI)	0.0 [0.0, 0.0]
6.2 After usual care	2	66	Mean Difference (IV, Random, 95% CI)	3.78 [-68.56, 76.11]
7 Physical function - weight-bearing (% body weight - affected side)	1	18	Mean Difference (IV, Random, 95% CI)	11.80 [0.89, 22.71]
7.1 During usual care	1	18	Mean Difference (IV, Random, 95% CI)	11.80 [0.89, 22.71]
7.2 After usual care	0	0	Mean Difference (IV, Random, 95% CI)	0.0 [0.0, 0.0]
8 Physical function - stair climbing, maximal (sec/step)	2	61	Std. Mean Difference (IV, Random, 95% CI)	-0.04 [-0.86, 0.77]
8.1 During usual care	0	0	Std. Mean Difference (IV, Random, 95% CI)	0.0 [0.0, 0.0]
8.2 After usual care	2	61	Std. Mean Difference (IV, Random, 95% CI)	-0.04 [-0.86, 0.77]
9 Physical function - Timed Up and Go (sec)	1	24	Mean Difference (IV, Random, 95% CI)	-1.20 [-11.84, 9.44]
9.1 During usual care	0	0	Mean Difference (IV, Random, 95% CI)	0.0 [0.0, 0.0]
9.2 After usual care	1	24	Mean Difference (IV, Random, 95% CI)	-1.20 [-11.84, 9.44]
10 Health related QoL - SF-36 physical functioning	1	20	Mean Difference (IV, Random, 95% CI)	1.47 [-4.24, 7.18]
10.1 During usual care	0	0	Mean Difference (IV, Random, 95% CI)	0.0 [0.0, 0.0]

10.2 After usual care	1	20	Mean Difference (IV, Random, 95% CI)	1.47 [-4.24, 7.18]
11 Health related QoL - SF-36 mental health	1	20	Mean Difference (IV, Random, 95% CI)	2.8 [-4.95, 10.55]
11.1 During usual care	0	0	Mean Difference (IV, Random, 95% CI)	0.0 [0.0, 0.0]
11.2 After usual care	1	20	Mean Difference (IV, Random, 95% CI)	2.8 [-4.95, 10.55]
12 Mood - Centre for Epidemiologic Studies for Depression scale (CES-D)	1	88	Mean Difference (IV, Random, 95% CI)	-5.49 [-9.78, -1.20]
12.1 During usual care	0	0	Mean Difference (IV, Random, 95% CI)	0.0 [0.0, 0.0]
12.2 After usual care	1	88	Mean Difference (IV, Random, 95% CI)	-5.49 [-9.78, -1.20]

Comparison 4. Resistence training versus control - end of retention follow-up

Outcome or subgroup title	No. of studies	No. of participants	Statistical method	Effect size
1 Physical fitness - muscle strength, knee extension (Nm)	1	24	Mean Difference (IV, Random, 95% CI)	17.4 [-0.01, 34.81]
1.1 During usual care	0	0	Mean Difference (IV, Random, 95% CI)	0.0 [0.0, 0.0]
1.2 After usual care	1	24	Mean Difference (IV, Random, 95% CI)	17.4 [-0.01, 34.81]
2 Physical fitness - muscle strength, knee flexion (Nm)	1	24	Mean Difference (IV, Random, 95% CI)	17.60 [-2.17, 37.37]
2.1 During usual care	0	0	Mean Difference (IV, Random, 95% CI)	0.0 [0.0, 0.0]
2.2 After usual care	1	24	Mean Difference (IV, Random, 95% CI)	17.60 [-2.17, 37.37]
3 Mobility - maximal gait speed (m/min)	1	24	Mean Difference (IV, Random, 95% CI)	-19.80 [-95.77, 56.17]
3.1 During usual care	0	0	Mean Difference (IV, Random, 95% CI)	0.0 [0.0, 0.0]
3.2 After usual care	1	24	Mean Difference (IV, Random, 95% CI)	-19.80 [-95.77, 56.17]
4 Mobility - gait endurance (6-MWT metres)	1	24	Mean Difference (IV, Random, 95% CI)	11.0 [-105.95, 127.95]
4.1 During usual care	0	0	Mean Difference (IV, Random, 95% CI)	0.0 [0.0, 0.0]
4.2 After usual care	1	24	Mean Difference (IV, Random, 95% CI)	11.0 [-105.95, 127.95]
5 Physical function - Timed Up and Go (sec)	1	24	Mean Difference (IV, Random, 95% CI)	-3.10 [-16.67, 10.47]
5.1 During usual care	0	0	Mean Difference (IV, Random, 95% CI)	0.0 [0.0, 0.0]
5.2 After usual care	1	24	Mean Difference (IV, Random, 95% CI)	-3.10 [-16.67, 10.47]
6 Mood - Centre for Epidemiologic Studies for Depression scale (CES-D)	1	86	Mean Difference (IV, Random, 95% CI)	-8.92 [-13.03, -4.81]
6.1 During usual care	0	0	Mean Difference (IV, Random, 95% CI)	0.0 [0.0, 0.0]
6.2 After usual care	1	86	Mean Difference (IV, Random, 95% CI)	-8.92 [-13.03, -4.81]

Comparison 5. Mixed training versus control - end of intervention

Outcome or subgroup title	No. of studies	No. of participants	Statistical method	Effect size
1 Case fatality	1	67	Odds Ratio (M-H, Random, 95% CI)	0.25 [0.03, 2.37]
1.1 During usual care	0	0	Odds Ratio (M-H, Random, 95% CI)	0.0 [0.0, 0.0]
1.2 After usual care	1	67	Odds Ratio (M-H, Random, 95% CI)	0.25 [0.03, 2.37]
2 Disability - Lawton IADL	2	113	Mean Difference (IV, Random, 95% CI)	0.83 [-0.51, 2.17]
2.1 During usual care	0	0	Mean Difference (IV, Random, 95% CI)	0.0 [0.0, 0.0]
2.2 After usual care	2	113	Mean Difference (IV, Random, 95% CI)	0.83 [-0.51, 2.17]
3 Disability - Barthel Index (BI)	3	178	Mean Difference (IV, Random, 95% CI)	1.99 [-2.32, 6.29]
3.1 During usual care	0	0	Mean Difference (IV, Random, 95% CI)	0.0 [0.0, 0.0]
3.2 After usual care	3	178	Mean Difference (IV, Random, 95% CI)	1.99 [-2.32, 6.29]
4 Disability - Barthel Index (BI) & Functional Independence Measure (FIM) combined	3	179	Std. Mean Difference (IV, Random, 95% CI)	0.24 [-0.16, 0.65]
4.1 During usual care	0	0	Std. Mean Difference (IV, Random, 95% CI)	0.0 [0.0, 0.0]
4.2 After usual care	3	179	Std. Mean Difference (IV, Random, 95% CI)	0.24 [-0.16, 0.65]
5 Disability - Nottingham Extended ADLs	1	66	Mean Difference (IV, Random, 95% CI)	-0.20 [-1.08, 0.68]
5.1 During usual care	0	0	Mean Difference (IV, Random, 95% CI)	0.0 [0.0, 0.0]
5.2 After usual care	1	66	Mean Difference (IV, Random, 95% CI)	-0.20 [-1.08, 0.68]
6 Disability - Rivermead Mobility Index (RMI)	1	66	Mean Difference (IV, Random, 95% CI)	0.20 [-0.41, 0.81]
6.1 During usual care	0	0	Mean Difference (IV, Random, 95% CI)	0.0 [0.0, 0.0]
6.2 After usual care	1	66	Mean Difference (IV, Random, 95% CI)	0.20 [-0.41, 0.81]
7 Disability - Stroke Impact Scale (SIS-16)	1	94	Mean Difference (IV, Random, 95% CI)	6.0 [0.19, 11.81]
7.1 During usual care	0	0	Mean Difference (IV, Random, 95% CI)	0.0 [0.0, 0.0]
7.2 After usual care	1	94	Mean Difference (IV, Random, 95% CI)	6.0 [0.19, 11.81]
8 Physical fitness - peak VO2 (ml/kg/min)	1	100	Mean Difference (IV, Random, 95% CI)	0.99 [0.35, 1.63]
8.1 During usual care	0	0	Mean Difference (IV, Random, 95% CI)	0.0 [0.0, 0.0]
8.2 After usual care	1	100	Mean Difference (IV, Random, 95% CI)	0.99 [0.35, 1.63]
9 Physical fitness - gait economy, VO2 (ml/kg/metre)	1	66	Mean Difference (IV, Random, 95% CI)	-0.01 [-0.03, -0.00]
9.1 During usual care	0	0	Mean Difference (IV, Random, 95% CI)	0.0 [0.0, 0.0]
9.2 After usual care	1	66	Mean Difference (IV, Random, 95% CI)	-0.01 [-0.03, -0.00]
10 Physical fitness - muscle strength, ankle dorsiflexion*	2	148	Std. Mean Difference (IV, Random, 95% CI)	0.80 [-0.82, 2.41]
10.1 During usual care	0	0	Std. Mean Difference (IV, Random, 95% CI)	0.0 [0.0, 0.0]
10.2 After usual care	2	148	Std. Mean Difference (IV, Random, 95% CI)	0.80 [-0.82, 2.41]
11 Physical fitness - muscle strength, knee extension*	3	202	Std. Mean Difference (IV, Random, 95% CI)	0.33 [0.05, 0.61]
11.1 During usual care	1	54	Std. Mean Difference (IV, Random, 95% CI)	0.29 [-0.25, 0.83]
11.2 After usual care	2	148	Std. Mean Difference (IV, Random, 95% CI)	0.36 [-0.02, 0.73]
12 Physical fitness - muscle strength, knee flexion	1	54	Mean Difference (IV, Random, 95% CI)	6.40 [-3.76, 16.56]
12.1 During usual care	1	54	Mean Difference (IV, Random, 95% CI)	6.40 [-3.76, 16.56]
12.2 After usual care	0	0	Mean Difference (IV, Random, 95% CI)	0.0 [0.0, 0.0]

13 Physical fitness - muscle strength, elbow extension force (N)	1	18	Mean Difference (IV, Random, 95% CI)	-19.43 [-54.11, 15. 25]
13.1 During usual care	1	18	Mean Difference (IV, Random, 95% CI)	-19.43 [-54.11, 15. 25]
13.2 After usual care	0	0	Mean Difference (IV, Random, 95% CI)	0.0 [0.0, 0.0]
14 Physical fitness - muscle strength, elbow flexion force (N)	1	18	Mean Difference (IV, Random, 95% CI)	-15.50 [-54.04, 23. 04]
14.1 During usual care	1	18	Mean Difference (IV, Random, 95% CI)	-15.50 [-54.04, 23. 04]
14.2 After usual care	0	0	Mean Difference (IV, Random, 95% CI)	0.0 [0.0, 0.0]
15 Physical fitness - muscle strength, grip strength (paretic hand)	2	165	Std. Mean Difference (IV, Random, 95% CI)	-0.05 [-0.36, 0.26]
15.1 During usual care	0	0	Std. Mean Difference (IV, Random, 95% CI)	0.0 [0.0, 0.0]
15.2 After usual care	2	165	Std. Mean Difference (IV, Random, 95% CI)	-0.05 [-0.36, 0.26]
16 Physical fitness - muscle strength, grip force (N)	1	18	Mean Difference (IV, Random, 95% CI)	-6.25 [-52.41, 39. 91]
16.1 During usual care	1	18	Mean Difference (IV, Random, 95% CI)	-6.25 [-52.41, 39. 91]
16.2 After usual care	0	0	Mean Difference (IV, Random, 95% CI)	0.0 [0.0, 0.0]
17 Physical fitness - muscle strength, leg extensor power (affected leg) W/Kg	1	66	Mean Difference (IV, Random, 95% CI)	0.07 [-0.08, 0.22]
17.1 During usual care	0	0	Mean Difference (IV, Random, 95% CI)	0.0 [0.0, 0.0]
17.2 After usual care	1	66	Mean Difference (IV, Random, 95% CI)	0.07 [-0.08, 0.22]
18 Mobility - preferred gait speed (m/min)	8	397	Mean Difference (IV, Random, 95% CI)	2.93 [0.02, 5.84]
18.1 During usual care	3	153	Mean Difference (IV, Random, 95% CI)	3.37 [-2.63, 9.37]
18.2 After usual care	5	244	Mean Difference (IV, Random, 95% CI)	2.93 [-0.50, 6.35]
19 Mobility - preferred gait speed (m/min); subgroup: therapy time	8	397	Mean Difference (IV, Random, 95% CI)	2.93 [0.02, 5.84]
19.1 Confounded	5	196	Mean Difference (IV, Random, 95% CI)	4.43 [-0.13, 8.99]
19.2 Unconfounded	3	201	Mean Difference (IV, Random, 95% CI)	0.49 [-2.96, 3.94]
20 Mobility - gait endurance (6 MWT metres)	3	168	Mean Difference (IV, Random, 95% CI)	30.59 [8.90, 52.28]
20.1 During usual care	0	0	Mean Difference (IV, Random, 95% CI)	0.0 [0.0, 0.0]
20.2 After usual care	3	168	Mean Difference (IV, Random, 95% CI)	30.59 [8.90, 52.28]
21 Mobility - Community Ambulation Speed (> 0.8 m/ sec)	3	232	Odds Ratio (M-H, Random, 95% CI)	1.38 [0.78, 2.42]
21.1 During usual care	1	67	Odds Ratio (M-H, Random, 95% CI)	1.75 [0.46, 6.65]
21.2 After usual care	2	165	Odds Ratio (M-H, Random, 95% CI)	1.31 [0.70, 2.44]
22 Physical function - Berg Balance scale	4	199	Std. Mean Difference (IV, Random, 95% CI)	0.26 [-0.14, 0.66]
22.1 During usual care	2	79	Std. Mean Difference (IV, Random, 95% CI)	-0.05 [-0.49, 0.39]
22.2 After usual care	2	120	Std. Mean Difference (IV, Random, 95% CI)	0.54 [0.17, 0.90]
23 Physical function - functional reach	2	166	Std. Mean Difference (IV, Random, 95% CI)	0.14 [-0.22, 0.50]
23.1 During usual care	0	0	Std. Mean Difference (IV, Random, 95% CI)	0.0 [0.0, 0.0]

23.2 After usual care	2	166	Std. Mean Difference (IV, Random, 95% CI)	0.14 [-0.22, 0.50]
24 Physical function - Nine Hole Peg Test (pegs/sec)	1	18	Mean Difference (IV, Random, 95% CI)	0.02 [-0.10, 0.14]
24.1 During usual care	1	18	Mean Difference (IV, Random, 95% CI)	0.02 [-0.10, 0.14]
24.2 After usual care	0	0	Mean Difference (IV, Random, 95% CI)	0.0 [0.0, 0.0]
25 Physical function - Action Research Arm Test	1	18	Mean Difference (IV, Random, 95% CI)	-1.40 [-16.58, 13.78]
25.1 During usual care	1	18	Mean Difference (IV, Random, 95% CI)	-1.40 [-16.58, 13.78]
25.2 After usual care	0	0	Mean Difference (IV, Random, 95% CI)	0.0 [0.0, 0.0]
26 Physical function - Timed Up and Go (sec)	3	176	Mean Difference (IV, Random, 95% CI)	-1.13 [-2.05, -0.21]
26.1 During usual care	1	62	Mean Difference (IV, Random, 95% CI)	-2.0 [-11.24, 7.24]
26.2 After usual care	2	114	Mean Difference (IV, Random, 95% CI)	-1.12 [-2.05, -0.20]
27 Physical function - Timed Up and Go (sec) - sensitivity analysis - unconfounded trials	2	128	Mean Difference (IV, Random, 95% CI)	-1.13 [-2.91, 0.65]
27.1 During usual care	1	62	Mean Difference (IV, Random, 95% CI)	-2.0 [-11.24, 7.24]
27.2 After usual care	1	66	Mean Difference (IV, Random, 95% CI)	-1.10 [-2.91, 0.71]
28 Health related QoL - EuroQuol (Health State)	1	67	Mean Difference (IV, Random, 95% CI)	0.12 [-0.03, 0.27]
28.1 During usual care	1	67	Mean Difference (IV, Random, 95% CI)	0.12 [-0.03, 0.27]
28.2 After usual care	0	0	Mean Difference (IV, Random, 95% CI)	0.0 [0.0, 0.0]
29 Health related QoL - EuroQuol (Self-perceived health)	1	67	Mean Difference (IV, Random, 95% CI)	9.10 [-0.14, 18.34]
29.1 During usual care	1	67	Mean Difference (IV, Random, 95% CI)	9.10 [-0.14, 18.34]
29.2 After usual care	0	0	Mean Difference (IV, Random, 95% CI)	0.0 [0.0, 0.0]
30 Health related QoL - SF-36 physical functioning	2	112	Std. Mean Difference (IV, Random, 95% CI)	0.48 [0.10, 0.85]
30.1 During usual care	0	0	Std. Mean Difference (IV, Random, 95% CI)	0.0 [0.0, 0.0]
30.2 After usual care	2	112	Std. Mean Difference (IV, Random, 95% CI)	0.48 [0.10, 0.85]
31 Health related QoL - SF-36 social role functioning	2	112	Std. Mean Difference (IV, Random, 95% CI)	0.48 [-0.22, 1.17]
31.1 During usual care	0	0	Std. Mean Difference (IV, Random, 95% CI)	0.0 [0.0, 0.0]
31.2 After usual care	2	112	Std. Mean Difference (IV, Random, 95% CI)	0.48 [-0.22, 1.17]
32 Health related QoL - SF-36 physical role functioning	3	178	Std. Mean Difference (IV, Random, 95% CI)	0.56 [0.26, 0.86]
32.1 During usual care	0	0	Std. Mean Difference (IV, Random, 95% CI)	0.0 [0.0, 0.0]
32.2 After usual care	3	178	Std. Mean Difference (IV, Random, 95% CI)	0.56 [0.26, 0.86]
33 Health related QoL - SF-36 emotional role functioning	1	93	Mean Difference (IV, Random, 95% CI)	15.5 [2.98, 28.02]
33.1 During usual care	0	0	Mean Difference (IV, Random, 95% CI)	0.0 [0.0, 0.0]
33.2 After usual care	1	93	Mean Difference (IV, Random, 95% CI)	15.5 [2.98, 28.02]
34 Mood - Stroke Impact Scale emotion score	1	93	Mean Difference (IV, Random, 95% CI)	6.5 [0.72, 12.28]
34.1 During usual care	0	0	Mean Difference (IV, Random, 95% CI)	0.0 [0.0, 0.0]
34.2 After usual care	1	93	Mean Difference (IV, Random, 95% CI)	6.5 [0.72, 12.28]
35 Mood - Geriatric Depression Scale	1	93	Mean Difference (IV, Random, 95% CI)	-1.90 [-3.10, -0.70]
35.1 During usual care	0	0	Mean Difference (IV, Random, 95% CI)	0.0 [0.0, 0.0]
35.2 After usual care	1	93	Mean Difference (IV, Random, 95% CI)	-1.90 [-3.10, -0.70]

36 Mood - Hospital Anxiety and Depression Scale (HADS)-anxiety score	1	66	Mean Difference (IV, Random, 95% CI)	-0.34 [-1.84, 1.16]
36.1 During usual care	0	0	Mean Difference (IV, Random, 95% CI)	0.0 [0.0, 0.0]
36.2 After usual care	1	66	Mean Difference (IV, Random, 95% CI)	-0.34 [-1.84, 1.16]
37 Mood - Hospital Anxiety and Depression Scale (HADS) - depression score	1	66	Mean Difference (IV, Random, 95% CI)	0.54 [-0.93, 2.01]
37.1 During usual care	0	0	Mean Difference (IV, Random, 95% CI)	0.0 [0.0, 0.0]
37.2 After usual care	1	66	Mean Difference (IV, Random, 95% CI)	0.54 [-0.93, 2.01]

Comparison 6. Mixed training versus control - end of retention follow-up

Outcome or subgroup title	No. of studies	No. of participants	Statistical method	Effect size
1 Case fatality	3	227	Odds Ratio (M-H, Random, 95% CI)	0.27 [0.05, 1.37]
1.1 During usual care	1	67	Odds Ratio (M-H, Random, 95% CI)	0.16 [0.01, 3.50]
1.2 After usual care	2	160	Odds Ratio (M-H, Random, 95% CI)	0.33 [0.05, 2.23]
2 Disability - Barthel (BI)	1	63	Mean Difference (IV, Random, 95% CI)	-6.90 [-21.05, 7.25]
2.1 During usual care	0	0	Mean Difference (IV, Random, 95% CI)	0.0 [0.0, 0.0]
2.2 After usual care	1	63	Mean Difference (IV, Random, 95% CI)	-6.90 [-21.05, 7.25]
3 Disability - Barthel Index (BI) & Functional Independence Measure (FIM) combined	2	146	Std. Mean Difference (IV, Random, 95% CI)	-0.09 [-0.41, 0.24]
3.1 During usual care	0	0	Std. Mean Difference (IV, Random, 95% CI)	0.0 [0.0, 0.0]
3.2 After usual care	2	146	Std. Mean Difference (IV, Random, 95% CI)	-0.09 [-0.41, 0.24]
4 Disability - Nottingham Extended ADLs	1	66	Mean Difference (IV, Random, 95% CI)	0.30 [-0.93, 1.53]
4.1 During usual care	0	0	Mean Difference (IV, Random, 95% CI)	0.0 [0.0, 0.0]
4.2 After usual care	1	66	Mean Difference (IV, Random, 95% CI)	0.30 [-0.93, 1.53]
5 Disability - Rivermead Mobility Index (RMI)	1	66	Mean Difference (IV, Random, 95% CI)	0.20 [-0.41, 0.81]
5.1 During usual care	0	0	Mean Difference (IV, Random, 95% CI)	0.0 [0.0, 0.0]
5.2 After usual care	1	66	Mean Difference (IV, Random, 95% CI)	0.20 [-0.41, 0.81]
6 Physical fitness - gait economy, VO2 (ml/kg/metre)	1	66	Mean Difference (IV, Random, 95% CI)	-0.00 [-0.02, 0.01]
6.1 During usual care	0	0	Mean Difference (IV, Random, 95% CI)	0.0 [0.0, 0.0]
6.2 After usual care	1	66	Mean Difference (IV, Random, 95% CI)	-0.00 [-0.02, 0.01]
7 Physical fitness - muscle strength, knee flexion	1	42	Mean Difference (IV, Random, 95% CI)	4.20 [-9.36, 17.76]
7.1 During usual care	1	42	Mean Difference (IV, Random, 95% CI)	4.20 [-9.36, 17.76]
7.2 After usual care	0	0	Mean Difference (IV, Random, 95% CI)	0.0 [0.0, 0.0]
8 Physical fitness - muscle strength, knee extension	1	42	Mean Difference (IV, Random, 95% CI)	4.20 [-12.71, 21.11]
8.1 During usual care	1	42	Mean Difference (IV, Random, 95% CI)	4.20 [-12.71, 21.11]
8.2 After usual care	0	0	Mean Difference (IV, Random, 95% CI)	0.0 [0.0, 0.0]

9 Physical fitness - muscle strength, leg extensor power (affected leg) W/Kg	1	66	Mean Difference (IV, Random, 95% CI)	0.02 [-0.13, 0.17]
9.1 During usual care	0	0	Mean Difference (IV, Random, 95% CI)	0.0 [0.0, 0.0]
9.2 After usual care	1	66	Mean Difference (IV, Random, 95% CI)	0.02 [-0.13, 0.17]
10 Physical fitness - grip strength (paretic hand)	1	63	Mean Difference (IV, Random, 95% CI)	-0.04 [-0.26, 0.18]
10.1 During usual care	0	0	Mean Difference (IV, Random, 95% CI)	0.0 [0.0, 0.0]
10.2 After usual care	1	63	Mean Difference (IV, Random, 95% CI)	-0.04 [-0.26, 0.18]
11 Mobility - preferred gait speed (m/min)	3	201	Mean Difference (IV, Random, 95% CI)	-2.12 [-4.85, 0.62]
11.1 During usual care	2	136	Mean Difference (IV, Random, 95% CI)	-1.02 [-8.64, 6.60]
11.2 After usual care	1	65	Mean Difference (IV, Random, 95% CI)	-2.28 [-5.21, 0.65]
12 Mobility - community ambulation speed (> 0.8 m/sec)	3	217	Odds Ratio (M-H, Random, 95% CI)	1.33 [0.70, 2.53]
12.1 During usual care	1	52	Odds Ratio (M-H, Random, 95% CI)	2.14 [0.56, 8.12]
12.2 After usual care	2	165	Odds Ratio (M-H, Random, 95% CI)	1.15 [0.48, 2.76]
13 Physical function - Berg Balance scale	1	62	Mean Difference (IV, Random, 95% CI)	-2.0 [-5.25, 1.25]
13.1 During usual care	1	62	Mean Difference (IV, Random, 95% CI)	-2.0 [-5.25, 1.25]
13.2 After usual care	0	0	Mean Difference (IV, Random, 95% CI)	0.0 [0.0, 0.0]
14 Physical function - functional reach	1	66	Mean Difference (IV, Random, 95% CI)	2.5 [-0.97, 5.97]
14.1 During usual care	0	0	Mean Difference (IV, Random, 95% CI)	0.0 [0.0, 0.0]
14.2 After usual care	1	66	Mean Difference (IV, Random, 95% CI)	2.5 [-0.97, 5.97]
15 Physical function - Timed Up and Go (sec)	2	128	Mean Difference (IV, Random, 95% CI)	-0.30 [-1.14, 0.55]
15.1 During usual care	1	62	Mean Difference (IV, Random, 95% CI)	0.0 [-6.97, 6.97]
15.2 After usual care	1	66	Mean Difference (IV, Random, 95% CI)	-0.30 [-1.15, 0.55]
16 Health related QoL - EuroQuol (Health State)	1	50	Mean Difference (IV, Random, 95% CI)	0.04 [-0.12, 0.20]
16.1 During usual care	1	50	Mean Difference (IV, Random, 95% CI)	0.04 [-0.12, 0.20]
16.2 After usual care	0	0	Mean Difference (IV, Random, 95% CI)	0.0 [0.0, 0.0]
17 Health related QoL - EuroQuol (Self-perceived health)	1	49	Mean Difference (IV, Random, 95% CI)	3.40 [-7.31, 14.11]
17.1 During usual care	1	49	Mean Difference (IV, Random, 95% CI)	3.40 [-7.31, 14.11]
17.2 After usual care	0	0	Mean Difference (IV, Random, 95% CI)	0.0 [0.0, 0.0]
18 Health related QoL - SF-36 physical functioning	2	146	Mean Difference (IV, Random, 95% CI)	2.46 [-7.20, 12.11]
18.1 During usual care	0	0	Mean Difference (IV, Random, 95% CI)	0.0 [0.0, 0.0]
18.2 After usual care	2	146	Mean Difference (IV, Random, 95% CI)	2.46 [-7.20, 12.11]
19 Health related QoL - SF-36 physical role functioning	2	146	Mean Difference (IV, Random, 95% CI)	11.61 [2.38, 20.84]
19.1 During usual care	0	0	Mean Difference (IV, Random, 95% CI)	0.0 [0.0, 0.0]
19.2 After usual care	2	146	Mean Difference (IV, Random, 95% CI)	11.61 [2.38, 20.84]
20 Health related QoL - SF-36 emotional role functioning	1	80	Mean Difference (IV, Random, 95% CI)	10.0 [-2.28, 22.28]
20.1 During usual care	0	0	Mean Difference (IV, Random, 95% CI)	0.0 [0.0, 0.0]
20.2 After usual care	1	80	Mean Difference (IV, Random, 95% CI)	10.0 [-2.28, 22.28]
21 Mood - Stroke Impact Scale emotion score	1	80	Mean Difference (IV, Random, 95% CI)	1.0 [-5.80, 7.80]
21.1 During usual care	0	0	Mean Difference (IV, Random, 95% CI)	0.0 [0.0, 0.0]

21.2 After usual care	1	80	Mean Difference (IV, Random, 95% CI)	1.0 [-5.80, 7.80]
22 Mood - Geriatric Depression Scale	1	80	Mean Difference (IV, Random, 95% CI)	-1.4 [-2.54, -0.26]
22.1 During usual care	0	0	Mean Difference (IV, Random, 95% CI)	0.0 [0.0, 0.0]
22.2 After usual care	1	80	Mean Difference (IV, Random, 95% CI)	-1.4 [-2.54, -0.26]
23 Mood - Hospital Anxiety and Depression Scale (HADS) - anxiety score	1	66	Mean Difference (IV, Random, 95% CI)	-0.25 [-1.79, 1.29]
23.1 During usual care	0	0	Mean Difference (IV, Random, 95% CI)	0.0 [0.0, 0.0]
23.2 After usual care	1	66	Mean Difference (IV, Random, 95% CI)	-0.25 [-1.79, 1.29]
24 Mood - Hospital Anxiety and Depression Scale (HADS) - depression score	1	66	Mean Difference (IV, Random, 95% CI)	0.18 [-1.27, 1.63]
24.1 During usual care	0	0	Mean Difference (IV, Random, 95% CI)	0.0 [0.0, 0.0]
24.2 After usual care	1	66	Mean Difference (IV, Random, 95% CI)	0.18 [-1.27, 1.63]

Comparison 7. Cardiorespiratory versus resistance versus mixed training

Outcome or subgroup title	No. of studies	No. of participants	Statistical method	Effect size
1 Mobility - gait preferred speed (m/min)	15		Mean Difference (IV, Random, 95% CI)	Subtotals only
1.1 Cardiorespiratory training	4	221	Mean Difference (IV, Random, 95% CI)	4.68 [1.40, 7.96]
1.2 Mixed training	8	397	Mean Difference (IV, Random, 95% CI)	2.93 [0.02, 5.84]
1.3 Resistance training	3	80	Mean Difference (IV, Random, 95% CI)	2.34 [-6.77, 11.45]
2 Mobility - gait preferred speed (m/min); sensitivity analysis: confounded studies removed	8		Mean Difference (IV, Random, 95% CI)	Subtotals only
2.1 Cardiorespiratory training	2	111	Mean Difference (IV, Random, 95% CI)	6.86 [1.24, 12.48]
2.2 Mixed training	3	201	Mean Difference (IV, Random, 95% CI)	0.49 [-2.96, 3.94]
2.3 Resistance training	3	80	Mean Difference (IV, Random, 95% CI)	2.34 [-6.77, 11.45]

ADDITIONAL TABLES

Table 1. Outline of the studies which focused on cardiorespiratory training interventions

Study ID	Mode of training	During or after usual care	Upper or lower body	Specific training	Intensity	Duration (minutes)	Frequency (days)	Programme length (weeks)	ACSM criteria met
Aidar 2007	Water training	After	Both	Yes	Unknown	45 to 60	2	12	Unknown

Table 1. Outline of the studies which focused on cardiorespiratory training interventions (*Continued*)

Lennon 2008	Cycle ergometer (cardiac rehabilitation programme)	After	Both	No	50-60% maximum heart rate	30	2	10	Yes
Moore 2010	Treadmill gait training with overhead harness	After	Lower body	Yes	80 to 85 age-predicted maximum heart rate	Unknown	2 to 5	4	Yes
Mudge 2009	Circuit training	After	Lower body	Yes	Unknown	30	3	4	Unknown
Smith 2008	Treadmill gait training	After	Lower body	Yes	Rate perceived exertion $\leq$ 13	20	3	4	Yes
Glasser 1986	Kinetron	During	Lower body	No	Unknown	20 to 60	5	3	Unknown
Cuviello-Palmer 1988	Kinetron	During	Lower body	No	Heart rate < resting + 20 beats/minute	7 to 17	5	3	No
da Cunha 2002	Treadmill gait training with body weight support (BWS)	During	Lower body	Yes	Unknown	20	5	2 to 3	Unknown
Pohl 2002	Treadmill gait training	During	Lower body	Yes	Unknown	30	3	4	Unknown
Eich 2004	Treadmill gait training	During	Lower body	Yes	60% heart rate reserve	30	5	6	Yes
Bateman 2001	Cycle ergometer	During	Lower body	No	60% to 80% age-re-	$\leq$ 30	3	12	Yes

Table 1. Outline of the studies which focused on cardiorespiratory training interventions (*Continued*)

					lated heart rate maximum				
Katz-Leurer 2003	Cycle ergometer	After	Lower body	No	≤ 60% heart rate reserve	20 then 30	5 then 3	2 then 6 (total 8)	Yes
Potempa 1995	Cycle ergometer	After	Lower body	No	30% to 50% max effort	30	3	10	Yes
Salbach 2004	Circuit training	After	Lower body	Yes	Unknown	55	3	6	Unknown

Table 2. Outline of the studies which focused on resistance training interventions

Study ID	Mode of training	During/ after usual care	Upper or lower body	Specific training	Intensity	Duration (minutes)	Frequency (days)	Programme length (weeks)	ACSM criteria
Bale 2008	Resistence training; weights	During	Lower body	No	10 to 15 repetitions to achieve moderate fatigue	50	3	4	Yes
Flansbjer 2008	Dynamic and isokinetic resistance training (Leg extension/curl rehab exercise machine)	After	Lower body	Yes	6 to 10 repetitions equivalent to 80% of maximum load	90	Unknown	10	Unclear (criteria nearly met)
Sims 2009	Resistance training; machine weights	After	Both	Yes	3 x 8/10 repetitions at 80% one repetition maximum	Unknown	2	10	Unclear (criteria nearly met)

Table 2. Outline of the studies which focused on resistance training interventions (*Continued*)

Inaba 1973	Resistance training	During	Lower body	No	50% and 100% maximum weight	Unknown	'Daily'	4 to 8	Yes
Winstein 2004	Resistance training; weights; Thera-band and grip devices	During	Upper body	No	Unknown	60	3 high 2 slow	4 to 6 (target of 20 sessions)	Unknown
Kim 2001	Resistance training; isokinetic dynamometer	After	Lower body	No	Maximal effort 3 x 10 repetitions	30	3	6	Yes
Ouellette 2004	Resistance training; weights and pneumatic resistance machines	After	Lower body	No	70% one repetition maximum: 3 x 8 to 10 repetitions	Not applicable	3	12	Unclear (criteria nearly met)

Table 3. Outline of the studies which focused on mixed training interventions

Study ID	Mode of training	During or after usual care	Upper or lower body	Specific training	Intensity	Duration (minutes)	Frequency (days)	Programme length (weeks)	ACSM criteria
Cooke 2010	Resistance training plus treadmill training	During	Lower body	Yes	Unknown	60	4	6	Unknown
Donaldson 2009	Paretic upper limb exercises and hand grip activities	During	Upper body	Yes	Unknown	60	4	6	Unknown

Table 3. Outline of the studies which focused on mixed training interventions (*Continued*)

Langhammer 2007	Walking, stationary bicycling, stair walking, treadmill, and resistance training	After	Both	Yes	70% to 80% maximum pulse (cardiorespiratory component) ; 50% to 60% one repetition maximum (strength component)	45	2/3	Unclear. Minimum 20 hours every third month in the first year after stroke	Yes
Richards 1993	Treadmill plus Kinetron plus tilt table	During	Lower body	Yes	Unknown	104	5	5	Unknown
Richards 2004	Treadmill plus Kinetron plus limb load monitor	During	Lower body	Yes	Unknown	60	5	8	Unknown
Duncan 1998	Walking or cycle ergometry; elastic resisted contractions	After	Both	Yes	Unknown	90	3	12	Cardio: no Strength: yes
Teixeira 1999	Walking and stepping or cycle ergometry; resistance training body mass, weights and elastic	After	Lower body	Yes	50% to 70% maximum work rate (cardiorespiratory component) 50% to 80% one repetition maxi-	60 to 90	3	10	Cardio: yes Strength: yes

Table 3. Outline of the studies which focused on mixed training interventions (*Continued*)

					mum, 3 x 10 repetitions (strength component)				
Duncan 2003	Circuit training	After	Lower body	Yes	50% to 60% heart rate reserve	90 to 120	3	4	Cardio: yes Strength: unclear
James 2002	Circuit training	After	Both	Yes	Unknown	90	3	12 to 14 (total of 36 sessions)	Cardio: no Strength: yes
Yang 2006	Functional stepping and chair rising	After	Lower body	Yes	Unknown	30	3	4	No
Mead 2007	Circuit including walking, stepping, cycle ergometry; resistance training body mass, weights and elastic	After	Both	Yes	Rating of perceived exertion: 13 to 16	40 to 75	3	12 to 14 (total of 36 sessions)	Unknown

Table 4. Pooled walking data for cardiorespiratory training, resistance training, and mixed training at the end of the training period and at follow-up

End of intervention					**End of follow-up**		
Intervention	**Walking outcome**	**Trials (number of participants)**	**MD (95% CI)**	**Significance level**	**Trials (number of participants)**	**MD (95% CI)**	**Significance level**
Cardiorespiratory training	Maximal gait speed	7 (365)	8.66 m/min (2.98, 14.34)	P = 0.003	3 (186)	8.21 m/min (3.38, 13.05)	P = 0.0009
	Preferred gait speed	4 (221)	4.68 m/min (1.40, 7.96)	P = 0.005	-	-	-

Table 4. Pooled walking data for cardiorespiratory training, resistance training, and mixed training at the end of the training period and at follow-up (*Continued*)

	6-Meter Walking Test	4 (219)	47.13 metres (19.39, 74.88)	P = 0.0009	2 (107)	69.3 metres (33.38, 105.23)	P = 0.0002
Resistance training	Maximal gait speed	4 (104)	1.92 m/min (-3.50, 7.35)	NS	1 (24)	-19. 8 m/min (-95. 77, 56.17)	NS
	Preferred gait speed	3 (80)	2.34 m/min (-6.77, 11.45)	NS	-	-	-
	6-Meter Walking Test	2 (66)	3.78 metres (-68.56, 76.11)	NS	1 (24)	11.0 m/min (-105.95, 127. 95)	NS
Mixed training	Maximal gait speed	-	-	-	-	-	-
	Preferred gait speed	8 (397)	2.93 m/min (0.02, 5.84)	P = 0.05	3 (201)	-2.12 m/min (-4.85, 0.62)	NS
	6-Meter Walking Test	3 (168)	30.59 metres (8.90, 52.28)	P = 0.006	-	-	-

CI: confidence interval
m: metre
MD: mean different
min: minutes
NS: non-significant

WHAT'S NEW

Last assessed as up-to-date: 7 April 2011.

Date	Event	Description
22 November 2010	New search has been performed	We have updated all main electronic search strategies to March 2010. We have included 11 additional randomised clinical trials and seven ongoing trials. We have clarified our inclusion criteria and objectives
22 November 2010	New citation required and conclusions have changed	New first author. We have revised the main text and conclusions of the review according to the findings of the new included trials

HISTORY

Protocol first published: Issue 4, 2001

Review first published: Issue 1, 2004

Date	Event	Description
2 March 2009	New search has been performed	We updated the search of the Cochrane Stroke Group Trials Register in March 2009
3 November 2008	New citation required and conclusions have changed	There is sufficient evidence to incorporate cardiorespiratory training, using walking as a mode of exercise, into the rehabilitation of patients with stroke in order to improve speed, tolerance and independence during walking, but further trials are needed to determine the optimal exercise prescription after stroke and to establish whether any long-term benefits exist
3 November 2008	New search has been performed	We updated the searches to March 2007. There are now 24 trials, involving 1147 participants, included in the review; 12 more trials than in the previous version. The text of the review has been revised throughout
23 October 2008	Amended	Converted to new review format.

CONTRIBUTIONS OF AUTHORS

Original review

DH Saunders, CA Greig, GE Mead and A Young contributed to writing the review protocol.
DH Saunders developed and ran searches, selected studies, extracted and interpreted data, performed the analyses, and co-wrote the review.
CA Greig and GE Mead selected studies, extracted and interpreted data, performed the analyses, and co-wrote the review.
A Young provided comments on interim drafts of the review.

For this update

M Brazzelli developed and ran searches, selected studies, extracted and interpreted data, performed the analyses, and wrote the review.
DH Saunders selected studies, extracted and interpreted data, and contributed to writing the review.
GE Mead and CA Greig selected studies and provided comments on a draft version of the review.

DECLARATIONS OF INTEREST

DH Saunders and CA Greig were co-authors of one included study (Mead 2007).

GE Mead has received research funding for exercise after stroke. She has received honoraria from Later Life Training to develop an educational course of exercise after stroke for exercise professionals. She has also received honoraria and expenses to present work on exercise after stroke at conferences. She has led a trial of exercise after stroke that is included in the review (Mead 2007).

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- No sources of support supplied

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INDEX TERMS

Medical Subject Headings (MeSH)

*Physical Fitness; Activities of Daily Living; Exercise Therapy [*methods]; Randomized Controlled Trials as Topic; Resistance Training; Stroke [*rehabilitation]

MeSH check words

Humans