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Physical fitness training for stroke patients (Review)

Saunders DH, Sanderson M, Hayes S, Johnson L, Kramer S, Carter DD, Jarvis H, Brazzelli M, Mead GE

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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 activity and physical fitness are low after stroke. Interventions to increase physical fitness could reduce mortality and reduce disability through increased function.

Objectives

The primary objectives of this updated review were to determine whether fitness training after stroke reduces death, death or dependence, and disability. The secondary objectives were to determine the effects of training on adverse events, risk factors, physical fitness, mobility, physical function, health status and quality of life, mood, and cognitive function.

Search methods

In July 2018 we searched the Cochrane Stroke Trials Register, CENTRAL, MEDLINE, Embase, CINAHL, SPORTDiscus, PsycINFO, and four additional databases. We also searched ongoing trials registers 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 (mixed training), with usual care, no intervention, or a non-exercise intervention in stroke survivors.

Data collection and analysis

Two review authors independently selected studies, assessed quality and risk of bias, and extracted data. We analysed data using random-effects meta-analyses and assessed the quality of the evidence using the GRADE approach. Diverse outcome measures limited the intended analyses.

Main results

We included 75 studies, involving 3017 mostly ambulatory participants, which comprised cardiorespiratory (32 studies, 1631 participants), resistance (20 studies, 779 participants), and mixed training interventions (23 studies, 1207 participants).

Death was not influenced by any intervention; risk differences were all 0.00 (low-certainty evidence). There were few deaths overall (19/3017 at end of intervention and 19/1469 at end of follow-up). None of the studies assessed death or dependence as a composite outcome. Disability scores were improved at end of intervention by cardiorespiratory training (standardised mean difference (SMD) 0.52, 95% CI 0.19 to 0.84; 8 studies, 462 participants; $P = 0.002$; moderate-certainty evidence) and mixed training (SMD 0.23, 95% CI 0.03 to 0.42; 9 studies, 604 participants; $P = 0.02$; low-certainty evidence). There were too few data to assess the effects of resistance training on disability.

Secondary outcomes showed multiple benefits for physical fitness (VO_2 peak and strength), mobility (walking speed) and physical function (balance). These physical effects tended to be intervention-specific with the evidence mostly low or moderate certainty. Risk factor data were limited or showed no effects apart from cardiorespiratory fitness (VO_2 peak), which increased after cardiorespiratory training (mean difference (MD) 3.40 mL/kg/min, 95% CI 2.98 to 3.83; 9 studies, 438 participants; moderate-certainty evidence). There was no evidence of any serious adverse events. Lack of data prevents conclusions about effects of training on mood, quality of life, and cognition. Lack of data also meant benefits at follow-up (i.e. after training had stopped) were unclear but some mobility benefits did persist. Risk of bias varied across studies but imbalanced amounts of exposure in control and intervention groups was a common issue affecting many comparisons.

Authors' conclusions

Few deaths overall suggest exercise is a safe intervention but means we cannot determine whether exercise reduces mortality or the chance of death or dependency. Cardiorespiratory training and, to a lesser extent mixed training, reduce disability during or after usual stroke care; this could be mediated by improved mobility and balance. There is sufficient evidence to incorporate cardiorespiratory and mixed training, involving walking, within post-stroke rehabilitation programmes to improve fitness, balance and the speed and capacity of walking. The magnitude of VO_2 peak increase after cardiorespiratory training has been suggested to reduce risk of stroke hospitalisation by ~7%. Cognitive function is under-investigated despite being a key outcome of interest for patients. Further well-designed randomised trials are needed to determine the optimal exercise prescription, the range of benefits and any long-term benefits.

PLAIN LANGUAGE SUMMARY

Physical fitness training for stroke survivors

Review question

We reviewed the evidence that examines whether physical fitness training is beneficial for health and function in people who have had a stroke.

Background

Physical fitness is important to allow people to carry out everyday activities such as walking and climbing stairs. Physical fitness varies among everyone. For example, fitness in men tends to be a little higher than in women and everyone's fitness declines as we get older and if we become less physically active. In particular, in stroke survivors' physical fitness is often low. This may limit their ability to perform everyday activities and also worsen stroke-related disability. For this reason fitness training has been proposed as a beneficial approach for people with stroke. However, taking part in fitness training could have a range of other benefits important to people with stroke such as improving cognitive function (thinking skills), improving mood, and quality of life, and it could reduce the chance of having another stroke.

Study characteristics

In July 2018 we identified 75 studies for inclusion in the review. The studies involved a total of 3617 participants at all stages of care including being in hospital or back living at home. Most of the people who took part were able to walk on their own. The studies tested different forms of fitness training; these included cardiorespiratory or 'endurance' training, resistance or 'strength' training, or mixed training, which is a combination of cardiorespiratory plus resistance training.

Key results

We found that cardiorespiratory fitness training, particularly involving walking, can improve fitness, balance and walking after stroke. The improvements in cardiorespiratory fitness may reduce the chance of stroke hospitalisation by 7%. Mixed training improves walking ability and improves balance. Strength training may have a role in improving balance. So, overall it seems likely that people with stroke are likely to benefit the most from training that involves cardiorespiratory training and that involves some walking. However, there was not enough information to draw reliable conclusions about the impact of fitness training on other areas such as quality of life, mood, or cognitive function. Cognitive function is under-investigated despite being a key outcome of interest for stroke survivors. There was no evidence that any of the different types of fitness training caused injuries or other health problems; exercise appears to be safe. We need more studies to examine the benefits that are most important to stroke survivors, in particular for those with more severe stroke who may be unable to walk.

Quality of the evidence

Studies of fitness training can be difficult to carry out. We have the highest confidence in the estimates of benefit from cardiorespiratory training (moderate/high). The evidence for other training types is moderate to low. However, some consistent findings emerged with different studies all tending to show similar effects in different groups of participants.

SUMMARY OF FINDINGS

Summary of findings for the main comparison. Cardiorespiratory training compared to control for people with stroke: end of intervention

Cardiorespiratory training compared to control for people with stroke: end of intervention

Patient or population: people with stroke

Setting: during and after usual care

Intervention: cardiorespiratory training

Comparison: control; end of intervention

Outcomes		Relative effect (95% CI)	Number of participants (studies)	Certainty of the evidence (GRADE)	Comments
Death		Risk difference 0.00 (-0.01 to 0.01)	1631 (32 RCTs)	⊕⊕⊕⊖ Low ^a	Death is very uncommon, with only 4 deaths; 2 deaths in the control group and 2 in the intervention group of a single study (Gordon 2013).
Analysis 1.1					
Dead or dependent		-	0 (0 RCTs)	-	No studies reported the composite outcome of death or dependency.
Disability	Pooled functional scales	SMD 0.52 higher (0.19 higher to 0.84 higher)	462 (8 RCTs)	⊕⊕⊕⊖ Moderate ^b	A SMD of global scales of disability is difficult to interpret. The magnitude of increase observed (> 0.5) can generally be categorised as a 'moderate' effect. Any improvement may be reflecting improved mobility since mobility items are commonly included in these assessment tools.
	Analysis 1.5				
Physical fitness	VO ₂ peak (mL/kg/min)	MD 3.4 mL/kg/min higher (2.98 higher to 3.83 higher)	438 (9 RCTs)	⊕⊕⊕⊖ Moderate ^c	An increase of 1 MET (3.3 mL/kg/min) is associated with a 7% risk reduction in stroke hospitalisation (Pandey 2016). The effect here is of similar magnitude and suggests secondary prevention targets could be achieved within short periods of training.
	Analysis 1.9				
	Muscle strength	-	-	-	No data; specificity of training gives little rationale to investigate
Mobility	Preferred gait speed (m/min)	MD 4.47 m/min faster (2.07 faster to 6.87 faster)	588 (12 RCTs)	⊕⊕⊕⊕ High ^d	These increases in preferred walking speed and walking capacity are relevant to community ambulation. The interventions are mostly those with a walking mode of exercise. These functional benefits are also maintained after the end of the training interventions. Maximal speed and other indices of gait also improve.
	Analysis 1.13				
	Gait endurance (6-MWT metres)	MD 33.41 m further (19.04 further to 47.78 further)	882 (16 RCTs)	⊕⊕⊕⊕ High ^e	
	Analysis 1.14				

Physical function	Berg Balance Scale (0 to 56, best balance = 56) Analysis 1.17	MD 1.92 units higher (0.16 higher to 3.68 higher)	471 (8 RCTs)	⊕⊕⊕⊖ Moderate ^f	Both of these outcomes are indices of balance.
	3-metre Timed Up and Go (seconds) Analysis 1.18	MD 3.42 s faster (2.05 faster to 4.78 faster)	223 (5 RCTs)	⊕⊕⊕⊖ Moderate ^g	

***The risk in the intervention group** (and its 95% confidence interval) is based on the assumed risk in the comparison group and the **relative effect** of the intervention (and its 95% CI).

6-MWT: 6-Minute Walk Test; **CI:** confidence interval; **MD:** mean difference; **MET:** metabolic equivalent; **RCT:** randomised controlled trial; **RR:** risk ratio; **SMD:** standardised mean difference

GRADE Working Group grades of evidence

High certainty: we are very confident that the true effect lies close to that of the estimate of the effect.

Moderate certainty: we are moderately confident in the effect estimate: the true effect is likely to be close to the estimate of the effect, but there is a possibility that it is substantially different.

Low certainty: our confidence in the effect estimate is limited: the true effect may be substantially different from the estimate of the effect.

Very low certainty: we have very little confidence in the effect estimate: the true effect is likely to be substantially different from the estimate of effect.

^aMost participants were high-functioning; risk of death was low among this group. There is some risk of bias from imbalanced exposure in 13 of the 20 included studies and some reporting uncertainties concerning reasons for dropouts in six of the 32 studies.

^bThere is some heterogeneity ($I^2 = 61\%$); other issues with individual studies account for this heterogeneity.

^cThere are some 'Risk of bias' items recorded as 'high' but these are among studies with a low weighting. There is uncertainty in the data of one study ([Jin 2013](#)). If we exclude this study, a clear effect is still present (MD 2.80 mL/kg/min higher (1.66 higher to 3.95 higher) with high-certainty evidence).

^dAlthough five out of 13 studies are confounded for exposure time the effect is still apparent when these are excluded.

^eSome heterogeneity is present ($I^2 = 30\%$) but sensitivity analysis of confounded studies and those using non-walking (cycling) exercise modes reduces this and a similar beneficial effect remains.

^fThere is some heterogeneity ($I^2 = 57\%$).

^gThree out of five studies are confounded for exposure time.

Summary of findings 2. Resistance training compared to control for people with stroke: end of intervention

Resistance training compared to control for people with stroke: end of intervention

Patient or population: people with stroke

Setting: during and after usual care

Intervention: resistance training

Comparison: control; end of intervention

Outcomes		Relative effect (95% CI)	Number of participants (studies)	Certainty of the evidence (GRADE)	Comments
Death		Risk difference 0.00 (-0.02 to 0.02)	803 (20 RCTs)	⊕⊕⊕⊕ Low ^a	Death is very uncommon, with only 2 deaths; 1 in the control group and 1 in the intervention group of a single study (Knox 2018).
Analysis 3.1					
Dead or dependent		-	0 (0 RCTs)	-	No studies reported the composite outcome of death or dependency.
Disability	Pooled functional scales	-	-	-	Too few data reporting global indices of disability to establish any consensus effects.
Physical Fitness	VO ₂ peak (mL/kg/min)	-	-	-	The rationale for resistance training is to increase muscle strength and not cardiorespiratory fitness therefore there is little rationale to investigate this outcome. Only 1 study measured VO ₂ peak and this indicated a 6% improvement.
	Muscle strength - composite measure	SMD 0.58 higher (0.06 higher to 1.1 higher)	60 (2 RCTs)	⊕⊕⊕⊕ Low ^b	Overall, 11 RCTs reported muscle strength outcomes. 10/11 studies, mostly examining lower limb fitness, demonstrated that resistance training can improve muscle strength and some studies also indicated that indices such as local muscular endurance and power output can be improved.
	Analysis 3.2				
	Muscle strength - paretic knee flexion	SMD 0.72 higher (0.10 higher to 1.34 higher)	93 (3 RCTs)	⊕⊕⊕⊕ Moderate ^c	Variation in the method for measuring strength restricts the pooling of data however three small groups of outcomes could be pooled. These show medium-sized effects (SMD > 0.5) only for one outcome, a composite measure of strength.
	Analysis 3.3				
	Muscle strength - paretic knee extension	SMD 1.09 higher (0.23 lower to 2.41 higher)	93 (3 RCTs)	⊕⊕⊕⊕ Low ^d	
	Analysis 3.4				
Mobility	Preferred gait speed (m/min)	MD 2.15 m/min faster (3.57 slower to 7.87 faster)	203 (5 RCTs)	⊕⊕⊕⊕ Moderate ^e	There was no statistically significant effect of training on preferred walking speed or on other indices of gait such as maximal walking speed. Only 6-MWT data showed a benefit but this and all other gait measures showed no statistically significant effect after a follow-up period. These training interventions were not based on a walking mode of exercise.
	Analysis 3.6				
	Gait endurance (6-MWT metres)	MD 24.98 m further (11.98 further to 37.98 further)	238 (5 RCTs)	⊕⊕⊕⊕ Low ^f	
	Analysis 3.7				

Physical Function	Berg Balance Scale (0 to 56, best balance = 56) Analysis 3.8	MD 3.27 higher (2.15 higher to 4.38 higher)	220 (5 RCTs)	⊕⊕○○ Low ^g	Both of these outcomes are indices of balance. The training only showed a statistically significant improvement in balance measured with the Berg Balance Scale.
	3-metre Timed Up and Go (seconds) Analysis 3.10	MD 3.46 s faster (0.02 slower to 6.94 faster)	224 (5 RCTs)	⊕⊕○○ Low ^h	

***The risk in the intervention group** (and its 95% confidence interval) is based on the assumed risk in the comparison group and the **relative effect** of the intervention (and its 95% CI).

6-MWT: 6-Minute Walk Test; **CI:** confidence interval; **MD:** mean difference; **RCT:** randomised controlled trial; **SMD:** standardised mean difference

GRADE Working Group grades of evidence

High certainty: We are very confident that the true effect lies close to that of the estimate of the effect

Moderate certainty: We are moderately confident in the effect estimate: The true effect is likely to be close to the estimate of the effect, but there is a possibility that it is substantially different

Low certainty: Our confidence in the effect estimate is limited: The true effect may be substantially different from the estimate of the effect

Very low certainty: We have very little confidence in the effect estimate: The true effect is likely to be substantially different from the estimate of effect

^aMost participants were high-functioning; risk of death was low among this group. There is serious risk of bias from imbalanced exposure in 12 of the 20 included studies.

^bOne of the two included studies has major risk of bias issues and the composite measure of muscle strength is indirect in nature.

^cOne of the three included studies has risk of bias issues. There is some heterogeneity ($I^2 = 47\%$).

^dOne of the three included studies has risk of bias issues. There is high heterogeneity ($I^2 = 87\%$).

^eHigh degree of heterogeneity ($I^2 = 76\%$).

^fVery serious risk of bias including three out of five studies confounded for exposure time; key 'Risk of bias' items affecting highest weighted studies.

^gVery serious risk of bias including three out of five studies confounded for exposure time.

^hHigh degree of heterogeneity ($I^2 = 89\%$) and four out of five studies confounded for exposure time.

Summary of findings 3. Mixed training compared to control for people with stroke: end of intervention

Mixed training compared to control for people with stroke: end of intervention

Patient or population: people with stroke

Setting: during and after usual care

Intervention: mixed training

Comparison: control; end of intervention

Outcomes		Relative effect (95% CI)	Number of participants (studies)	Certainty of the evidence (GRADE)	Comments
Death		Risk difference 0.00 (-0.02 to 0.01)	1231 (23 RCTs)	⊕⊕⊕⊙ Low ^a	Although there were more deaths in the control group there was no statistically significant difference between the groups.
Dead or dependent		-	0 (0 RCTs)	-	No studies reported the composite outcome of death or dependency.
Disability	Pooled functional scales Analysis 5.5	SMD 0.23 higher (0.03 higher to 0.42 higher)	604 (9 RCTs)	⊕⊕⊕⊙ Low ^b	A SMD of global scales of disability is difficult to interpret. The magnitude of increase observed (0.2 to 0.5) can generally be categorised as a 'small' effect. Any improvement may be reflecting improved mobility since mobility items are commonly included in these assessment tools. 7/9 studies were confounded for exposure time so any effects may be exaggerated. Any improvement may be connected to improved mobility since mobility items are a common feature of these scales.
Physical fitness	VO ₂ peak (mL/kg/min) Analysis 5.8	MD 1.4 mL/kg/min higher (-0.19 lower to 2.99 higher)	140 (2 RCTs)	⊕⊕⊕⊙ Low ^c	There were too few cardiorespiratory fitness data reported to establish any consensus effects for mixed training.
	Muscle strength - ankle dorsiflexion Analysis 5.10	SMD 0.8 stronger (-0.82 weaker to 2.41 stronger)	148 (2 RCTs)	⊕⊕⊕⊙ Very low ^d	Overall 6 RCTs reported muscle strength outcomes. Variation in the method for measuring strength restricted the pooling of data; however, 3 groups of strength outcomes could be pooled.
	Muscle strength - knee extension Analysis 5.11	SMD 0.33 stronger (0.05 stronger to 0.61 stronger)	202 (3 RCTs)	⊕⊕⊕⊙ Low ^e	Only knee extensor strength showed a small (> 0.2) beneficial effect on knee extension strength.
	Muscle strength - paretic grip strength (kg) Analysis 5.12	MD 0.32 Kg stronger (-0.88 weaker to 1.52 stronger)	147 (3 RCTs)	⊕⊕⊕⊙ Low ^f	
Mobility	Preferred gait speed (m/min) Analysis 5.14	MD 4.71 m/min faster (1.32 faster to 8.1 faster)	738 (10 RCTs)	⊕⊕⊕⊙ Moderate ^g	These increases in preferred walking speed and walking capacity are relevant to community ambulation. The interventions are mostly those with a walking mode of exercise. These functional benefits in the 6-MWT were also maintained after the end of the training interventions.

	Gait endurance (6-MWT metres) Analysis 5.15	MD 35 m further (15.91 further to 54.09 further)	720 (10 RCTs)	⊕⊕⊕⊖ Low ^h	
Physical function	Berg Balance Scale (0 to 56, best balance = 56) Analysis 5.17	MD 2.12 higher (0.82 higher to 3.41 higher)	419 (9 RCTs)	⊕⊕⊕⊖ Low ⁱ	Both of these outcomes are indices of balance, only the Berg Balance Scale demonstrated a statistically significant improvement.
	3-metre Timed Up and Go (seconds) Analysis 5.20	MD 2.21 sec faster (0.02 slower to 4.43 faster)	586 (7 RCTs)	⊕⊕⊕⊖ Low ^j	

***The risk in the intervention group** (and its 95% confidence interval) is based on the assumed risk in the comparison group and the **relative effect** of the intervention (and its 95% CI).

6-MWT: 6-Minute Walk Test; **CI:** confidence interval; **MD:** mean difference; **OR:** odds ratio; **RCT:** randomised controlled trial; **RR:** risk ratio; **SMD:** standardised mean difference

GRADE Working Group grades of evidence

High certainty: We are very confident that the true effect lies close to that of the estimate of the effect

Moderate certainty: We are moderately confident in the effect estimate: The true effect is likely to be close to the estimate of the effect, but there is a possibility that it is substantially different

Low certainty: Our confidence in the effect estimate is limited: The true effect may be substantially different from the estimate of the effect

Very low certainty: We have very little confidence in the effect estimate: The true effect is likely to be substantially different from the estimate of effect

^aMost participants were high-functioning; risk of death was low among this group. There is serious risk of bias from imbalanced exposure in 16 of the 23 included studies.

^bThere is heterogeneity ($I^2 = 21\%$) in addition to very serious risk of bias from imbalanced exposure in seven of the nine included studies.

^cThere is heterogeneity ($I^2 = 35\%$) in addition to very serious risk of bias from imbalanced exposure in the study weighted 79.6%.

^dSubstantial heterogeneity ($I^2 = 76\%$); very serious risk of bias; both studies with imbalanced exposure.

^eVery serious risk of bias; all three studies with imbalanced exposure.

^fVery serious risk of bias with 3/3 studies with imbalanced exposure.

^gSubstantial heterogeneity ($I^2 = 76\%$).

^hVery serious risk of bias with nine out of 10 studies with imbalanced exposure times.

ⁱVery serious risk of bias with five out of nine studies with imbalanced exposure; there is no beneficial effect if these five studies are excluded.

^jThere is heterogeneity ($I^2 = 45\%$) in addition to serious risk of bias from imbalanced exposure in seven of the nine included studies.

BACKGROUND

Physical activity and exercise recommendations exist for a wide range of healthy, older, and patient populations (O'Donovan 2010; Powell 2019), including those with specific health problems such as stroke (Billinger 2014). Exercise and physical activity are widely promoted during life after stroke. The current evidence in the previous version of this review indicates that exercise can reduce disability and improve physical fitness and aspects of physical function (Saunders 2016). More evidence is needed to examine the effects of different types and doses of exercise and to examine the effects on a wide spectrum of outcome measures.

What is physical fitness training?

Exercise refers to a subset of physical activity that is planned, structured, repetitive, and deliberately performed to train (improve) one or more components of physical fitness, physical performance, or health (USDHHS 2018). 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 can be defined as, "The ability to carry out daily tasks with vigor and alertness, without undue fatigue and with ample energy to enjoy leisure-time pursuits and meet unforeseen emergencies" (USDHHS 2018). The most important components of physical fitness are those directly connected to energy expenditure and muscular work.

- Cardiorespiratory fitness: this is the ability to transport and use oxygen and is usually expressed as maximal oxygen uptake (VO₂ max). Cardiorespiratory fitness confers 'endurance', that is the ability to perform physical activity for an extended period.
- Musculoskeletal fitness: the ability of muscle to generate force can be expressed in terms of strength and power. 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. 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 (e.g. relative amounts of fat and fat-free mass).

Determinants of fitness

Sex has a direct influence on indices of physical fitness, which tends to be lower in women compared with men. For example, in women cardiorespiratory fitness is around 27% lower than men of the same age throughout the lifespan (Kaminsky 2015).

Increasing age results in deterioration of fitness; this is a normal consequence of healthy ageing. For example, cardiorespiratory fitness shows a linear decline of approximately 1% per year throughout adulthood (20 to 80 years of age; Kaminsky 2015). Muscle strength is well retained up to the age of around 50 to 60

years, after which it deteriorates quickly at approximately 1.6% per year (Kemmler 2018).

Physical inactivity causes rapid loss of musculoskeletal fitness and cardiorespiratory fitness. For example, just 10 days of bed rest causes rapid loss of muscle strength (-13.2%), muscle power (-14%), and cardiorespiratory fitness (-12%) (Kortebein 2008).

Secondary consequences of chronic disease, such as inflammation, are also associated with loss of muscle strength and muscle mass (Degens 2006; Westbury 2018).

Functional importance of fitness

When the level of fitness is low (irrespective of the reason) physical activities may either become limited by fatigue or impossible to perform (Young 2001). Levels of fitness below the level needed to perform instrumental activities of daily living (ADL) may mean that these become impossible and this then may risk loss of independence. For example, cardiorespiratory fitness below 15 to 18 mL/kg/min is associated with loss of independence (Shephard 2009). Similarly muscle strength of various lower limb muscles below threshold values prevent older people performing ADL (Hasegawa 2008). Even without dropping below such threshold values reduced fitness is associated with reduced function. For example, low muscle power output in older people is associated with reduced mobility and an increased risk of falls (McKinnon 2017).

Description of the condition

The classic definition of stroke is "rapidly developing clinical signs of focal (at times global) disturbance of cerebral function, lasting more than 24 hours or leading to death with no apparent cause other than that of vascular origin" (Hatano 1976). A stroke is caused by an interruption to the circulation of the brain, either by a clot (ischaemic stroke) or a bleed (haemorrhagic stroke). Stroke can lead to death or cause disability; it can affect the way people move, think, feel, and behave. Globally, in 2016, stroke was the second leading cause of death and second leading cause of disability-adjusted life years (WHO 2018), with around 50% of stroke survivors experiencing long-term disability (Mackay 2004).

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 physical and psychological complications occur after stroke (Indredavik 2008; Langhorne 2000). Levels of physical activity are low in people with stroke in both inpatients (Bernhardt 2004; Bernhardt 2007), and also in community-dwelling stroke survivors (English 2014). In community-dwelling stroke survivors cardiorespiratory fitness ranges from 26% to 87% of the value expected in age- and gender-matched healthy people (Smith 2012). Muscle strength (Gerrits 2009; Horstman 2008), and muscle power (Saunders 2008), are also impaired with bilateral deficits, which suggest the influence of physical inactivity in addition to hemiparesis.

The level of post-stroke fitness may be low due to a range of factors directly and indirectly connected to stroke.

- Pre-stroke fitness levels may already be low because of physical inactivity (Lee 2002), and low levels of fitness (Kurl 2003), and are both risk factors for stroke. Stroke is not a disease restricted

to elderly people; two-thirds of strokes are in people aged under 70 years (Feigin 2017); however, the effects of increasing age will have a part to play as will the presence of comorbid conditions.

- Direct neurological effects of stroke reduce the muscle mass available for activation (e.g. hemiparesis).
- Post-stroke physical inactivity 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 (Flansbjerg 2006; Patterson 2007; Saunders 2008).

Therefore, when levels of physical fitness are low after stroke (for whatever reason) this may exacerbate or cause some common post-stroke physical limitations (Saunders 2013a). 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

The basic structure and content of all physical fitness training interventions are guided by a common set of well-established principles (ACSM 2011). The design of physical fitness training interventions varies across healthy people, older people, and different patient groups.

Type of training

Most physical fitness training programmes are classified as either:

- cardiorespiratory training (to improve cardiorespiratory fitness);
- resistance training (to improve muscular strength and muscle power); or
- 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 that 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, firstly, the amount of training (e.g. programme length (weeks, months), frequency (days/week), and duration (minutes) of sessions), and secondly, the intensity of training (rate of work or effort made).

It is the manipulation of type, mode, and dose that defines an exercise prescription; however, the effectiveness is also influenced by some other critically important principles of training (ACSM 2011), 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 2018). 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 (Bangsbo 2019; 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, for example by 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.

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 people with stroke (French 2016). Fitness training is repetitive in nature and is commonly task-related in nature, therefore participation in it may lead to functional benefits even when 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). Fitness training is commonly delivered in a group setting; therefore, in these instances simply participating in physical fitness training may be beneficial, particularly when group activities are delivered in a non-medical environment (Young 2019).

Cognitive function impairments are common after stroke and are predicted by low indices of physical fitness (Lee 2014). In older adults (aged over 65 years) with cognitive impairment, exercise interventions have been shown to improve cognitive function (Heyn 2004). Further, in people with stroke and traumatic brain injury, systematic review evidence suggests that exercise exerts a positive effect on global cognitive function, though further studies are required (Vanderbeken 2017). Therefore, there is some rationale that fitness training interventions could benefit cognition in people with stroke.

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 exercise interventions can reduce blood pressure (Cornelissen 2013; Smart 2019); improve vascular risk factors in obesity (Shaw 2006), and type II diabetes (Thomas 2006); improve cardiovascular mortality (Anderson 2016); and improve depressive symptoms regardless of health status (Gordon 2018). Therefore, post-stroke cardiorespiratory and resistance training could reduce morbidity

and mortality through secondary prevention of stroke and comorbid disease

In summary, physical fitness training does not simply offer 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, as well as benefits there may also be risks associated with fitness training 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 three key areas.

- The range of possible benefits is not fully explored. The top 10 most important research priorities for 'life after stroke' have been defined by a partnership of patients, carers, and clinicians (Pollock 2012). These include, in order of priority, the need to identify interventions for 1) cognition, 2) coming to terms with long-term consequences, 3) aphasia, 4) arm function, 5) vision, 6) fatigue, 7) balance, gait and mobility, 8) speech, 9) confidence, and 10) exercise interventions for function, quality of life, and secondary prevention. Exercise interventions may have a beneficial role in at least four of these domains (1, 4, 7 and 10; Saunders 2014a).
- Enough evidence is available to implement fitness training for stroke, the optimal exercise prescription has yet to be defined (Mead 2011).
- Fitness training has a plausible benefit for secondary stroke prevention but there still remains a lack of direct evidence about secondary stroke and cardiovascular risk.

There has been sustained interest in physical fitness interventions for stroke evidenced by the studies included in previous updates of this review: Saunders 2004a (12 studies), Saunders 2009 (24 studies), Brazzelli 2011b (32 studies), Saunders 2013b (45 studies), and Saunders 2016 (58 studies). Considering the degree of incomplete knowledge, the high level of interest, and the clinical relevance of this review for improving patient care, we believe it is essential to continue updating the earlier version of this review.

OBJECTIVES

The primary objectives of this updated review were to determine whether fitness training after stroke reduces death, death or dependence, and disability.

The secondary objectives were to determine the effects of training on adverse events, risk factors, physical fitness, mobility, physical function, health status and quality of life, mood, and cognitive function.

METHODS

Criteria for considering studies for this review

Types of studies

All studies described as randomised controlled trials (RCTs), single-blinded or open, which 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. For studies with multiple follow-up phases we analysed data from the longest follow-up period.

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 (e.g. cognitive tasks or sham training). Therefore, we deemed the following comparisons suitable for inclusion where 'usual care' refers to inpatient hospital care or other standard rehabilitation given to all stroke patients delivered as a normal part of stroke care in the region in which the studies were performed:

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

We included full-text reports of published and unpublished studies. Studies communicated via conference proceedings alone or by abstract alone provide only limited data and do not allow full assessment of study quality. Therefore, we did not exclude any studies that were potentially relevant but we retained them as 'awaiting classification' pending further information or full publication. We did not exclude studies 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 additional publications.

Types of participants

Adult stroke survivors who were considered suitable for fitness training by the studies' authors; we used the study authors' definition of stroke. Participants were considered eligible irrespective of the time since stroke onset.

Types of interventions

We included the following interventions.

Cardiorespiratory training interventions

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 (e.g. treadmill, cycling, rowing) or by utilising modes of activity such as walking or climbing stairs.

Resistance training interventions

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 interventions

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 studies 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 sought measures of adherence to training since this can modify the dose of training received by study 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 studies that focused on different types of standard rehabilitation techniques but did not include a physical fitness training component. We also excluded studies 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 studies investigating virtual reality approaches.

We excluded studies that 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.

Control interventions

The control interventions included: 1) usual care; 2) no intervention or waiting-list control; or 3) attention control, sham intervention, or adjunct intervention. The types of comparison are as follows.

- Physical fitness training interventions versus no intervention or waiting-list control
- Physical fitness training interventions versus attention control, sham intervention or adjunct intervention
- Physical fitness training interventions plus usual care versus no intervention or waiting-list control plus usual care
- Physical fitness training interventions plus usual care versus attention control, sham intervention or adjunct intervention plus usual care

Types of outcome measures

We anticipated that existing studies 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 outcomes

- Death: numbers of deaths from all causes
- Death or dependence: composite outcome where dependence is classified as having a Barthel Index score of less than 20 or modified Rankin Scale score of 3, 4, or 5 (Lindley 1994).
- Disability: assessed by functional scales such as the Functional Independence Measure (Hamilton 1994); Barthel Index (Collin 1988); Rivermead Mobility Index (Collen 1991); 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).

In the International Classification of Functional Disability and Handicap (ICF) classification the term 'disability' is an umbrella term for impairments and activity limitations (WHO 2001). In this 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 outcomes

- 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; glucose tolerance; body mass index (BMI)
- Physical fitness: maximum or peak oxygen uptake (peak VO₂); muscle strength and power output
- Mobility: gait speed (maximum or preferred speed); gait capacity (e.g. Six-Minute Walk Test (6-MWT)); Functional Ambulation Categories
- Physical function: balance; stair climbing; weight bearing; Timed Up and Go test
- Health status and quality of life: any relevant scale such as the Short Form 36 Health Survey Questionnaire (Ware 1992), 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)
- Cognitive function: any subscale of disability or health status outcomes that relate to cognitive function, or any specific cognition instrument, for example the Repeatable Battery for the Assessment of Neuropsychological Status (Randolph 1998); the Montreal Cognitive Assessment (MOCA; Nasreddine 2005).

Search methods for identification of studies

See the methods for the [Cochrane Stroke Specialised Register](#). We searched for relevant studies in all languages and arranged translation of relevant papers where necessary.

Electronic searches

The search strategies used for this review have been significantly revised and updated to account for newly identified relevant terms and to improve sensitivity and specificity. All discontinued versions of search strategies used are still available in the previous version of this review (Saunders 2016).

We searched the [Cochrane Stroke Specialised Register](#) and the following electronic databases.

- Cochrane Central Register of Controlled Trials (CENTRAL; 2018, Issue 1; [Appendix 1](#)) in the Cochrane Library;
- MEDLINE Ovid (from 1946 to July 2018; [Appendix 2](#));
- Embase Ovid (from 1974 to July 2018; [Appendix 3](#));
- CINAHL EBSCO (Cumulative Index to Nursing and Allied Health Literature; from 1937 to July 2018; [Appendix 4](#));
- SPORTDiscus EBSCO (from 1949 to July 2018; [Appendix 5](#));
- PsycINFO Ovid (from 1806 to July 2018; [Appendix 6](#));
- Conference Proceedings Citation Index- Science (Web of Science; from 1990 to July 2018; [Appendix 7](#));
- PEDro (Physiotherapy Evidence database (www.pedro.fhs.usyd.edu.au/index.html) July 2018; [Appendix 8](#)).

The search strategy includes Cochrane Highly Sensitive Search Strategies for identification of RCTs, as described in the *Cochrane Handbook for Systematic Reviews of Interventions* ([Lefebvre 2011](#)), and Cochrane Stroke's search strategies for the identification of 'stroke' studies in respective databases and other resources. These are supplemented with strategies to identify exercise interventions. We have added PsycINFO to the search resources in this update in recognition of the increasing interest in cognition outcomes.

In order to identify other published, unpublished, and ongoing studies we searched for ongoing studies using the following registries.

- US National Institutes of Health Ongoing Trials Register ClinicalTrials.gov (clinicaltrials.gov/)
- World Health Organization International Clinical Trials Registry Platform (ICTRP; apps.who.int/trialsearch)

Searching other resources

We searched for theses in the following (using the search terms in [Appendix 9](#)):

- ProQuest Dissertations and Theses Global (www.proquest.com/products-services/pqdtglobal.html);

- British Library ETHOS (e-theses online service; www.bl.uk/ethos-and-theses);
- DART-Europe E-theses PortAL (www.dart-europe.eu/basic-search.php).

We searched grey literature using:

- Google Scholar

We checked the bibliographies of included studies and performed forward citation tracking of all included studies (and other relevant studies) using Google Scholar (scholar.google.co.uk/) for further references to relevant studies.

We contacted researchers in the field to obtain additional information on relevant studies and contacted original authors for clarification and further data if study reports were unclear.

Data collection and analysis

Selection of studies

Two review authors (DS or MS or SH or DC or SK or LJ or HJ) independently screened titles and abstracts of the unique references obtained as a result of our searching activities. We excluded studies that two review authors classified as 'exclude'; we retained all other studies for full-text screening.

We retrieved the full-text articles for the remaining references and two review authors (DS or MS or SH or DC or SK or LJ or HJ) independently screened the full-text articles to identify studies for inclusion, and identify and record reasons for exclusion of the ineligible studies. We resolved any disagreements through discussion or, if required, we consulted a third review author (GM or MB). We collated multiple reports of the same study so that each study, not each reference, was the unit of interest in this review.

We used the [Covidence](#) tool to carry out the selection process and to record this in sufficient detail to complete a PRISMA flow chart ([Moher 2009](#); [Figure 1](#)), and the 'Characteristics of excluded studies' table.

Figure 1. Study flow diagram for the current update of this review

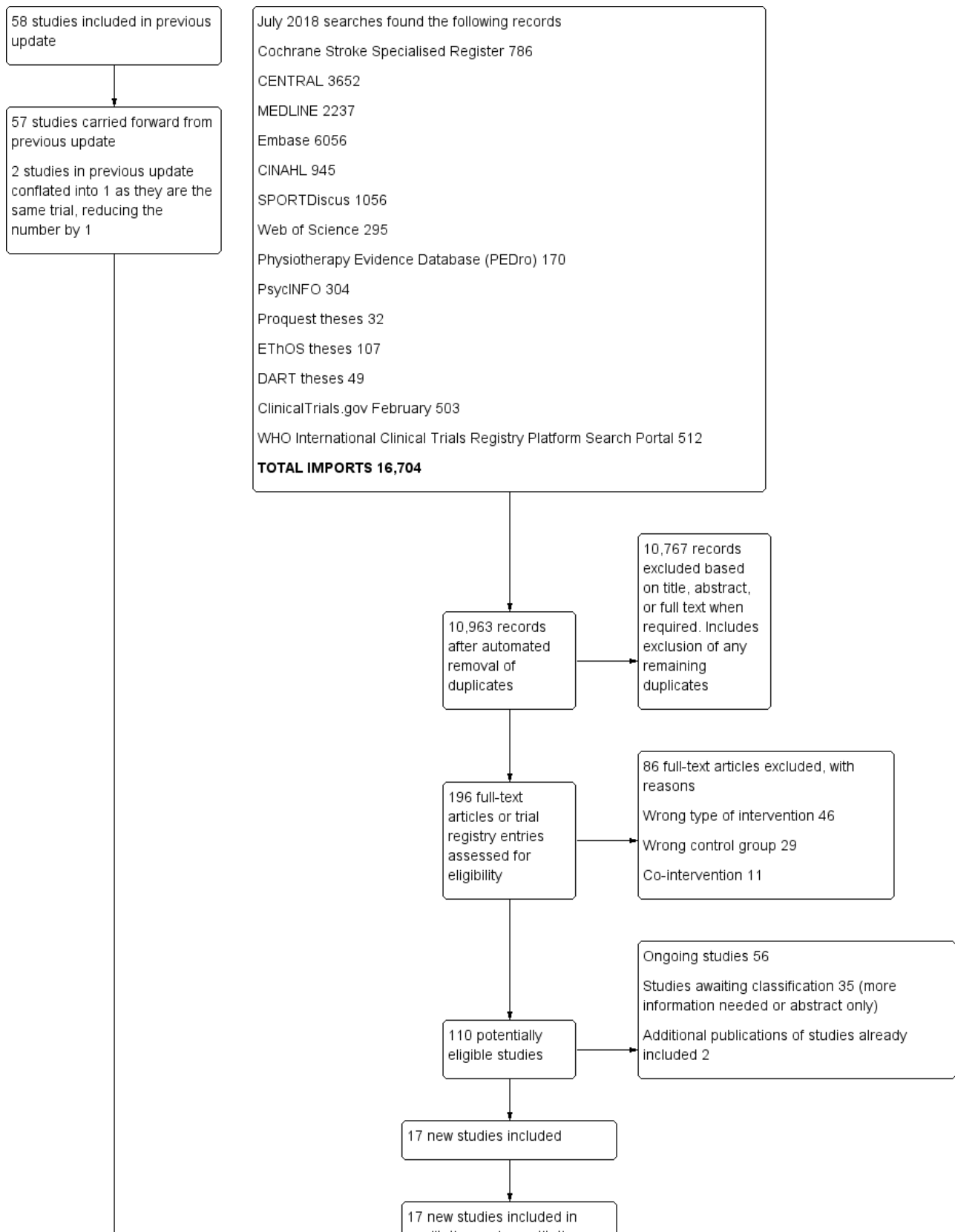
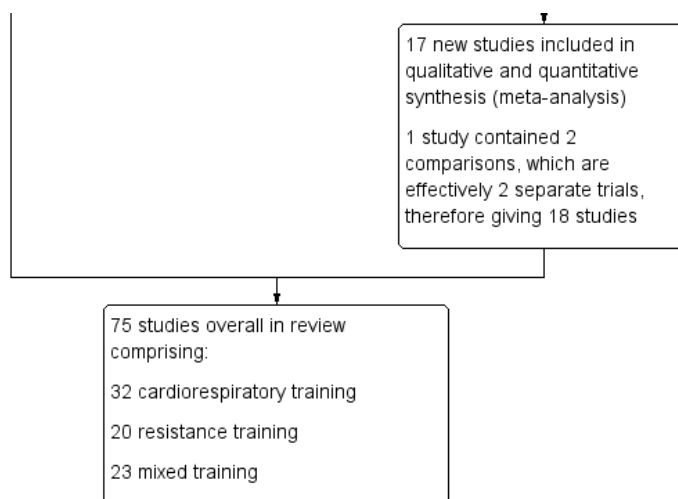


Figure 1. (Continued)



We included studies irrespective of publication status providing available reports had sufficient detail to apply eligibility criteria and perform quality assessment.

We retained potentially relevant studies with insufficient information to either include or exclude in the '[Characteristics of studies awaiting classification](#)' table.

Data extraction and management

One review author (DS or MS or SH or DC or SK or LJ or HJ) extracted data from each included study and entered the outcome data directly into Review Manager 5 ([Review Manager 2014](#)). A second review author (DS or MS or SH or DC or SK or LJ or HJ) then cross-checked all entered data. We contacted study authors to obtain any missing data if required.

The domains for data extraction for each study included but were not limited to:

- publication details: authors, year of publication, publication status (published, unpublished, or ongoing), citation of other relevant studies;
- 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 study, setting in which the study 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), outcome data, reported outcomes, missing outcomes.

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

Assessment of risk of bias in included studies

Two review authors (DS, MS, SH and either LJ, SH, MK, HJ) independently assessed each study using Cochrane's tool for assessing risk of bias ([Higgins 2017](#)). We resolved any disagreements by discussion or by involving another review author (GM or MB). We assessed the risk of bias for each of the standard domains in the Cochrane 'Risk of bias' tool with the following exceptions and amendments.

Blinding of participants (performance bias and detection bias)

Participant blinding is often impossible to achieve in behavioural interventions. However, we considered studies to be at low risk of bias if the study authors described some attempt to disguise the true purpose of the comparisons being made (e.g. describing a study as a comparison of two different interventions or some kind of 'sham' intervention). We considered studies to be at high risk of bias if there was an imbalanced exposure such as would occur with no control intervention or a waiting-list control.

Incomplete outcome data (attrition bias)

We assessed this domain twice, once at the end of intervention and once at the end of follow-up. We considered studies to be at high risk of bias where we judged imbalanced losses to have occurred coupled with a per-protocol analysis. If overall participant attrition was 20% or greater of those randomised, we considered a study at high risk of bias ([Schulz 2002](#)), irrespective of distribution of losses, reasons given or analytical approach (e.g. imputations, intention-to-treat).

Other bias

We considered 'Risk of bias' items relevant to cluster-RCTs in this domain.

Imbalanced exposures

We included this additional 'Risk of bias' item because an imbalanced exposure could exaggerate benefits (or harms) in a way where it is impossible to separate the effects of the intervention content from the effects of attention. Therefore, strictly speaking, this is a confounding effect rather than a bias effect, but it is appropriate to record it and analyse it in the same way as other bias items. We considered studies to be at low risk of bias if a 'dose' of exposure or attention was provided in the control group that matched that in the intervention groups (e.g. attention control or sham intervention). We considered studies to be at high risk of bias if the control group received no control intervention including being allocated to a waiting-list control.

In all categories when there was insufficient information to assign either a 'low risk' or 'high risk' of bias, we contacted the study authors and asked them for clarification. Where we could not obtain missing supplementary information, we recorded an 'unclear' risk of bias. We recorded 'high', 'low' or 'unclear' risk of bias along with a descriptive justification for our judgment in the 'Risk of bias' tables. We presented the data in 'Risk of bias' summary graphs.

Measures of treatment effect

Dichotomous data

For dichotomous outcome data we calculated odds ratios (OR) and 95% confidence intervals (CIs).

Continuous data

Where possible, we presented the effects of interventions on all continuous outcome data as a mean difference (MD) and 95% CIs. In instances where studies used different scales to measure the same clinical outcome, we presented the data as standardised mean difference (SMD) and 95% CIs.

Unit of analysis issues

Cluster-RCTs: if clustering as a unit of allocation was not controlled by the study authors, we implemented this, where appropriate, during meta-analysis using the methods described in the *Cochrane Handbook for Systematic Reviews of Interventions* (Deeks 2017).

Cross-over studies: the data can be truncated after the first iteration of a cross-over study and treated as an RCT. We ignored subsequent iterations because of the risk of carry-over effects.

Lag-control or waiting-list studies: we dealt with these in the same way as cross-over studies. We ignored the delayed or waiting-list iteration of the study because of the risk of carry-over effects.

In studies with more than one relevant control group, we used only one control group within a meta-analysis. We performed sensitivity analysis to examine the relative influence of selecting each group on meta-analysis results. Where data from multiple control groups were similar we considered combining the control group data using the methods described in section 16.5.4 of the *Cochrane Handbook for Systematic Reviews of Interventions* (Higgins 2011).

In studies with more than one relevant intervention group, we included all intervention groups as separate comparisons within a meta-analysis, with the control group data replicated across all comparisons, but with the control group sample size divided evenly

across among the comparisons to prevent inflation of overall sample size.

The principal time points for outcome measurement were: 1) at the end of intervention, and 2) at the end of follow-up.

Dealing with missing data

Missing participants: we account for the nature and extent of missing participant data (e.g. losses to follow-up) and how the study authors dealt with this (e.g. intention-to-treat analysis) via one of the 'Risk of bias' assessments ([Assessment of risk of bias in included studies](#); incomplete outcome data).

Incomplete reporting: if RCTs had missing information we contacted the study authors to request this. Where there was insufficient information to include or exclude a potentially relevant study and this could not be retrieved we retained the study in the 'Characteristics of studies awaiting classification' section in case the information emerges at a later date.

Assessment of heterogeneity

We assessed heterogeneity using the I^2 statistic (Higgins 2003), presented as part of the forest plots in [Review Manager 2014](#). We interpreted values of I^2 statistic exceeding 50% as indicating substantial heterogeneity. In these cases we investigated potential causes of variation by inspecting study effects and by using subgroup and sensitivity analysis if appropriate.

Assessment of reporting biases

The comprehensive search strategy helped ameliorate reporting biases.

When meta-analyses included a minimum of 10 studies, we used a funnel plot (treatment effect versus study size).

Data synthesis

Where we considered studies to be sufficiently similar, we conducted a meta-analysis by pooling the appropriate data using [Review Manager 2014](#).

We used random-effects meta-analysis models to calculate measures of effect and 95% CIs at the end of intervention and the end of follow-up for each outcome measure with sufficient suitable data to pool.

Summary of findings and assessment of the certainty of the evidence

We used GRADE to assess the evidence for the primary outcomes death, or dependence, and disability, plus the secondary outcomes relating to physical fitness (cardiorespiratory fitness, muscle strength), mobility (preferred walking speed, gait endurance), and physical function (Berg balance scores, three-metre Timed Up and Go). We performed these analyses and presented the results in a 'Summary of findings' table generated using [GRADEpro GDT](#) software.

Subgroup analysis and investigation of heterogeneity

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 for all outcomes in the following main subgroups:

- type of training (cardiorespiratory versus resistance training versus mixed training);
- time of training (during usual care versus after usual care).

The complexity of exercise interventions and low numbers of studies in the meta-analyses meant that subgroup analyses were difficult to perform and difficult to interpret.

Sensitivity analysis

We planned to explore for all outcomes the influence of studies that were confounded by increased training time.

RESULTS

Description of studies

Results of the search

The previous version of this review included 58 studies, involving 2797 participants (Saunders 2016). In this updated version we used the updated electronic searches and other relevant searches in July 2018. We screened a total of 16,704 citations; this includes duplicates.

We identified 29 new systematic reviews of exercise interventions and screened these for relevant studies (Abbasian 2018; Ammann 2014; Austin 2014; Baldwin 2016; Bonini-Rocha 2018; Boyne 2017; Chen 2016; Crozier 2018; D'Isabella 2017; Dorsch 2018; English 2017; Hasan 2016; Iatridou 2018; Ilunga Tshiswaka 2018; Jeon 2015; Kendall 2016; Mehrholz 2017; Oberlin 2017; Plummer 2018; Salter 2016; Saltychev 2016; Tally 2017; Van Crieckinge 2019; Van Duijnhoven 2016; Vanderbeken 2017; Vloothuis 2016; Wang 2018; Wist 2016; Zheng 2016).

The results of our searching activities are summarised in Figure 1. We applied the eligibility criteria, with the following results.

- We excluded 86 studies that did not meet the eligibility criteria (see Characteristics of excluded studies table).
- We identified 56 new ongoing studies (see Characteristics of ongoing studies table).
- We identified 35 studies for which we require more information to establish eligibility, including those for which only the abstract is currently available (see Characteristics of studies awaiting classification table).
- We identified one study that was a secondary analysis of two studies already included in the previous update. These two previously included studies, authored by Aidar in 2012 and in 2014, have since been recognised as the being same trial and are now conflated along with their more recent publication to be collectively referred to as Aidar 2016.
- We identified one study that was a secondary analysis of a study included in the previous update (Aidar 2018).
- We identified 17 new studies that met the eligibility criteria.

With regard to ongoing studies and those awaiting classification in the previous version of this review:

- of the 13 ongoing studies, four have been completed and met the eligibility criteria and we have added them to the included

studies (Dean 2018; Ivey 2017; Sandberg 2016; Vanroy 2017). The remainder either completed but we excluded them as irrelevant, were terminated, or the data were never published or made available;

- of the nine abstract-only studies awaiting classification, one is now included (Buyukvural 2015). The remainder have been excluded or have no full-text paper published or made available;
- of the three full publication studies awaiting classification that need further information to include or exclude, only one author team responded and we were able to exclude the data.

Included studies

We included 17 new studies in this update (Arabzadeh 2018; Buyukvural 2015; Coroian 2018; Dean 2018; Fernandez-Gonzalo 2016; Furnari 2014; Ivey 2017; Kim 2016a; Kim 2017a; Knox 2018; Mao 2015; Moore 2015; Sandberg 2016; Taylor-Pilliae 2014; Topcuoglu 2015; Vanroy 2017; Zou 2015).

Two separate studies in the previous update (Saunders 2016), have emerged as being the same study. These have now been conflated with a further recent publication and together these now form Aidar 2016.

One of the 17 included studies (Knox 2018), includes a strength training intervention group and a mixed training intervention group, both of which we included and analysed as two separate studies each sharing the same control group (effectively giving 18 new studies). For clarity, we counted the control group ($n = 48$) once to calculate the total number of unique participants in the review ($n = 3617$). We split the control participants across the resistance training ($n = 24$) and mixed training ($n = 24$) groups where we were comparing them in a meta-analysis. In other meta-analyses, we used all 48 control participants; we ensured that there was no double counting at any point.

In summary, when these adjustments are reconciled, this update includes a total of 75 studies comprising 3617 participants (see Characteristics of included studies table).

Participants

Characteristics

A total of 3617 stroke survivors (sample range 13 to 250 individuals) were randomised to physical fitness training or control interventions in the 75 included clinical studies. The mean age of the participants was approximately 62 years. The mean time since onset of symptoms ranged from 8.8 days in studies assessing participants before discharge from hospital (Richards 1993), to 7.7 years in studies assessing participants after hospital discharge (Teixeira 1999).

Two studies recruited non-ambulatory stroke survivors (Richards 1993; Wang 2014), three studies recruited both ambulatory and non-ambulatory participants (Bateman 2001; Cooke 2010; Lennon 2008), six studies did not report this information (Donaldson 2009; Lee 2013a; Verheyden 2009; Winstein 2004; Topcuoglu 2015; Zou 2015), and all the remaining studies recruited ambulatory stroke survivors.

Sample size

Of the 75 included studies:

- 16 studies had 20 participants or fewer ([Arabzadeh 2018](#); [Bale 2008](#); [Coroian 2018](#); [Cuviallo-Palmer 1988](#); [da Cunha 2002](#); [Donaldson 2009](#); [Duncan 1998](#); [Glasser 1986](#); [James 2002](#); [Kim 2001](#); [Kim 2016a](#); [Letombe 2010](#); [Moore 2010](#); [Richards 1993](#); [Smith 2008](#); [Teixeira 1999](#));
- four studies had over 100 participants ([Ada 2013](#) 102 participants; [Gordon 2013](#) 128 participants; [Jin 2013](#) 128 participants; [Van de Port 2012](#) 250 participants);
- one publication had over 100 participants ([Knox 2018](#) 144 participants) but is counted as two studies in this review;
- 54 remaining studies recruited between 21 and 100 participants.

Interventions

Cardiorespiratory training

Thirty-two studies with a total of 1631 randomised participants (range 15 to 128 individuals) examined cardiorespiratory training ([Ada 2013](#); [Aidar 2018](#); [Bateman 2001](#); [Cuviallo-Palmer 1988](#); [da Cunha 2002](#); [Eich 2004](#); [Glasser 1986](#); [Globas 2012](#); [Gordon 2013](#); [Ivey 2010](#); [Ivey 2011](#); [Jin 2013](#); [Kang 2012](#); [Katz-Leurer 2003](#); [Kim 2014](#); [Kuys 2011](#); [Lennon 2008](#); [MacKay-Lyons 2013](#); [Mao 2015](#); [Moore 2010](#); [Mudge 2009](#); [Park 2011](#); [Pohl 2002](#); [Potempa 1995](#); [Salbach 2004](#); [Sandberg 2016](#); [Smith 2008](#); [Takami 2010](#); [Topcuoglu 2015](#); [Vanroy 2017](#); [Wang 2014](#); [Yang 2014](#)). Details of the nature and dose of the cardiorespiratory interventions are summarised in [Table 1](#).

Two of these studies assessed circuit training ([Mudge 2009](#); [Salbach 2004](#)).

One study assessed aquatic training ([Aidar 2018](#)).

Twelve studies used some form of ergometry: seven assessed cycle ergometry ([Bateman 2001](#); [Jin 2013](#); [Katz-Leurer 2003](#); [Lennon 2008](#); [Potempa 1995](#); [Sandberg 2016](#); [Yang 2014](#)), two assessed seated/recumbent cycle ergometry ([Vanroy 2017](#); [Wang 2014](#)), two assessed a 'Kinetron' ergometer ([Cuviallo-Palmer 1988](#); [Glasser 1986](#)), and one assessed arm cranking ergometer ([Topcuoglu 2015](#)).

Seventeen studies focused on walking using treadmills ([da Cunha 2002](#); [Eich 2004](#); [Globas 2012](#); [Ivey 2010](#); [Ivey 2011](#); [Kang 2012](#); [Kuys 2011](#); [MacKay-Lyons 2013](#); [Mao 2015](#); [Moore 2010](#); [Pohl 2002](#); [Smith 2008](#); [Takami 2010](#)), overground walking ([Gordon 2013](#); [Kim 2014](#); [Park 2011](#)), or a combination of treadmill and overground walking ([Ada 2013](#)).

The training programmes comprised regular weekly sessions of sufficient duration (usually longer than 20 minutes), the exercise intensity was clearly described in 20 of the 32 included studies. In 16 studies the cardiorespiratory training started after usual care, while in 16 studies it started during usual care. In five of these studies participants were recruited in the acute phase of stroke, less than one month post-stroke ([Cuviallo-Palmer 1988](#); [da Cunha 2002](#); [MacKay-Lyons 2013](#); [Sandberg 2016](#); [Takami 2010](#)).

Three of the included cardiorespiratory training studies had more than one intervention group that met the eligibility criteria; these compare two different durations, intensities, and modes of training. Each of these studies therefore has two entries when included in any meta-analyses, each sharing 50% of the number of participants in the single control group from each study.

- [Ada 2013](#): Group 1 - duration four months' training; Group 2 - duration two months' training
- [Pohl 2002](#): Group 1 - intensity high due to rapid progression; Group 2 - intensity lower due to limited progression
- [Takami 2010](#): Group 1 - mode: backward walking on treadmill; Group 2 - mode: forward walking on treadmill

Resistance training

Twenty studies with a total of 779 randomised participants (range 18 to 93 individuals) assessed the effects of resistance training ([Aidar 2016](#); [Arabzadeh 2018](#); [Bale 2008](#); [Buyukvural 2015](#); [Coroian 2018](#); [Fernandez-Gonzalo 2016](#); [Flansbjerg 2008](#); [Inaba 1973](#); [Ivey 2017](#); [Kim 2001](#); [Knox 2018](#); [Lee 2013a](#); [Lee 2013b](#); [Ouellette 2004](#); [Sims 2009](#); [Son 2014](#); [Taylor-Pilliae 2014](#); [Verheyden 2009](#); [Winstein 2004](#); [Zou 2015](#)). Details of the nature and dose of the resistance training intervention studies are summarised in [Table 2](#).

All employed muscle contractions resisted by weights, exercise machines, or elastic devices. One study trained the upper limbs ([Winstein 2004](#)), one trained the trunk ([Verheyden 2009](#)), two studies trained both the upper and lower limbs ([Aidar 2016](#); [Sims 2009](#)), one was unclear ([Taylor-Pilliae 2014](#)), and the remaining studies involved the lower limbs only. Most programmes were short (less than 12 weeks) apart from [Aidar 2016](#), [Fernandez-Gonzalo 2016](#), [Ivey 2017](#), [Knox 2018](#), [Ouellette 2004](#), and [Taylor-Pilliae 2014](#) (12 weeks). Twelve studies started resistance training after usual care ([Aidar 2016](#); [Fernandez-Gonzalo 2016](#); [Flansbjerg 2008](#); [Ivey 2017](#); [Kim 2001](#); [Knox 2018](#); [Lee 2013a](#); [Lee 2013b](#); [Ouellette 2004](#); [Sims 2009](#); [Son 2014](#); [Taylor-Pilliae 2014](#); [Zou 2015](#)), whilst eight studies started it during usual care ([Arabzadeh 2018](#); [Bale 2008](#); [Buyukvural 2015](#); [Coroian 2018](#); [Inaba 1973](#); [Verheyden 2009](#); [Winstein 2004](#)). Only [Winstein 2004](#) recruited participants during the acute phase of stroke (less than one month post-onset).

Three of the studies appear similar in terms of participants and interventions and have a shared authorship ([Lee 2013a](#); [Lee 2013b](#); [Son 2014](#)). Although the sample sizes are different there is a possibility that these three publications share some of the same participants. We have not had a response to queries to establish this.

Mixed training

Twenty-three studies with a total of 1207 randomised participants (range 13 to 250 individuals) assessed the effects of mixed training ([Cooke 2010](#); [Dean 2018](#); [Donaldson 2009](#); [Duncan 1998](#); [Duncan 2003](#); [Furnari 2014](#); [Galvin 2011](#); [James 2002](#); [Kim 2016a](#); [Kim 2017a](#); [Knox 2018](#); [Langhammer 2007](#); [Letombe 2010](#); [Mead 2007](#); [Moore 2015](#); [Richards 1993](#); [Richards 2004](#); [Shin 2011](#); [Teixeira 1999](#); [Toledano-Zarhi 2011](#); [Van de Port 2012](#); [Yang 2006](#); [Zedlitz 2012](#)). Details of the nature and dose of the mixed training interventions are summarised in [Table 3](#).

The modes of exercise are quite diverse since these comprise circuit training or various combinations of walking, treadmill training, and resistance training. All interventions contained one or more functionally relevant activity (such as walking). Most programmes were short, with six studies meeting or exceeding 12 weeks ([Duncan 1998](#); [Knox 2018](#); [Mead 2007](#); [Moore 2015](#); [Van de Port 2012](#); [Zedlitz 2012](#)). Nine studies occurred during usual care; five of these recruited participants in the acute phase of stroke, less than one month post-onset ([Galvin 2011](#); [Kim 2016a](#); [Letombe 2010](#); [Richards](#)

1993; Toledano-Zarhi 2011), and four at a later stage of care (Furnari 2014; Kim 2017a; Richards 2004; Shin 2011).

Adherence to the intervention

We defined adherence to the interventions 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 33 of the 75 included studies (Ada 2013; Aidar 2016; Bateman 2001; Duncan 1998; Duncan 2003; Eich 2004; Fernandez-Gonzalo 2016; Flansbjerg 2008; Globas 2012; Ivey 2017; Kim 2016a; Kuys 2011; Langhammer 2007; MacKay-Lyons 2013; Mead 2007; Moore 2015; Mudge 2009; Park 2011; Ouellette 2004; Pohl 2002; Richards 1993; Richards 2004; Salbach 2004; Sandberg 2016; Sims 2009; Taylor-Pilliae 2014; Toledano-Zarhi 2011; Van de Port 2012; Wang 2014; Winstein 2004; Yang 2006; Zedlitz 2012; Zou 2015). The proportion of attended training sessions ranged from 65% up to 100%. Seven studies measured attendance for the training and the control groups separately and showed similar rates between groups (Bateman 2001; Langhammer 2007; MacKay-Lyons 2013; Mead 2007; Ouellette 2004; Salbach 2004; Taylor-Pilliae 2014). A few other studies 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 study specifically excluded those participants who attended fewer than nine training sessions from the statistical analyses (da Cunha 2002); this prevents an intention-to-treat assessment of results.

Compliance

Compliance with the scheduled exercise programme during training sessions was described in only a few studies.

For cardiorespiratory training interventions, Langhammer 2007 stated that the compliance with the individualised training levels was 'high'; other studies reported that participants 'tolerated' training (Globas 2012; MacKay-Lyons 2013; Pohl 2002; Kim 2016a), or showed no discomfort (Jin 2013). Salbach 2004 maintained that most of the participants completed nine out of 10 circuit training exercises. Mao 2015 recorded compliance data but this was not reported.

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. Dean 2018 reported that 70% of the participants received an "appropriate dose" of training. Information on compliance was not available for the remaining studies. Zedlitz 2012 described the compliance of participants with training as 'good'. Two studies reported good compliance of therapists in delivery of the content of the planned protocol (MacKay-Lyons 2013; Zedlitz 2012).

Comparisons

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

Balanced comparisons

The nature of some of these comparisons allows intervention and control groups to be 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.

- Training plus a proportion of usual care versus usual care
- Training plus usual care versus non-exercise intervention plus usual care
- Training versus non-exercise intervention - after usual care
- Training versus usual outpatient care

Confounded comparisons

Other comparisons make it impossible to have a comparable intervention and control group exposure time (e.g. the 'training versus no intervention' comparison). We described these comparisons in the 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.

- Training plus usual care versus usual care
- Training plus non-exercise intervention versus non-exercise intervention - after usual care
- Training versus no intervention - after usual care

Outcome measures

The included studies recorded outcome measures at the end of the training period (end of intervention), or at any other defined point either within the study duration or after completion of the training programme, or both (scheduled end of follow-up).

Some outcome measures involved continuous data (e.g. assessment scales) with skewed distributions. Due to time and resource constraints we did not attempt to transform these data. We therefore combined continuous skewed data and continuous normal-distributed data.

Excluded studies

The most common reasons for exclusion were interventions that either did not meet the criteria for fitness training ('wrong intervention') or were confounded by other intervention components ('co-intervention') along with inappropriate control groups, such as those with an active physical intervention ('wrong control'). These are documented in the [Characteristics of excluded studies](#) table.

Risk of bias in included studies

Details and justifications for 'Risk of bias' assessments in individual studies are shown in the [Characteristics of included studies](#) table. For Knox 2018, the risk of bias scores are included twice as there are two entirely separate classes of intervention in this study giving a total of 75 studies. As this is a complex review we decided to apply

the 'Risk of bias' assessments to 'all outcomes' for simplicity apart from incomplete outcome data, for which we assessed bias at both

the end of the intervention and the end of follow-up. We present the summary results in [Figure 2](#) and [Figure 3](#).

Figure 2. 'Risk of bias' summary: review authors' judgements about each 'Risk of bias' item for each included study. In studies with no follow-up measurement we did not assess risk of bias for the item labelled 'Incomplete outcome data (attrition bias): end of follow-up'; this results in some blank spaces

	Random sequence generation (selection bias)	Allocation concealment (selection bias)	Blinding (performance bias and detection bias)	Blinding of outcome assessment (detection bias)	Incomplete outcome data (attrition bias): End of intervention	Incomplete outcome data (attrition bias): End of follow-up	Selective reporting (reporting bias)	Other bias	Imbalanced exposure
Ada 2013	+	+	-	+	+	+	+	+	-
Aidar 2016	?	?	-	+	-		?	?	-
Aidar 2018	?	?	-	?	?		?	+	-
Arabzadeh 2018	?	?	?	-	?	+	+	+	+
Bale 2008	?	?	?	+	+		?	+	+
Bateman 2001	+	+	?	+	-	-	?	+	+
Buyukural 2015	?	?	-	?	?		?	?	-
Cooke 2010	+	+	-	+	-	-	+	+	-
Coroian 2018	+	+	?	+	+	?	-	-	+
Cuviello-Palmer 1988	?	?	-	?	+		?	+	+
da Cunha 2002	+	?	?	?	+		?	+	+
Dean 2018	+	+	-	+	+	+	+	?	-
Donaldson 2009	+	+	?	+	+	-	?	+	-
Duncan 1998	?	?	-	?	+		?	+	-
Duncan 2003	?	?	-	+	?	-	?	+	-
Eich 2004	+	?	-	-	+	?	?	+	-
Fernandez-Gonzalo 2016	+	?	-	?	+	+	+	+	-
Flansbjerg 2008	+	-	-	-	+	-	?	+	-
Furnari 2014	?	?	?	+	?	+	?	+	+
Galvin 2011	+	?	-	-	+	?	+	+	-

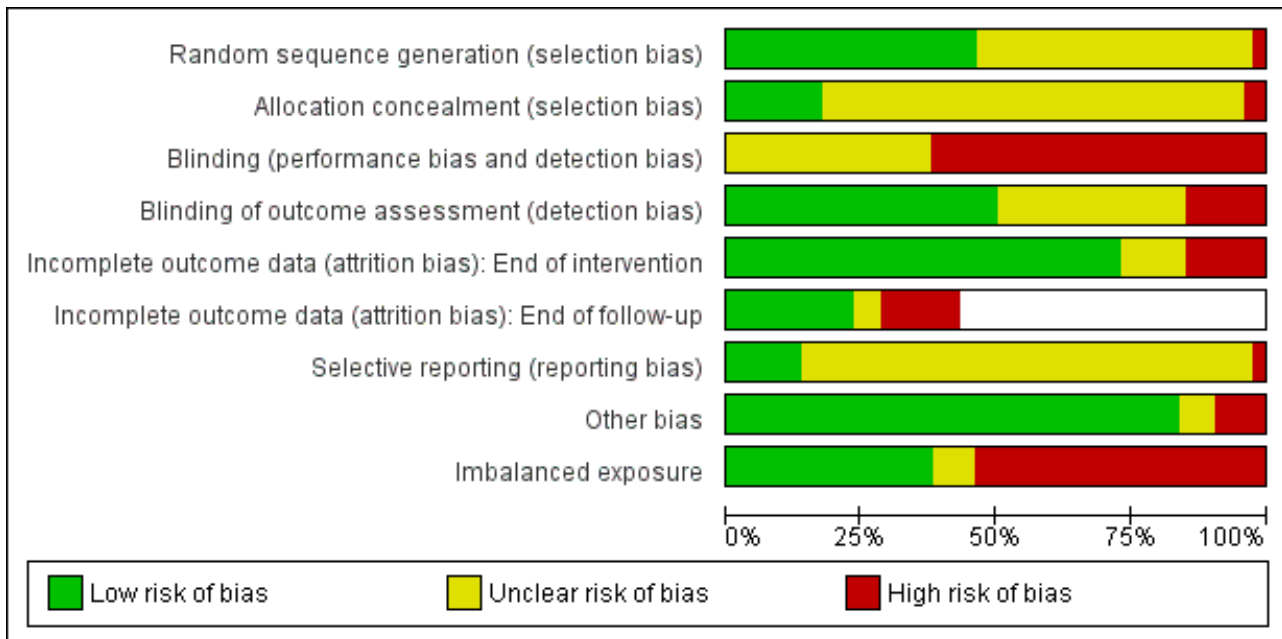
Figure 2. (Continued)

Galvin 2011	+	?	-	-	+	?	+	+	-
Glasser 1986	?	?	-	?	+		?	+	?
Globas 2012	+	?	-	-	+		?	-	?
Gordon 2013	?	?	-	+	+		?	+	+
Inaba 1973	?	?	-	?	-	-	?	+	-
Ivey 2010	+	?	-	-	-		?	+	+
Ivey 2011	-	?	-	?	-		?	+	+
Ivey 2017	-	+	?	-	-		?	+	+
James 2002	+	?	-	?	+		?	+	-
Jin 2013	+	?	?	?	?		?	+	+
Kang 2012	+	?	?	+	+		?	+	+
Katz-Leurer 2003	?	?	?	+	+	?	?	+	?
Kim 2001	+	?	?	+	+		?	+	+
Kim 2014	?	-	-	+	-		?	+	-
Kim 2016a	?	?	-	+	+	+	?	+	-
Kim 2017a	?	?	-	?	+	+	?	+	-
Knox 2018	+	?	-	+	+	+	-	+	-
Kuys 2011	+	?	-	+	+	-	+	+	-
Langhammer 2007	+	?	-	+	+	+	?	+	?
Lee 2013a	?	?	-	?	+		?	+	-
Lee 2013b	?	?	-	?	+		?	+	-
Lennon 2008	+	?	-	?	+		?	+	-
Letombe 2010	?	?	-	?	+		?	+	-
MacKay-Lyons 2013	+	+	?	+	+	-	?	+	+
Mao 2015	?	?	?	+	-	+	?	+	+
Mead 2007	+	+	?	+	+	+	+	+	+
Moore 2010	+	?	-	-	+		?	+	-
Moore 2015	+	+	?	+	+		?	-	+
Mudge 2009	+	?	?	?	+	+	?	+	?
Ouellette 2004	?	?	?	+	+		?	-	+
Park 2011	?	?	-	+	+		?	+	-

Figure 2. (Continued)

Park 2011	?	?	-	+	+		?	+	-
Pohl 2002	?	?	?	?	+		?	+	?
Potempa 1995	?	?	?	?	+		?	+	+
Richards 1993	?	?	?	+	-		?	+	+
Richards 2004	?	?	?	+	+	-	?	+	+
Salbach 2004	+	?	?	-	+		?	+	+
Sandberg 2016	+	?	-	?	?	+	+	+	-
Shin 2011	?	?	?	?	+		?	+	+
Sims 2009	+	+	-	?	+	+	?	-	-
Smith 2008	?	?	-	-	+	+	?	+	-
Son 2014	+	?	?	?	+		?	+	+
Takami 2010	?	?	?	?	?		?	+	+
Taylor-Pilliae 2014	?	?	-	+	+	+	?	?	-
Teixeira 1999	?	?	-	?	+		?	-	-
Toledano-Zarhi 2011	?	?	-	?	+		?	+	-
Topcuoglu 2015	+	?	-	+	+		?	+	-
Van de Port 2012	+	+	?	+	+	+	?	+	-
Vanroy 2017	+	+	-	+	+		?	+	+
Verheyden 2009	?	?	-	+	+		?	+	-
Wang 2014	?	?	-	+	-		?	+	-
Winstein 2004	?	?	-	-	+	-	?	+	-
Yang 2006	?	?	-	+	+		?	+	-
Yang 2014	+	?	-	+	+		?	+	-
Zedlitz 2012	?	?	-	+	?	-	+	-	-
Zou 2015	?	-	?	+	+		?	?	+

Figure 3. 'Risk of bias' graph: review authors' judgements about each 'Risk of bias' item presented as percentages across all included studies. In studies with no follow-up measurement, we did not assess risk of bias for the item labelled 'Incomplete outcome data (attrition bias): end of follow-up'; this results in some blank spaces



Allocation

Randomisation

We assessed 35 out of 75 (47%) of the included studies as having a low risk of selection bias (Ada 2013; Bateman 2001; Cooke 2010; Coroian 2018; da Cunha 2002; Dean 2018; Donaldson 2009; Eich 2004; Fernandez-Gonzalo 2016; Flansbjerg 2008; Galvin 2011; Globas 2012; Ivey 2010; James 2002; Jin 2013; Kang 2012; Kim 2001; Knox 2018 (both comparisons); Kuys 2011; Langhammer 2007; Lennon 2008; MacKay-Lyons 2013; Mead 2007; Moore 2010; Moore 2015; Mudge 2009; Salbach 2004; Sandberg 2016; Sims 2009; Son 2014; Topcuoglu 2015; Van de Port 2012; Vanroy 2017; Yang 2014). We assessed 2 out of 75 (3%) of studies as being at high risk of bias (Ivey 2011; Ivey 2017) and the remaining 39 out of 75 (52%) of studies were assessed as unclear risk of bias because there was not enough information to make a judgement. All studies identified that randomisation had occurred but many did not describe the actual mechanism of how they had achieved this. Therefore, uncertainties remain among a number of studies. Most studies of fitness training are small; therefore, the use of techniques to balance participant numbers (e.g. block randomisation) and participant characteristics (e.g. stratification or minimisation based on age, gender, or outcomes of interest recorded at baseline) is quite common.

Allocation concealment

We assessed 13 out of 75 (17%) of the included studies at low risk of bias (Ada 2013; Bateman 2001; Cooke 2010; Coroian 2018; Dean 2018; Donaldson 2009; Ivey 2017; MacKay-Lyons 2013; Mead 2007; Moore 2015; Sims 2009; Van de Port 2012; Vanroy 2017). We assessed 2 out of 75 (3%) of studies being at high risk of bias (Flansbjerg 2008; Kim 2014; Zou 2015) and the remaining 60 out of 75 studies (80%) of studies were assessed as unclear risk of bias because there was not enough information to make a judgement.

Mechanisms of allocation concealment were poorly reported. There are instances when centralised assignment mechanisms are used where allocation concealment is automatic (e.g. Mead 2007), in which case we rated the risk of bias as low. Other studies, where allocation concealment mechanisms were needed, frequently used envelopes. Numbered, sealed, opaque envelopes (e.g. Cooke 2010; Donaldson 2009), are appropriate. Many studies reporting the use of 'sealed envelopes' did not specify whether they were sequentially numbered or opaque, therefore we were unable to exclude potential selection bias with certainty.

Taking these together, only 12 of 75 studies (16%) were at low risk of bias issues relating to allocation.

Blinding

Participant blinding

We assessed none of the 75 included studies as being at low risk of performance bias. We assessed 47 out of 75 (63%) as being at high risk of bias (Ada 2013; Aidar 2016; Aidar 2018; Buyukvural 2015; Cooke 2010; Cuviallo-Palmer 1988; Dean 2018; Duncan 2003; Eich 2004; Fernandez-Gonzalo 2016; Flansbjerg 2008; Galvin 2011; Glasser 1986; Globas 2012; Gordon 2013; Inaba 1973; Ivey 2010; Ivey 2011; James 2002; Kim 2014; Kim 2016a; Kim 2017a; Knox 2018 (both comparisons); Kuys 2011; Langhammer 2007; Lee 2013a; Lee 2013b; Lennon 2008; Letombe 2010; Moore 2010; Park 2011; Sandberg 2016; Sims 2009; Smith 2008; Taylor-Pilliae 2014; Teixeira 1999; Toledano-Zarhi 2011; Topcuoglu 2015; Vanroy 2017; Verheyden 2009; Wang 2014; Winstein 2004; Yang 2006; Yang 2014; Zedlitz 2012) and the remaining 28 out of 75 studies (37%) of studies were assessed as unclear risk of bias because there was not enough information to make a judgement.

Participants cannot be blinded to physical interventions such as fitness training; therefore, we judged no studies to be at low risk of

bias. However, some studies utilised an attention control or other means to disguise the 'true nature' of the comparison.

Investigator blinding

We assessed the outcome assessment to be at low risk of detection bias in 38 out of 75 (50%) of the included studies (Ada 2013; Aidar 2016; Bale 2008; Bateman 2001; Cooke 2010; Coroian 2018; Dean 2018; Donaldson 2009; Duncan 2003; Furnari 2014; Gordon 2013; Kang 2012; Katz-Leurer 2003; Kim 2001; Kim 2014; Kim 2016a; Knox 2018 (both comparisons); Kuys 2011; Langhammer 2007; MacKay-Lyons 2013; Mao 2015; Mead 2007; Moore 2015; Ouellette 2004; Park 2011; Richards 1993; Richards 2004; Taylor-Pilliae 2014; Topcuoglu 2015; Van de Port 2012; Vanroy 2017; Verheyden 2009; Wang 2014; Yang 2006; Yang 2014; Zedlitz 2012; Zou 2015). We assessed 11 out of 75 (15%) as being at high risk of detection bias because outcome assessment was not blinded (Arabzadeh 2018; Eich 2004; Flansbjerg 2008; Galvin 2011; Globas 2012; Ivey 2010; Ivey 2017; Moore 2010; Salbach 2004; Smith 2008; Winstein 2004) and the remaining 26 out of 75 (35%) were assessed as unclear risk of bias because there was not enough information to make a judgement. Among studies that used blinded outcome assessment some instructed participants not to reveal group assignments (Bateman 2001; Duncan 2003; Flansbjerg 2008; Mead 2007). However, some degree of unmasking can easily occur and was documented in some studies (e.g. Eich 2004; Mudge 2009; Salbach 2004).

Incomplete outcome data

We assessed risk of attrition bias at the end of intervention (75 studies) and at the end of follow-up where data existed (33 studies only).

We assessed 55 out of 75 (73%) included studies as being at low risk of attrition bias at the end of intervention (Ada 2013; Bale 2008; Coroian 2018; Cuviallo-Palmer 1988; da Cunha 2002; Dean 2018; Donaldson 2009; Duncan 1998; Eich 2004; Fernandez-Gonzalo 2016; Flansbjerg 2008; Galvin 2011; Glasser 1986; Globas 2012; Gordon 2013; James 2002; Kang 2012; Katz-Leurer 2003; Kim 2001; Kim 2016a; Kim 2017a; Knox 2018 (both comparisons); Kuys 2011; Langhammer 2007; Lee 2013a; Lee 2013b; Lennon 2008; Letombe 2010; MacKay-Lyons 2013; Mead 2007; Moore 2010; Moore 2015; Mudge 2009; Ouellette 2004; Park 2011; Pohl 2002; Potempa 1995; Richards 2004; Salbach 2004; Shin 2011; Sims 2009; Smith 2008; Son 2014; Taylor-Pilliae 2014; Teixeira 1999; Toledano-Zarhi 2011; Topcuoglu 2015; Van de Port 2012; Vanroy 2017; Verheyden 2009; Winstein 2004; Yang 2006; Yang 2014; Zou 2015). We assessed 11 out of 75 (15%) studies as being at high risk of attrition bias at the end of intervention (Aidar 2016; Bateman 2001; Cooke 2010; Inaba 1973; Ivey 2010; Ivey 2011; Ivey 2017; Kim 2014; Mao 2015; Richards 1993; Wang 2014). The remaining 9 out of 75 studies (12%) were assessed as unclear risk of bias because there was not enough information to make a judgement based on the nature and extent of dropouts or on whether an intention-to-treat approach was used or not.

We assessed 18 out of 33 (55%) included studies as being at low risk of attrition bias at the end of follow-up (Ada 2013; Arabzadeh 2018; Dean 2018; Fernandez-Gonzalo 2016; Furnari 2014; Kim 2016a; Kim 2017a; Knox 2018 (both comparisons); Langhammer 2007; Mao 2015; Mead 2007; Mudge 2009; Sandberg 2016; Sims 2009; Smith 2008; Taylor-Pilliae 2014; Van de Port 2012). We assessed 11 out of 33 (33%) as being at high risk of bias (Bateman 2001; Cooke 2010; Donaldson 2009; Duncan 2003; Flansbjerg 2008; Inaba 1973; Kuys 2011; MacKay-Lyons 2013; Richards 2004; Winstein 2004; Zedlitz

2012) and the remaining four out of 33 studies (12%) of studies were assessed as unclear risk of bias because there was not enough information to make a judgement based on the nature and extent of dropouts or on whether an intention-to-treat.

One of the included studies did not analyse data for the participants who dropped out but we were able to impute sometimes large numbers of missing values in individual participant data obtained from Bateman 2001. This did not influence any of the findings; therefore, we included only the imputed data in this review for simplicity.

The bias assessment could not be applied to the 42 out of 75 (56%) studies with no end of follow-up measurement. Therefore, there are 42 blank spaces in Figure 2 since a 'Risk of bias' judgement was not possible.

Selective reporting

We assessed nine out of 75 (12%) studies as being at low risk of reporting bias (Ada 2013; Arabzadeh 2018; Cooke 2010; Fernandez-Gonzalo 2016; Galvin 2011; Kuys 2011; Mead 2007; Sandberg 2016; Zedlitz 2012). We assessed three out of 75 (4%) of studies as being at high risk of reporting bias (Coroian 2018; Knox 2018 both comparisons). The remaining 63 out of 75 studies (84%) of studies were assessed as unclear risk of bias because there was not enough information to make a judgement. This is because the majority of studies did not have readily available protocols. In most cases, where these were available, there was no evidence of selective reporting of outcomes relevant to this review.

Other potential sources of bias

We assessed 63 out of 75 (84%) studies as being at low risk of other biases (Ada 2013; Aidar 2018; Arabzadeh 2018; Bale 2008; Bateman 2001; Cooke 2010; Cuviallo-Palmer 1988; da Cunha 2002; Donaldson 2009; Duncan 1998; Duncan 2003; Eich 2004; Fernandez-Gonzalo 2016; Flansbjerg 2008; Furnari 2014; Galvin 2011; Glasser 1986; Gordon 2013; Inaba 1973; Ivey 2010; Ivey 2011; Ivey 2017; James 2002; Jin 2013; Kang 2012; Katz-Leurer 2003; Kim 2001; Kim 2014; Kim 2016a; Kim 2017a; Knox 2018 (both comparisons); Kuys 2011; Langhammer 2007; Lee 2013a; Lee 2013b; Lennon 2008; Letombe 2010; MacKay-Lyons 2013; Mao 2015; Mead 2007; Moore 2010; Mudge 2009; Park 2011; Pohl 2002; Potempa 1995; Richards 1993; Richards 2004; Salbach 2004; Sandberg 2016; Shin 2011; Smith 2008; Son 2014; Takami 2010; Toledano-Zarhi 2011; Topcuoglu 2015; Van de Port 2012; Vanroy 2017; Verheyden 2009; Wang 2014; Winstein 2004; Yang 2006; Yang 2014). We assessed 7 out of 75 (9%) of studies as being at high risk of other biases. These included those that recruited via media advertisements (Globas 2012; Ouellette 2004; Teixeira 1999; Zedlitz 2012), involved different travel demands between intervention and control exposures (Moore 2015), had baseline differences in outcomes of interest (Sims 2009), and reluctance to recruit some participants (Coroian 2018). The remaining 5 out of 75 studies (7%) of studies were assessed as unclear risk of bias because there was not enough information to make a judgement.

Confounded by additional training time (imbalanced exposure)

We judged studies in which the participants received an unequal amount of exposure to the intervention and comparison arms of the study to be at high risk of bias. Technically this could be

described as a source of confounding rather than bias but it is appropriate to record it here

.We assessed 28 out of 75 studies (37%) as being at low risk of confounding as they had balanced exposures in control and intervention groups (Arabzadeh 2018; Bale 2008; Bateman 2001; Coroian 2018; Cuviallo-Palmer 1988; da Cunha 2002; Furnari 2014; Gordon 2013; Ivey 2010; Ivey 2011; Ivey 2017; Jin 2013; Kang 2012; Kim 2001; MacKay-Lyons 2013; Mao 2015; Mead 2007; Moore 2015; Ouellette 2004; Potempa 1995; Richards 1993; Richards 2004; Salbach 2004; Shin 2011; Son 2014; Takami 2010; Vanroy 2017; Zou 2015). We assessed 41 out of 75 studies (55%) as being at high risk of confounding as they had imbalanced exposure across the control and intervention groups (Ada 2013; Aidar 2016; Aidar 2018; Buyukvural 2015; Cooke 2010; Dean 2018; Donaldson 2009; Duncan 1998; Duncan 2003; Eich 2004; Fernandez-Gonzalo 2016; Flansbjer 2008; Galvin 2011; Inaba 1973; James 2002; Kim 2014; Kim 2016a; Kim 2017a; Knox 2018 (both comparisons); Kuys 2011; Lee 2013a; Lee 2013b; Lennon 2008; Letombe 2010; Moore 2010; Park 2011; Sandberg 2016; Sims 2009; Smith 2008; Taylor-Pilliae 2014; Teixeira 1999; Toledano-Zarhi 2011; Topcuoglu 2015; Van de Port 2012; Verheyden 2009; Wang 2014; Winstein 2004; Yang 2006; Yang 2014; Zedlitz 2012). The remaining six out of 75 (8%) were assessed as unclear risk of confounding because there was not enough information to make a judgement. In summary, the design of more than half of the studies in this review meant that in 41 out of 75 studies (55%) the effects of fitness training could be exaggerated because the training intervention groups received greater time of exposure irrespective of the content of the training programme.

Effects of interventions

See: [Summary of findings for the main comparison Cardiorespiratory training compared to control for people with stroke: end of intervention](#); [Summary of findings 2 Resistance training compared to control for people with stroke: end of intervention](#); [Summary of findings 3 Mixed training compared to control for people with stroke: end of intervention](#)

Effect of training on primary outcome measures

Death

Overall there were few deaths; there were 19 deaths in 3017 participants (0.53%) before end of intervention. At the end of follow-up there were 19 deaths out of 1469 participants (1.29%), 10 of these 19 occurred between end of intervention and the end of follow-up.

Cardiorespiratory training (comparisons 1 and 2)

End of intervention

Out of the 32 studies of cardiorespiratory training (1631 participants) only Gordon 2013 reported death ($n = 2$ in each study arm) as a reason for participant losses. There was no statistically significant overall effect (RD 0.00, 95% CI -0.01 to 0.01 ; $I^2 = 0\%$; Analysis 1.1). There is low certainty in this estimate due to indirectness, imbalanced exposure (13/32 studies), and the fact that 6/32 studies in this analysis did report dropouts but could either not contact participants (Kuys 2011: $n = 1$), or did not fully describe all reasons for dropouts (Aidar 2016; Bateman 2001; Ivey 2011; Jin 2013; Sandberg 2016).

End of follow-up

One out of six studies (Katz-Leurer 2003), reported that one participant died in the training group (1/46) compared with one participant in the control group (1/46) with no statistically significant effect (RD 0.00, 95% CI -0.03 to 0.03 ; $I^2 = 0\%$; 360 participants; Analysis 2.1).

Resistance training (comparisons 3 and 4)

End of intervention

One of the 20 studies (Knox 2018), reported two deaths in the intervention group (1/45) and the control group (1/48). Overall, there is no statistically significant effect (RD 0.00, 95% CI -0.02 to 0.02 ; $I^2 = 0\%$; 803 participants; Analysis 3.1); however, there is low certainty in this estimate due to indirectness, imbalanced exposures in 12 out of 20 studies, and because four studies had undocumented attrition (Aidar 2016; Arabzadeh 2018; Buyukvural 2015; Inaba 1973), including one with a large number of undocumented dropouts (Inaba 1973).

End of follow-up

One out of five studies (Knox 2018), reported four deaths in the intervention group (2/45) and the control group (2/48) with no statistically significant effect (RD 0.00, 95% CI -0.04 to 0.04 ; $I^2 = 0\%$; 251 participants; Analysis 4.1). One study had a large number of undocumented dropouts (Inaba 1973).

Mixed training (comparisons 5 and 6)

End of intervention

Three of the 23 studies (1231 participants) reported 13 deaths between the baseline and the end of intervention assessments: Knox 2018 (3/51 training, 1/48 control); Langhammer 2007 (1/32 training, 6/35 control); and Van de Port 2012 (0/126 training, 2/124 control). Overall, there was no statistically significant effect (RD -0.00 , 95% CI -0.02 to 0.01 ; $I^2 = 0\%$; Analysis 5.1). There is low certainty in this estimate due to indirectness and imbalanced exposures affecting 16 out of 23 studies. Also, in Langhammer 2007, three of the six deaths in the control group and the one death in the training group occurred before discharge and before the intervention began; after excluding these data, the effect of training was still not statistically significant. The other 20 studies reported no deaths; however, two described undocumented losses: Richards 1993 (2 control); and Richards 2004 (5 training, 7 control) mentioning only that some participants were not available.

End of follow-up

Five of the 13 studies reported a total of 14 deaths (Cooke 2010; Duncan 2003; Galvin 2011; Knox 2018; Van de Port 2012), with no statistically significant effect (RD -0.01 , 95% CI -0.03 to 0.01 ; $I^2 = 0\%$; 906 participants; Analysis 6.1). The other eight mixed training studies reported that no losses to follow-up were attributable to death apart from Richards 1993 (2 control), Richards 2004 (5 training, 7 control), and Zedlitz 2012 (4 control), which describe only that some participants were lost or not available for follow-up.

Death or dependence

None of the studies reported the composite outcome of death or dependence.

Disability

Cardiorespiratory training (comparisons 1 and 2)

End of intervention

Three studies assessed Functional Independence Measure (FIM) score, one during usual care ([Bateman 2001](#)), and two after usual care ([CuvIELlo-Palmer 1988](#); [Katz-Leurer 2003](#)). Overall, there was no statistically significant effect of training (SMD 0.21, 95% CI -0.10 to 0.52; $P = 0.18$; [Analysis 1.2](#)). However, the [Bateman 2001](#) data were problematic because the procedures for obtaining FIM data at the end of intervention were not uniform and there was a high proportion of missing FIM data at the end of intervention (38%); exclusion of this study does not change the result (SMD 0.17, 95% CI -0.29 to 0.63; $P = 0.46$).

Three studies assessed Barthel Index scores, two during usual care ([Bateman 2001](#); [Wang 2014](#)), and one after usual care ([Gordon 2013](#)), and there was no overall effect with (MD 6.65, 95% CI -0.67 to 13.98; [Analysis 1.3](#)) or without the problematic data from [Bateman 2001](#). The high heterogeneity within this analysis could stem from the data from [Wang 2014](#) whose participants were non-ambulatory.

Two studies assessed Rivermead Mobility Index (RMI) scores during usual care ([Bateman 2001](#); [Takami 2010](#)), and one study after usual care ([Globas 2012](#)). There was a small overall improvement in scores (MD 1.56, 95% CI 0.20 to 2.92; $P = 0.02$; [Analysis 1.4](#)). When we excluded the data from [Bateman 2001](#) (risk of bias) the effect was strengthened (MD 2.18, 95% CI 0.99 to 3.37; $P = 0.0003$).

- One study reported Physical Activity and Disability Scale scores ([Mudge 2009](#)).
- One study reported Older Americans Resources and Services Questionnaire ([Gordon 2013](#)).
- One study reported that FIM scores were better than the control but no data were reported ([Topcuoglu 2015](#)).

We combined all the available disability scale data from these individual outcomes (using FIM data from [Bateman 2001](#)), and can be moderately certain of an overall effect in favour of cardiorespiratory training (SMD 0.52, 95% CI 0.19 to 0.84; $P = 0.002$; 462 participants; moderate-certainty evidence; [Analysis 1.5](#)). Exclusion of the [Bateman 2001](#) data made a trivial difference. One of the included studies was confounded for exposure time and had multiple bias concerns ([Wang 2014](#)); if excluded, the heterogeneity disappeared and the overall beneficial effect remained (SMD 0.35 0.15 to 0.55; $P = 0.0007$). This study, of non-ambulatory stroke survivors, had the largest individual effect size.

End of follow-up

Studies reported a range of different global scales at follow-up including RMI scores ([Bateman 2001](#)), Nottingham Extended ADL ([Bateman 2001](#)), Physical Activity and Disability Scale scores ([Mudge 2009](#)), and the Frenchay Activities Index (FAI; [Katz-Leurer 2003](#)). When we combined all the disability scale data from these individual outcomes (Nottingham Extended ADL data from [Bateman 2001](#)), there was no statistically significant effect of cardiorespiratory training at the end of follow-up (SMD 0.20, 95% CI -0.07 to 0.46; $P = 0.14$; [Analysis 2.2](#)). When the analysis was repeated using RMI data from [Bateman 2001](#) instead of Nottingham Extended ADL data there was still no statistically significant effect. There was a considerable proportion of interpolated missing data

(21%) and therefore the data from [Bateman 2001](#) should be treated with caution; their exclusion does not change the findings.

Resistance training (comparisons 3 and 4)

End of intervention

There were no resistance training data suitable for pooling.

- One study reported the various subscales Late Life Function and Disability Instrument ([Ouellette 2004](#)). Those who received resistance training felt less self-perceived limitation; however, there was no detectable effect on overall disability or function components of this tool.
- One study reported an effect favouring improved Rivermead Mobility Index score ([Buyukvural 2015](#)).
- Three studies reported subscales or specific dimensions of existing functional scales and were not considered ([Inaba 1973](#); [Winstein 2004](#); [Buyukvural 2015](#)).

End of follow-up

There were no resistance training data suitable for pooling.

Mixed training (comparisons 5 and 6)

End of intervention

Nine studies assessed the effects of mixed training at the end of the treatment phase or at follow-up using a variety of scales that measured disability outcomes: Lawton Instrumental Activities of Daily Living (IADL) scores reported by [Duncan 1998](#) and [Duncan 2003](#) at the end of intervention showed no statistically significant effect (MD 0.83, 95% CI -0.51 to 2.17; $P = 0.22$; [Analysis 5.3](#)).

Six studies assessed the Barthel Index during usual care ([Galvin 2011](#); [Kim 2016a](#); [Letombe 2010](#)), and after usual care ([Duncan 1998](#); [Duncan 2003](#); [Langhammer 2007](#)), at the end of intervention and showed no statistically significant effect (MD 2.84, 95% CI -0.48 to 6.17; $P = 0.09$; [Analysis 5.2](#)). Barthel Index scores reached ceiling level in five out of 20 participants at baseline and 10 out of 20 participants at end of intervention ([Duncan 1998](#)); excluding this study reduces heterogeneity (I^2 statistic from 21% to 10%) and gives a statistically significant beneficial effect (MD 4.02, 95% CI 0.16 to 7.88; $P = 0.04$).

RMI was assessed by three studies after usual care ([Dean 2018](#); [Mead 2007](#); [Van de Port 2012](#)). The direction of benefit favoured training but the effect was not significant (MD 0.41, 95% CI -0.02, 0.84; [Analysis 5.4](#)).

- One study reported Nottingham Extended Activities of Daily Living (EADL; [Mead 2007](#)). In addition, [Van de Port 2012](#) separately reported four subscales of the Nottingham EADL scale; only one was significantly affected in favour of the usual care rather than mixed training; all other subscales showed no statistically significant effect.
- One study reported FIM data ([Mead 2007](#)), and showed no statistically significant effect at the end of intervention.
- One study reported the Stroke Impact Scale ([Duncan 2003](#)), showing a marginal benefit. In addition, [Van de Port 2012](#) separately reported 11 subscales of the Stroke Impact Scale. One subscale was significantly affected in favour of the usual care rather than mixed training; all other subscales were unaffected.

- One study reported the Katz ADL scale (Letombe 2010), and showed no statistically significant effect at the end of intervention.
- One study reported the Modified Patient-Specific Functional Scale (Dean 2018), with no statistically significant effect shown at end of intervention.

We combined all available studies with disability scale data (nine studies, 604 participants) from the end of intervention, including the Barthel Index (Duncan 1998; Duncan 2003; Galvin 2011; Kim 2016a; Langhammer 2007; Letombe 2010), FIM (Mead 2007), and RMI (Dean 2018; Van de Port 2012). There was very low certainty in the small significant effect of mixed training at the end of the intervention (SMD 0.23, 95% CI 0.03 to 0.42; $P = 0.02$; Analysis 5.5). There were several potential combinations of data that could be included in this analysis as individual studies reported more than one disability scale; we presented Barthel Index, FIM and RMI data. We observed moderate inconsistency among studies' heterogeneity: ($I^2 = 21\%$), and this may relate to the different specific domains each tool addresses. Seven of the nine studies included in these analyses were confounded by increased training time whereby the amount of contact with therapists in the experimental groups was greater than in the control groups (Dean 2018; Duncan 1998; Duncan 2003; Galvin 2011; Kim 2016a; Letombe 2010; Van de Port 2012). The remaining two studies without this source of confounding were among the smallest individual effects (Langhammer 2007; Mead 2007).

End of follow-up

Two studies reported the Barthel Index (Galvin 2011; Langhammer 2007); there was no statistically significant effect at the end of follow-up (MD 1.82, 95% CI -13.69 to 17.33; $P = 0.82$; Analysis 6.2).

Two studies reported Nottingham EADL (Galvin 2011; Mead 2007); there was no statistically significant effect at the end of follow-up (MD 3.10, 95% CI -5.20 to 11.40; $P = 0.46$; Analysis 6.3).

Three studies reported RMI (Dean 2018; Mead 2007; Van de Port 2012); there was a statistically significant benefit at the end of three to four months of follow-up (MD 0.35, 95% CI 0.02 to 0.69; $P = 0.04$; Analysis 6.4). However, two of the three studies were confounded for increased training time (Dean 2018; Van de Port 2012).

When we combined all studies with disability scale data from the end of follow-up, including Barthel Index (Galvin 2011; Langhammer 2007), Modified Patient-Specific Functional Scale (Dean 2018), FIM (Mead 2007), and RMI (Van de Port 2012), there was no statistically significant effect (SMD 0.10, 95% CI -0.17 to 0.37; $P = 0.45$; Analysis 6.5). It is worth noting that three studies included in these analyses were confounded by increased training time (Dean 2018; Galvin 2011; Van de Port 2012). There were several potential combinations of data that could be included in this analysis as individual studies reported more than one disability scale; we presented Barthel Index, FIM and RMI data

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

We performed a subgroup analysis to directly compare the effects of the different types of training (cardiorespiratory training versus resistance training versus mixed training) on pooled disability outcomes at the end of the intervention (Analysis 7.1). There was only one includable study for resistance training (Ouellette 2004),

but there were enough data to compare cardiorespiratory training and mixed training. Both of these show beneficial effects although there is some overall heterogeneity ($I^2 = 22\%$). In summary, cardiorespiratory training, with or without resistance training included, improves scores of global disability.

Effect of training on secondary outcomes

Adverse events

Adverse events were not typically sought (a priori) as an outcome measure but were instead reported in a more ad hoc fashion. However, a number of studies specifically reported no serious adverse events (Coroian 2018; Ivey 2017; Kim 2016a; Kim 2017a; Moore 2015; Sandberg 2016). One study reported serious adverse events ($n = 6$) that were mostly considered unconnected to the intervention (Dean 2018). One study reported excessive fatigue among participants after strength training (Coroian 2018).

The following studies reported falls.

- Mead 2007 reported 11 falls in eight of the 32 participants allocated to mixed training and five falls in four of the 34 participants in the control group ($P = 0.21$, non-significant). None of these falls occurred within training sessions.
- Van de Port 2012 reported 29 falls in participants allocated to mixed training and 26 falls in those allocated to usual care ($P = 0.93$, non-significant); one fall occurred during exercise training.
- Dean 2018 reported 10 falls during the intervention; one fall occurred at the training venue.
- Taylor-Pilliae 2014 reported 29 falls; 14 in the intervention group and 15 in the control group.
- Vanroy 2017 reported one fall in the intervention and one in the control group.

With regard to secondary cerebrovascular events; 11 participants (seven participants receiving the training intervention and four control participants) were reported to have had a cerebrovascular event between baseline and the end of the training intervention. In the studies that included a follow-up assessment, 11 participants (five participants receiving the training intervention and six control participants) were reported to have had a cerebrovascular event between the end of intervention and the end of follow-up.

With regard to cerebrovascular events, three participants (one participant receiving the training intervention and two control participants) were reported to have suffered a cardiovascular event between baseline and the end of the training intervention.

Cardiometabolic risk factors

Few studies within each type of training reported cardiometabolic risk factor data so meta-analysis was limited. Cardiorespiratory fitness, discussed in the next section, is also a risk factor predictive of stroke.

Cardiorespiratory training (comparisons 1 and 2)

Five studies of cardiorespiratory training, with a total of 318 participants, showed no statistically significant training effects on systolic (MD -0.20, 95% CI -6.00 to 5.60; $P = 0.95$; Analysis 1.6), or diastolic blood pressure (MD -0.15, 95% CI -2.28 to 1.98; $P = 0.89$; Analysis 1.7) at the end of intervention (da Cunha 2002; Jin 2013; Katz-Leurer 2003; Lennon 2008; Potempa 1995). One study

(da Cunha 2002), had an unusually high systolic blood pressure in the intervention group; this introduced heterogeneity but had little effect on the pooled effect size. One study stated that there was an effect of cardiorespiratory training on blood pressure but did not provide data (Ivey 2011).

Two studies (174 participants) reported body mass index (BMI) data at the end of cardiorespiratory training interventions with no evidence of effect (MD 1.19, 95% CI -0.38 to 2.76; Analysis 1.8).

One study (Lennon 2008) reported waist girth measures but these were not affected by cardiorespiratory training.

One study of cardiorespiratory fitness training reported that glucose control (two-hour glucose), fasting insulin, insulin sensitivity (HOMA: Homeostatic Model Assessment), and total triglycerides improved after training (Wang 2014). There was no statistically significant effect on cholesterol levels (high-density lipoprotein (HDL), low-density lipoprotein (LDL)) or fasting glucose levels.

Resistance training (comparisons 3 and 4)

One study of resistance training (Zou 2015), reported post-training improvements in glucose control (two-hour glucose), fasting insulin, insulin sensitivity (HOMA), and in cholesterol levels (total, HDL, LDL). There was no statistically significant effect on fasting glucose or total triglycerides.

One resistance training study measured BMI; there was no statistically significant effect (Zou 2015).

No resistance training studies reported blood pressure outcomes.

Mixed training (comparisons 5 and 6)

Two studies of mixed training examined blood pressure (Moore 2015; Toledano-Zarhi 2011), and meta-analysis showed no effects on systolic (Analysis 5.6), or diastolic blood pressure (Analysis 5.7).

One study reported no effect of mixed training on body composition outcomes (body mass index and fat mass) (Moore 2015).

One study of mixed training reported post-training improvements in HDL cholesterol (representing a risk reduction) (Moore 2015). There was no statistically significant effect on glucose control (two-hour glucose), insulin sensitivity (HOMA), and total and LDL cholesterol levels.

Physical fitness

Cardiorespiratory training (comparisons 1 and 2)

Cardiorespiratory fitness

Nine studies (317 participants) assessed cardiorespiratory fitness using directly measured peak VO_2 (mL/kg/minute) at the end of the intervention. Most of the studies took place after usual care and there was a consistent pattern of improvement in peak VO_2 measures. We can be moderately certain that cardiorespiratory fitness increased significantly in the training groups (MD 3.40 mL/kg/minute, 95% CI 2.98 to 3.83; $I^2 = 0\%$; $P = 0.00001$; Analysis 1.9). Doses of training varied between four weeks and six months among the studies. All studies demonstrated the same beneficial direction of effect; the effect was similar for interventions delivered during or after usual care. One study had unusually small values reported

for the standard deviation (Jin 2013), and this study dominates the weighting (86%). If excluded, a slightly smaller effect occurs (MD 2.80 mL/kg/minute, 95% CI 1.66 to 3.95; $I^2 = 0\%$; $P = 0.00001$). If we assumed that the reported values were standard error values incorrectly reported and we then converted them to SD, the effect was again similar (MD 2.86 mL/kg/minute, 95% CI 1.77 to 3.96; $I^2 = 0\%$; $P = 0.00001$) and the weighting becomes comparable to the other studies (8.8%).

- One study estimated peak VO_2 indirectly from workload and showed a beneficial effect of training at the end of intervention (Lennon 2008).
- One study assessed peak VO_2 after a 12-month follow-up and suggests a training-induced benefit still remained (MacKay-Lyons 2013). This study is small ($n = 50$) but at low risk of bias.
- One study assessed VO_2 cost during the 12-MWT and did not show any significant training effect at the end of intervention (Moore 2010).
- One study planned oxygen uptake measures but did not report them (Kuys 2011).

Six studies (336 participants) assessed maximum cycling work rate at the end of intervention. This indicated that cardiorespiratory fitness improved significantly in participants who received the training intervention (MD 10.60 watts, 95% CI 1.88 to 19.33; $I^2 = 85\%$; $P = 0.02$; Analysis 1.10). The large number of dropouts in Bateman 2001 means these data are at risk of bias; if excluded, the overall effect was strengthened and all the heterogeneity disappeared (MD 12.90 watts, 95% CI 8.39 to 17.42; $I^2 = 0\%$). Data from Bateman 2001 suggested that the improvement measured by maximal cycling work rate was not maintained at follow-up.

Musculoskeletal fitness

No studies reported indices of musculoskeletal fitness.

Resistance training (comparisons 3 and 4)

Cardiorespiratory fitness

One study showed a small increase in cardiorespiratory fitness (VO_2 peak: 6%) after strength training (Ivey 2017).

Musculoskeletal fitness

Musculoskeletal fitness data, including muscle strength data, were awkward to synthesise because data can be collected from different muscle groups, using different equipment, different muscle contraction types (e.g. isometric, concentric), and reported as different data dimensions (e.g. force, torque, power). A total of 11 studies examined the effects of resistance training on indices relating to muscle strength.

Two studies with a total of 60 participants assessed the effects of resistance training on a composite measure of muscle strength at the end of intervention, during and after usual care (Kim 2001; Winstein 2004). Kim 2001 used a composite measure (i.e. 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 (i.e. the sum of the torque of the extensors and flexors of the wrist, elbow, and shoulder) to assess the strength of the upper limbs. We have low certainty in the pooled estimate of effect in favour of the resistance training group (SMD 0.58, 95% CI 0.06 to 1.10; $P = 0.03$; Analysis 3.2). However, Winstein 2004 was biased by lack

of blinding and the use of a dynamometer that was hand-held by the investigator, and confounded by increased training time in the intervention group.

Three studies with a total of 93 participants showed that training could increase knee flexion strength in the affected leg; we have moderate certainty in this effect (SMD 0.72, 95% CI 0.10 to 1.34; $P = 0.02$; [Analysis 3.3](#)). The same studies showed no increase in knee extension strength of the affected leg; we have low certainty in this effect (SMD 1.09, 95% CI -0.23 to 2.41; $I^2 = 87%$; [Analysis 3.4](#)). Only one of these studies ([Flansbjerg 2008](#)), included any follow-up data.

- One study examined strength bilaterally in the lower limb extensors and unilaterally in the knee extensors and the ankle flexors (plantar and dorsi; [Ouellette 2004](#)). They reported that all strength measures improved significantly after resistance training compared with the control group except for ankle dorsiflexion on the unaffected side. They presented the data as graphs and we could not extract them satisfactorily for further analyses.
- One study 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 ([Inaba 1973](#)). No statistically significant differences were observed between groups after two months of training. [Inaba 1973](#) did not report any measures of variance and therefore we were not able to include these data in our analyses.
- One study reported significant gains in maximal strength (bilateral one-repetition maximum (1-RM)) in a range of upper and lower body muscle groups after resistance training compared with the control group ([Aidar 2016](#)).
- One study reported no statistically significant gains in elbow and wrist strength (3-RM; peak torque of flexors and extensors) at either the end of intervention (six weeks) or the end of follow-up (six months; [Coroian 2018](#)).
- One study reported increases in static and dynamic strength (1-RM, Newtons) of the extensors of the whole lower limb (hip and knee) in the trained (more affected) leg ([Fernandez-Gonzalo 2016](#)). This was accompanied by muscle hypertrophy (+9.4%). In addition, there were strength gains in the less affected (untrained) leg.
- One study showed that maximum strength (1-RM, pounds) of extensors of the whole lower limb (hip and knee) improved in the paretic leg (143%) and non-paretic leg (121%) plus there was a small increase in cardiorespiratory fitness (VO₂ peak; 6%; [Ivey 2017](#)).

One study showed that submaximal muscular endurance (number of repetitions) of extensors of the whole lower limb (hip and knee) increased after strength training with an increase in total number of repetitions in the paretic leg (178%) and non-paretic leg (161%; [Ivey 2017](#)).

Two studies reported peak explosive power output measures. [Fernandez-Gonzalo 2016](#) reported increases in power output (watts) of the extensors of the whole lower limb (hip and knee) in the trained (more affected) leg. This was accompanied by muscle hypertrophy (+9.4%). In addition there were power gains in the less affected (untrained) leg. [Ouellette 2004](#) suggested that peak power was improved during unilateral knee extensions but not during

bilateral extension of the whole lower limb; they presented the data as graphs and we could not extract them satisfactorily to pool in meta-analysis.

Mixed training (comparisons 5 and 6)

Cardiorespiratory fitness

Two studies (140 participants) reported cardiorespiratory fitness data as VO₂ peak scores and showed effect of cardiorespiratory fitness; we have low certainty in this effect (MD 1.40, 95% CI -0.19 to 2.99; $I^2 = 35%$; [Analysis 5.8](#)). [Letombe 2010](#) also reported beneficial differences in VO₂ peak (+30%) but incomplete reporting prevented incorporation in this meta-analysis.

- Two studies measured peak work rate (watts) as an index of cardiorespiratory fitness: [Moore 2015](#) reported that peak work rate increased after training. [Letombe 2010](#) also reported changes in peak work rate (watts: +20%) but incomplete reporting prevented meta-analysis of these two studies.
- One study examined gait economy (net VO₂ mL/kg per metre walked; [Mead 2007](#)). A small beneficial effect at the end of intervention disappeared after a three-month follow-up.
- One study examined walking performance (time or metabolic equivalents (METs)) during a Modified Bruce treadmill protocol and reported no statistically significant effect of mixed training ([Toledano-Zarhi 2011](#)).

Musculoskeletal fitness

A total of six studies examined the effects of mixed training on indices relating to muscle strength.

Two studies (148 participants) assessed ankle dorsiflexion strength but did not show any effect of training; we have very low certainty in this effect (SMD 0.80, 95% CI -0.82 to 2.41; $I^2 = 94%$; [Analysis 5.10](#)). There was considerable heterogeneity between their results and both studies were confounded by increased training time. [Yang 2006](#) also reported a range of other 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.

Three studies (202 participants) assessed knee extension strength. We have moderate certainty in the small effect size in favour of the mixed training group at the end of intervention (SMD 0.33, 95% CI 0.05 to 0.61; $P = 0.02$; [Analysis 5.11](#)). One of the studies showed that this training effect was not retained at the end of the scheduled follow-up ([Cooke 2010](#)).

Three studies (147 participants) that assessed grip strength of the paretic hand did not show any significant improvement after mixed training at the end of intervention; we have low certainty in this effect (MD 0.32, 95% CI -0.88 to 1.52; $I^2 = 0%$; [Analysis 5.12](#)). One other study reported grip strength data that we could not pool in this meta-analysis, and showed no statistically significant effect of training at end of intervention or after a range of follow-up time points ([Langhammer 2007](#)).

- One study assessed knee flexion strength and showed no statistically significant effect at the end of intervention or end of follow-up ([Cooke 2010](#)).
- One study assessed the effect of mixed training on elbow extension, elbow flexion, and pinch force at the end of

intervention but did not detect any significant training effect (Donaldson 2009).

- One study assessed the maximum explosive extensor power of the affected and unaffected lower limb and showed no statistically significant effect at the end of intervention or end of follow-up (Mead 2007).

Mobility

Cardiorespiratory training (comparisons 1 and 2)

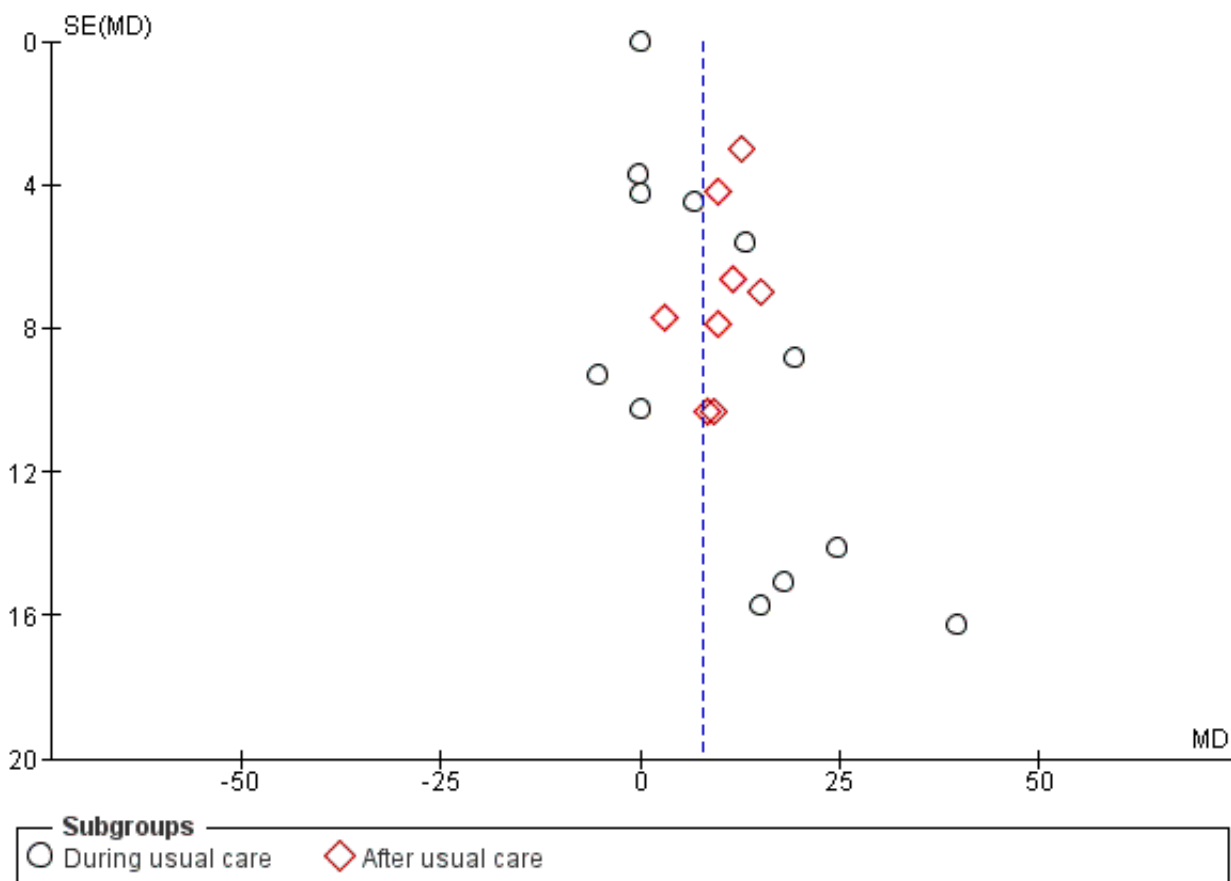
Functional Ambulation Category

Two studies, 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 significantly better in stroke survivors who received cardiorespiratory training during usual care (MD 0.53, 95% CI 0.21 to 0.85; P = 0.001; Analysis 1.11). We could not pool the FAC data reported by one study due to the way it was reported; there was no evidence of an effect of training on FAC in this study (Vanroy 2017).

Maximum walking speed (MWS)

Seventeen studies with 20 comparisons and a total of 782 participants measured maximum walking speed (metres per minute) at the end of intervention. The pooled MD showed significant consensus in favour of the training group (MD +7.66 m/minute, 95% CI 3.65 to 11.68; P = 0.0002; Analysis 1.12). This analysis also shows a consistent effect across the studies as a whole and a similar magnitude of effect arising from training delivered during or after usual care. The mode of cardiorespiratory training in all these studies was walking-specific apart from cycle ergometry (Bateman 2001; Sandberg 2016; Vanroy 2017), circuit type-training (Mudge 2009), and aquatic exercise (Aidar 2018). Nine of the 20 comparisons were confounded for imbalanced exposure time. If the exposure-confounded studies and non-walking studies were excluded seven out of eight of the remaining studies show a beneficial direction of effect and together show a substantial consensus of benefit (MD +12.49 m/minute, 95% CI 4.02 to 20.95). A funnel plot of the complete data in this analysis showed a tendency toward asymmetry, suggesting potential publication bias and this is focused on those studies occurring during usual care (Figure 4).

Figure 4. Funnel plot of comparison 1. Cardiorespiratory training versus control - end of intervention, outcome: 1.12 mobility - walking maximal speed (over 5 to 10 metres; m/min)



Five studies with six comparisons (312 participants) also provided follow-up data on maximum walking speed and observed a significant training effect at the end of follow-up (MD 6.71 m/minute, 95% CI 2.40 to 11.02; P = 0.002; Analysis 2.3). Although the

overall effect is consistent, the two comparisons of Ada 2013 show the smallest effect. Ada 2013 used a 12-month follow-up whilst all the others used a three-month follow-up period. If we excluded

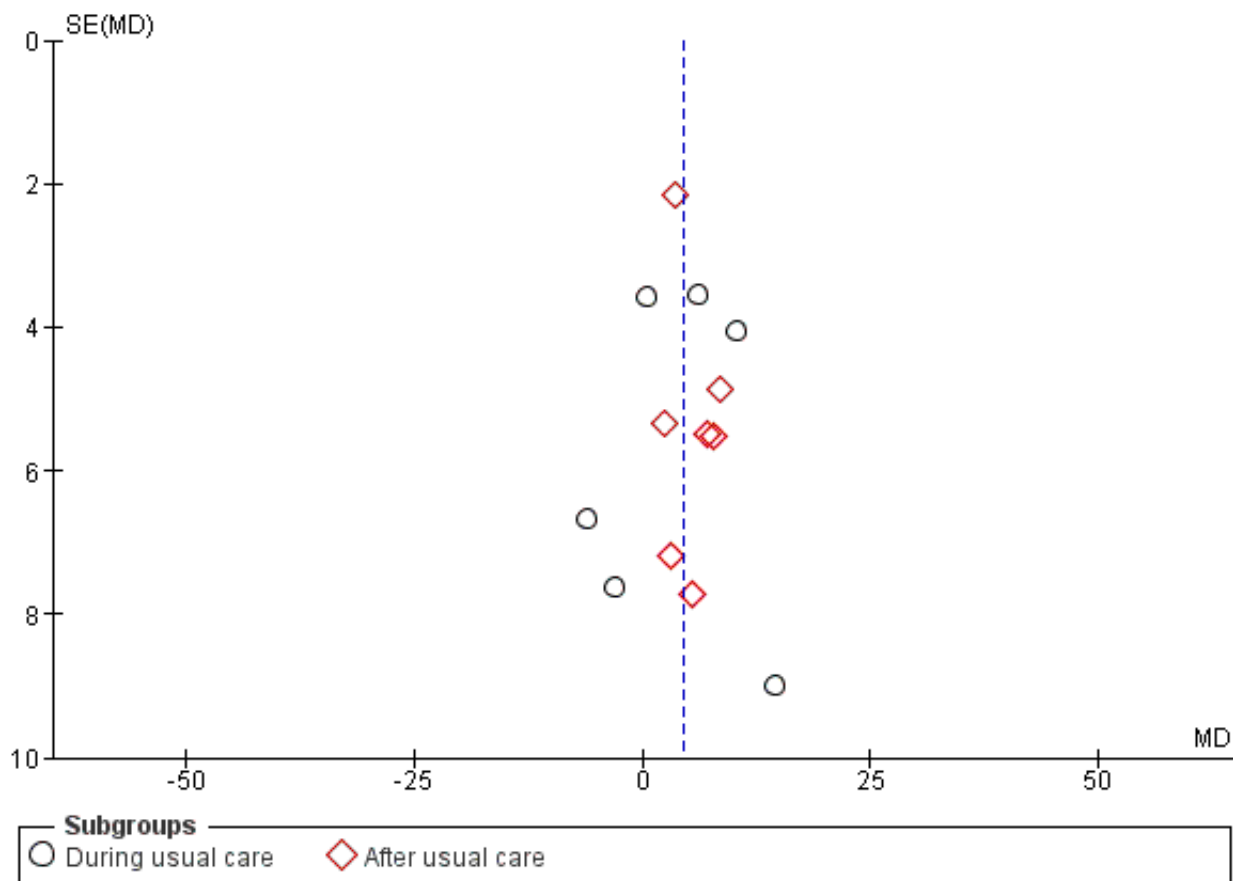
the data, heterogeneity was reduced and the confidence in the treatment effect strengthened.

Preferred walking speed (PWS)

Twelve studies with 13 comparisons (588 participants) measured the preferred gait speed (metres per minute) at the end of intervention. We have high certainty in the pooled MD, which indicates a significant effect in favour of training (MD 4.47 m/minute, 95% CI 2.07 to 6.87; $P = 0.0003$; Analysis 1.13). This pooled effect is contributed to mostly by the consistent positive directions

of effect among the studies taking place after usual care. The mode of cardiorespiratory training in all these studies was walking-specific, apart from three studies that used cycle ergometry (Katz-Leurer 2003; Vanroy 2017; Yang 2014). Five of the 13 comparisons are confounded for exposure time. If confounded and non-walking studies are excluded, the consistent beneficial effect among the remaining six studies is still apparent (MD +5.83 m/minute, 95%CI 2.32 to 9.34). A funnel plot of the complete data shows no evidence of asymmetry (Figure 5).

Figure 5. Funnel plot of comparison 1. Cardiorespiratory training versus control - end of intervention, outcome: 1.13 mobility - walking preferred speed (m/min)



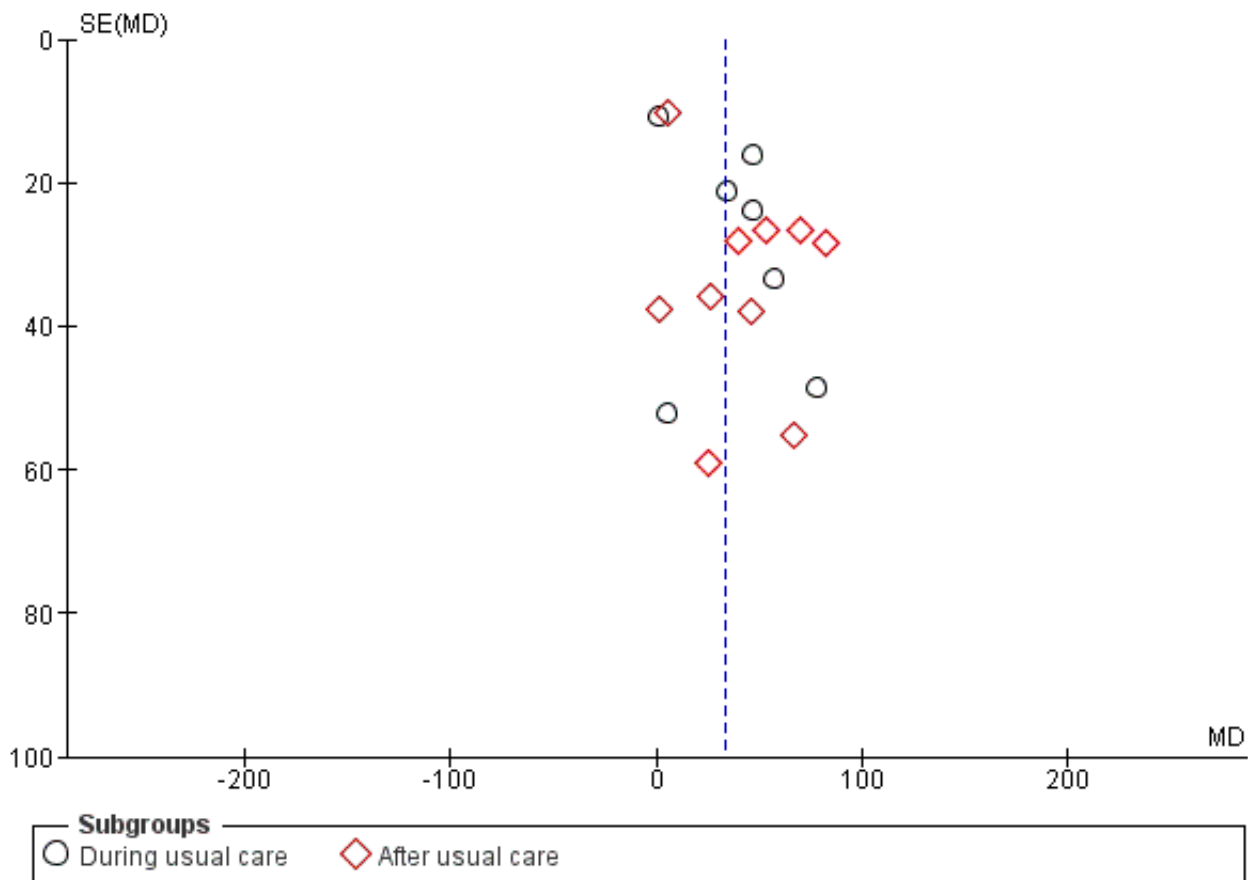
Three studies provided follow-up data at three months (Kuyss 2011), and 12 months (Ada 2013; MacKay-Lyons 2013), after the intervention. Pooling these data showed no evidence of retention (Analysis 2.4).

Six-Minute Walk Test (6-MWT)

Sixteen studies with 17 comparisons (882 participants) assessed walking endurance using the 6-MWT (total metres walked in six minutes). We have high certainty that cardiorespiratory training significantly increased the walking capacity at the end of intervention (MD +33.41 metres/6 minutes, 95% CI 19.04, 47.78; $P = 0.00001$; Analysis 1.14). A consistent direction of effect was

demonstrated at all stages of care although some heterogeneity is present ($I^2 = 30\%$). Nine of the 17 comparisons are confounded for exposure time. All studies contained walking-specific interventions apart from two that used cycle ergometry (Jin 2013; Yang 2014). If studies confounded for exposure and those using cycle ergometry are excluded then six of the remaining seven studies each show beneficial directions of effect and together these give a clear consensus effect in favour of training (MD +40.30 metres/6 minutes, 95% CI 13.24 to 67.37); this is dominated by studies occurring after usual care. A funnel plot of the complete data shows no evidence of asymmetry (Figure 6).

Figure 6. Funnel plot of comparison 1. Cardiorespiratory training versus control - end of intervention, outcome: 1.14 mobility - walking capacity (6-Minute Walk Test (metres))



Five studies provided follow-up data at three months (Eich 2004; Kuys 2011; Mudge 2009), and 12 months (Ada 2013; MacKay-Lyons 2013), after the intervention. When pooled these data show some evidence of retention (MD 38.29 metres, 95% CI 7.19 to 69.39; $P = 0.02$; Analysis 2.5). Although overall heterogeneity is low, the effects are variable and not obviously associated to either the shorter or longer follow-up periods.

Other mobility outcomes

Similar to the 6-MWT data, three studies measured walking endurance (reported as 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 metres/minute, 95% CI 1.35 to 16.40; $P = 0.02$; Analysis 1.15).

Two studies reported time taken for the community walk test (Kim 2014; Park 2011). There was a small difference between participants who received community ambulation training and controls at the end of intervention (MD -10.54 minutes, 95% CI -14.11 to -6.98; $P = 0.00001$; Analysis 1.16).

- One study 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 (Glasser 1986).

Resistance training (comparisons 3 and 4)

Maximal walking speed (MWS)

Six studies (274 participants) measured maximal walking speed (metres per minute). Resistance training did not increase the walking velocity at the end of intervention (MD 2.83 m/minute, 95% CI -0.49 to 6.14; Analysis 3.5). There was some moderate heterogeneity; studies showing positive directions of effect either involved walking-related exercise (Bale 2008), or were problematic due to either use of interpolated data (Buyukvural 2015), or due to being confounded for exposure time (Buyukvural 2015; Knox 2018). Follow-up data pooled from two studies did not show any effect of retained training effects (Flansbjerg 2008; Knox 2018; Analysis 4.2).

Preferred walking speed (PWS)

Five studies (203 participants) measured preferred gait speed (metres per minute) but failed to demonstrate any effect of resistance training at the end of intervention; we have moderate certainty in this effect (MD 2.15 m/min, 95% CI -3.57 to 7.87; Analysis 3.6). One study measured comfortable walking speed after follow-up; the intervention effect exceeded the control group (Knox 2018).

Six-Minute Walk Test (6-MWT)

Five studies (238 participants) assessed walking capacity as metres walked in six minutes. We have low certainty in the effect of resistance training at the end of intervention (MD 24.98 metres, 95% CI 11.98 to 37.98; $P = 0.0002$; [Analysis 3.7](#)). Three of the five studies are confounded for exposure time, or have multiple risk of bias concerns ([Ivey 2017](#)). Two studies provided follow-up data that showed no training effect on walking capacity at the end of follow-up ([Analysis 4.3](#)).

Mixed training (comparisons 5 and 6)

Maximum walking speed (MWS)

Three studies (168 participants) reported an increase in maximum walking speed (MD +8.48 m/minute, 95% CI 1.76 to 15.20; [Analysis 5.13](#)). Two of the included studies are confounded for exposure time, which could exaggerate the response.

- Only one included follow-up data and suggested that end of intervention benefit was retained after 12 weeks of follow-up ([Knox 2018](#)).

Preferred walking speed (PWS)

Ten studies (738 participants) measured the effects of mixed training on preferred walking speed (metres per minute). We have moderate certainty in the walking speed increase at the end of intervention in stroke survivors who received mixed training (MD 4.71 m/minute, 95% CI 1.32 to 8.10; $P = 0.006$; [Analysis 5.14](#)). The effect is influenced mostly by data from interventions delivered after usual care and there is significant heterogeneity within this subgroup as well as overall. Only the interventions in three of the 10 studies had balanced control and training exposures and these show no statistically significant effect overall ([Mead 2007](#); [Richards 1993](#); [Richards 2004](#)). A funnel plot of these data (not included) did not show any evidence of asymmetry.

Five studies (542 participants) that provided follow-up data for preferred gait speed did not show a training effect at the end of the scheduled follow-up ([Analysis 6.7](#)).

- 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 ([Richards 1993](#)).

Six-Minute Walk Test (6-MWT)

Ten studies (720 participants) measured walking capacity (metres walked in six minutes). We have low certainty in the significant increase shown after mixed training (MD 35.00 metres, 95% CI 15.91 to 54.09; $P < 0.0003$; [Analysis 5.15](#)). All studies in this meta-analysis, apart from [Moore 2015](#), were confounded for exposure time. A funnel plot of these data (not included) did not show any asymmetry.

Four studies (464 participants) included a follow-up and showed that walking capacity remained significantly greater in the groups who had participated in training (MD 47.48 metres, 95% CI 23.72 to 71.23; $P = 0.0001$; [Analysis 6.8](#)). It is worth noting, however, that in all studies in this analysis the intervention groups were confounded by additional training time, which could exaggerate the effect.

Other mobility outcomes

Three studies (232 participants) measured community ambulation speed (the ability to walk at 0.8 metres per second or more) and did not demonstrate any significant training effects either at the end of intervention ([Analysis 5.16](#)), or at follow-up ([Analysis 6.9](#)).

- One study examined FAC scores and detected no statistically significant effect of training at the end of intervention or at end of three-month follow-up ([Van de Port 2012](#)).

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

Where sufficient data existed we performed a subgroup analysis to compare the effects of the different types combined with sensitivity analyses to examine combinations of training types on mobility outcomes at the end of intervention. The effect sizes described below arise from the sensitivity analyses below and are not shown in [Analysis 7.2](#), [Analysis 7.3](#), or [Analysis 7.4](#).

Maximal walking speed

Maximal walking speed increased significantly after cardiorespiratory training and mixed training but not after resistance training ([Analysis 7.2](#)). We examined pair-wise combination of these subgroups. Excluding the resistance training subgroup showed that cardiorespiratory training with or without a resistance training element (mixed) benefits maximal walking speed (MD 7.77 m/min, 95% CI 4.11 to 11.44; $P = 0.00001$); the heterogeneity in this analysis was greatly reduced when we removed studies confounded for intervention exposure. Excluding the cardiorespiratory training subgroup showed that resistance training with or without a cardiorespiratory training element (mixed) also appears to benefit maximal walking speed (MD 3.63 m/min, 95% CI 0.64 to 6.63; $P = 0.02$); however, this benefit is due to mixed training interventions not the resistance training.

Preferred walking speed (PWS)

Preferred walking speed increased significantly after cardiorespiratory and mixed training but not after resistance training ([Analysis 7.3](#)). We examined pair-wise combination of these subgroups. Excluding the resistance training subgroup showed that cardiorespiratory training with or without a resistance training element benefits preferred walking speed (MD 4.56 m/min, 95% CI 2.35 to 6.77; $P \text{ value} < 0.0001$); excluding studies confounded for intervention time preserves a benefit whilst greatly reducing the heterogeneity. Excluding the cardiorespiratory training subgroup showed that resistance training with or without a cardiorespiratory element benefits preferred walking speed (MD 3.80 m/min, 95% CI 1.07 to 6.53; $P = 0.006$). All this benefit arises from the mixed training subgroup; however, seven out of 10 studies were confounded for intervention time.

Six-Minute Walk Test (6-MWT)

Gait endurance increased significantly after cardiorespiratory and mixed training but not after resistance training ([Analysis 7.4](#)). We examined pair-wise combination of these subgroups. Excluding the resistance training subgroup showed that cardiorespiratory training, with or without a resistance training element, benefits gait endurance (MD 33.97 metres, 95% CI 22.59 to 45.35; $P \text{ value} < 0.00001$). There is a similar contribution from both subgroups but the majority of studies were confounded for intervention time. Excluding the cardiorespiratory training subgroup showed that

resistance training, with or without a cardiorespiratory element, benefits gait endurance (29.53 metres 95% CI 18.87, 40.18; P value < 0.00001); the majority of studies (12/15) were confounded for intervention time.

Physical function

The included studies assessed participants' physical function using a variety of different measures including rating scales (e.g. Berg Balance Scale) and specific measures of functional performance (e.g. functional reach, Timed Up and Go test, stair climbing).

Cardiorespiratory training (comparisons 1 and 2)

Balance outcomes

Seven studies with eight comparisons (471 participants) assessed the effects of cardiorespiratory training on balance using the Berg Balance Scale. We have moderate certainty in the increase in balance scores (MD 1.92, 95% CI 0.16 to 3.68; P = 0.03; [Analysis 1.17](#)). All studies except [Bateman 2001](#) and [Jin 2013](#) included a walking component; when we excluded these two studies the effect was strengthened (MD 2.99, 95% CI 0.95 to 5.02; P = 0.004). The backwards-walking group of [Takami 2010](#) appeared to produce a larger benefit compared with the forwards-walking group from the same study. [Bateman 2001](#) and [MacKay-Lyons 2013](#) also assessed participants at the end of the follow-up period but did not show any effect ([Analysis 2.6](#)).

- One study assessed balance using a single leg stance test (left and right legs, with and without eyes closed) and demonstrated a beneficial direction of effect in all ([Sandberg 2016](#)).
- One study showed Brunel Balance Scores did not change after training ([Mao 2015](#)).

Other outcomes

Five studies (223 participants) showed that performance of the Timed Up and Go test improved; we have moderate certainty in this effect (MD -3.42 sec, 95% CI -4.78 to -2.05; P value 0.00001; [Analysis 1.18](#)).

- One study showed that functional reach was higher after training ([Kang 2012](#)).
- One study showed that Fugl-Meyer scores did not change after training ([Mao 2015](#)).
- One study demonstrated a medium beneficial effect of training on time taken to rise from a chair ([Aidar 2018](#)).

Resistance training (comparisons 3 and 4)

Balance outcomes

Five studies (220 participants) assessed balance using the Berg Balance scale. We have low certainty in the pooled after training (MD 3.27, 95% CI 2.15 to 4.38; P = 0.00001; [Analysis 3.8](#)). Only [Knox 2018](#) reported Berg Balance data again after follow-up (at three months) and showed a small positive direction of benefit.

- One study assessed the maximum weight-bearing on the affected leg (% body weight) and showed a beneficial change after training ([Bale 2008](#)).
- One study examined the effect on indices of postural sway (centre of pressure). This could not be pooled but suggested a beneficial effect of training ([Arabzadeh 2018](#)).

- One study assessed the effect on antero-posterior and medio-lateral sway velocity and showed a beneficial effect of training ([Lee 2013a](#)).
- One study assessed the effect on antero-posterior and medio-lateral sway distance and showed a beneficial effect of training ([Son 2014](#)).

Step tests

Four studies examined the effect of resistance training on stair climbing speed using different protocols.

Two studies (91 participants) reported time needed to ascend stairs using similar protocols (10 steps; [Ouellette 2004](#); 11 steps [Buyukvural 2015](#)), and showed a beneficial effect of intervention at the end of the training period (MD -2.07 sec, 95% CI -3.18 to -0.96; P value 0.0003; [Analysis 3.9](#)).

Two other studies reported data not suitable to pool due to protocol differences. We could not use SMD as there would be a mix of end-score and change-score data.

- One study reported time to climb four steps. Change scores showed no statistically significant effect on maximal or chosen speed ([Kim 2001](#)).
- One study used a two-minute step test and showed beneficial effect on stair climbing ([Taylor-Pilliae 2014](#)).

Timed Up and Go

Five studies (224 participants) examined the effect of resistance training on the Timed Up and Go test. There was no benefit and we have low certainty in the estimate (MD -3.46 sec, 95% CI -6.94 to 0.02; I² = 89%; [Analysis 3.10](#)). The during- and after-usual-care subgroups did each show a beneficial effect; however, four out of five studies were confounded for intervention time, there is substantial heterogeneity, and [Buyukvural 2015](#) is based on variance data interpolated from published P values.

Two studies (117 participants) examined Timed Up and Go data at follow-up and this shows no statistically significant effect of retained benefits ([Analysis 4.4](#))

Other outcomes

- One study examined the effect of resistance training on the Trunk Impairment Scale; there was no statistically significant effect size ([Verheyden 2009](#)).
- One study concluded there was no benefit of isokinetic upper limb training to upper limb function (upper limb Fugl-Meyer scores and Box and Block tests; [Coroian 2018](#)).
- One study showed trivial direction benefit from lower limb training on lower limb and total Fugl-Meyer scores ([Zou 2015](#)).
- One study showed no beneficial effect of training on the Short Physical Performance Battery score; only the 'strength' subscale showed a beneficial direction of change ([Taylor-Pilliae 2014](#)).

Mixed training (comparisons 5 and 6)

Balance outcomes

Nine studies (419 participants) assessed balance using the Berg Balance Scale. We have low certainty in the beneficial effect (MD 2.12, 95% CI 0.82 to 3.41; P = 0.001; [Analysis 5.17](#)). Heterogeneity is low in this meta-analysis; however, five of the nine studies were

confounded for increased exposure time in the intervention groups; excluding these studies extinguishes the beneficial effect. Follow-up data from three studies (201 participants) did not show any significant retention of training effects ([Analysis 6.10](#)).

Two studies 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 ([Duncan 2003](#); [Mead 2007](#); [Analysis 5.18](#)). One study provided follow-up data ([Mead 2007](#)); this did not show any retention effects.

Other study balance data included;

- One study measured the Four Square Step Test; however, these data were very different at baseline in a way that benefited the control group ([Toledano-Zarhi 2011](#)).
- One study measured balance using the timed balance test after intervention and after three-month follow-up ([Van de Port 2012](#)).
- One study measured postural sway (static balance) in a range of conditions and planes of movement; however, the study authors concluded there was no statistically significant effect of mixed training ([Shin 2011](#)).
- One study reported multiple benefits of aquatic exercise to a range of balance and stance outcomes measured using a 'baropodometric' system ([Furnari 2014](#)).

There were sufficient data among the all different measures of balance described above to justify pooling using SMD meta-analysis (12 studies, 755 participants). This showed an overall beneficial improvement in balance at the end of intervention (SMD 0.28, 95% CI 0.11 to 0.45; $P = 0.001$; [Analysis 5.19](#)). However, seven of the 12 included studies were confounded by additional training time; when we excluded these data there was no statistically significant effect of training on balance. A funnel plot of these data (not included) appears asymmetrical; however, the asymmetry is caused by two small studies each showing negative effects ([Kim 2016a](#); [Toledano-Zarhi 2011](#)).

Other outcomes

Seven studies (586 participants) measured the time to complete the Timed Up and Go test and showed no statistically significant effect of training; we have low certainty in this effect (MD -2.21 sec, 95% CI -4.43 to 0.02; $I^2 = 45\%$; [Analysis 5.20](#)). Five of these seven included studies were confounded by additional training time. Follow-up data in five studies (510 participants) did not show a significant retention of mixed training benefits ([Analysis 6.12](#)); these data are also dominated by studies confounded for intervention time.

- One study assessed upper extremity functional performance using the Action Research Arm test and showed no difference at end of intervention ([Donaldson 2009](#)).
- One study recorded physical activity data (diary and accelerometer) at end of intervention and end of follow-up but did not analyse this (pilot study; [Dean 2018](#)). We calculated a MD and 95% CI and the data show no beneficial direction of effect for any domain of physical activity (total, light, moderate, vigorous (MVPA)) at either the end of intervention or end of follow up.
- One study reported Fugl-Meyer scores for the paretic lower limb; there was no evidence of an intervention effect ([Kim 2016a](#)).

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

Where sufficient data existed we performed a subgroup analysis to compare the effects of the different types combined with sensitivity analyses to examine combinations of training types on the Berg Balance Scale and Timed Up and Go data at the end of intervention. The effect sizes described below arise from the sensitivity analyses below and are not shown in [Analysis 7.5](#) or [Analysis 7.6](#).

Balance

Excluding the resistance training subgroup showed that cardiorespiratory training with or without a resistance training element benefits balance (MD 1.87, 95% CI 0.76 to 2.99; $P = 0.0009$; [Analysis 7.5](#)); this is contributed to similarly for both training types but exclusion of the studies confounded for intervention time cancels out evidence of beneficial effect. Excluding the cardiorespiratory training subgroup showed that resistance training with or without a cardiorespiratory training element benefits balance (MD 2.75, 95% CI 1.92 to 3.58; P value < 0.00001). Both intervention types contribute in a similar and consistent way and the benefit is still evident when the studies confounded for intervention time are excluded (MD 2.81, 95% CI 1.47 to 4.15; P value < 0.0001).

Timed Up and Go

Excluding the resistance training subgroup showed that cardiorespiratory training with or without a resistance training element benefits Timed Up and Go (MD -2.61 sec, 95% CI -3.93 to -1.29; P value < 0.0001 ; [Analysis 7.6](#)). Excluding the cardiorespiratory training subgroup showed that resistance training with or without a cardiorespiratory training element benefits Timed Up and Go (MD -2.88 sec, 95% CI -5.02 to -0.75; P value < 0.00001). Taking into account these data as a whole the magnitude of effect across the three training types was very similar and was consistent, with 15 out of 17 studies showing a positive direction of benefit. However, many of the studies (12/17) are confounded for intervention time.

Health status and quality of life

Cardiorespiratory training (comparisons 1 and 2)

Two studies (164 participants) examined effects of training on the component summary measures shared by the SF-12 scale ([Globas 2012](#)), and the SF-36 scale ([Gordon 2013](#)). This showed that cardiorespiratory training benefited the 'physical health' component (SMD 0.51, 95% CI 0.20 to 0.82; $P = 0.001$; [Analysis 1.19](#)) but not the 'mental health' component ([Analysis 1.20](#)).

Two studies with three comparisons (158 participants) reported EuroQoL scores and this showed no pooled effect of training at the end of intervention ([Analysis 1.21](#)), or the end of follow-up ([Analysis 2.7](#)).

- One study reported the SF-36 'physical functioning' scale and the 'emotional role' scale showing the scores to be significantly better after training ([Aidar 2018](#)).
- One study reported hand and shoulder pain being improved in the intervention group ([Topcuoglu 2015](#)).

Resistance training (comparisons 3 and 4)

Three studies (70 participants) assessed the 'physical functioning' or 'mental health' scales of the SF-36 at the end of intervention. There was no statistically significant effect on 'physical functioning' ([Analysis 3.11](#)) but there was evidence of benefit for 'mental health' (MD 7.69, 95% CI 1.56 to 13.83; [Analysis 3.12](#)). The two studies with the largest contributing effects were confounded for intervention exposure time.

- One study reported no training effect in the two 'physical health' and 'mental health' composite scores of the SF-36 at the end of intervention ([Taylor-Pilliae 2014](#)).
- One study showed that all eight scales of the SF-36 improved after training (but did not report the two composite scores); this intervention is confounded for exposure time ([Aidar 2016](#)).
- One study reported a benefit in Stroke Specific Quality of Life scale ([Buyukvural 2015](#)).

Mixed training (comparisons 5 and 6)

SF-36 data

Two studies (112 participants) showed significantly better scores in the SF-36 'physical functioning' scale in the mixed training group at the end of intervention (SMD 0.48, 95% CI 0.10 to 0.85; 0.01; [Analysis 5.21](#)), but not after follow-up ([Analysis 6.13](#)). There was no statistically significant effect on the 'social role functioning' scale at the end of intervention ([Analysis 5.23](#)).

Three studies (178 participants) showed significantly better scores in the SF-36 'physical role functioning' scale for the mixed training group at the end of intervention (SMD 0.56, 95% CI 0.26 to 0.86; $P = 0.0003$; [Analysis 5.22](#)). This effect was retained at follow-up (MD 11.61, 95% CI 2.38 to 20.84; $P = 0.01$; [Analysis 6.14](#)).

- One study showed that participants receiving mixed training had significantly better results in the 'emotional role functioning' scale of the SF-36 compared with controls at the end of the training period ([Duncan 2003](#)).

Other outcome data

- One study reported the two components of the EuroQol scale (health state and perceived health state). Although not significant there was a positive direction of effect after intervention but not at follow-up ([Cooke 2010](#)).
- One study assessed the effect of mixed training on the Stroke-Adapted Sickness Impact profile and showed no statistically significant effect at the end of intervention or end of six-month follow-up ([Zedlitz 2012](#)).
- One study recorded quality of life using various metrics (Stroke QoL Scale, EQ-5D-5L, SF-12 physical and mental health components) at end of follow-up only but did not analyse this (pilot study; [Dean 2018](#)). We calculated MDs and 95% CI and these showed no effects. The direction of effect was beneficial for SF-12 scores but not for the Stroke QoL Scale or EQ-5D-5L.
- One study reported the domains of the Stroke Impact Scale as quality of life with only two out of 10 reported domains showing a beneficial direction of effect ([Moore 2015](#)).

Seven of the nine studies for mixed training in comparison 5 and 6 were confounded by additional training time, leaving only [Mead 2007](#) and [Moore 2010](#) unaffected.

Mood

Cardiorespiratory training (comparisons 1 and 2)

Two studies (56 participants) reported Beck Depression Index data at the end of intervention ([Analysis 1.22](#)) and showed no beneficial effect. Only one of these studies reported follow-up data too ([Smith 2008](#)).

- One study used the Beck Depression Index and stated depression was improved in the intervention group, but did not report any data ([Topcuoglu 2015](#)).
- One study using HADS reported that the depression score improved in the intervention group but not in the control group ([Lennon 2008](#)). We were, however, unable to include these study data in our analyses as they were presented in a format not suitable for [Review Manager 2014](#).
- One study reported anxiety using HADS ([Bateman 2001](#)). The anxiety score decreased immediately after cardiorespiratory training but not at follow-up. This study had, however, substantial missing values at the end of intervention (29%) and end of follow-up (37%) and, therefore, we did not pool these with other depression scores.
- One study reported medium-sized beneficial effects in Anxiety Trait and Anxiety State measures ([Aidar 2018](#)).

Resistance training (comparisons 3 and 4)

Two studies (180 participants) reported 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 -3.76, 95% CI -6.98 to -0.54; [Analysis 3.13](#)). One of these studies demonstrated that the effect was retained after a follow-up ([Sims 2009](#)).

One study reported a significant benefit in measures of the Beck Depression Inventory at the end of intervention ([Aidar 2016](#)). Combining data from the different depression scales reported in three studies (209 participants) showed a significant benefit at the end of intervention (SMD -0.36, 95% CI -0.64 to -0.09; $P = 0.01$; [Analysis 3.14](#)). All three of these studies have major bias and confounding issues

- One study used the Brazilian translation of the State-Trait Anxiety Inventory and showed no effects ([Aidar 2016](#)).

Mixed training (comparisons 5 and 6)

Three studies (391 participants) used the anxiety and depression components of the HADS ([Mead 2007](#); [Van de Port 2012](#); [Zedlitz 2012](#)). No immediate training effects were observed on either HADS component at the end of the intervention ([Analysis 5.24](#); [Analysis 5.25](#)). No retained training effects were observed on either HADS component at the end of follow-up ([Analysis 6.17](#); [Analysis 6.18](#)).

Two studies ([Duncan 2003](#); [Van de Port 2012](#); 335 participants) assessed mood using the 'emotion' domain of the Stroke Impact Scale (SIS) and showed no statistically significant effect at the end of intervention ([Analysis 5.26](#)), or after three-month follow-up ([Analysis 6.15](#)).

One study reported Geriatric Depression Scale scores ([Duncan 2003](#)). Combining all available depression data from four studies (484 participants) showed no statistically significant effect of

training at the end of intervention ([Analysis 5.27](#)), or the end of follow-up ([Analysis 6.19](#)).

Cognitive function

Cardiorespiratory training (comparisons 1 and 2)

One study of cardiorespiratory training showed no statistically significant effect on FIM cognitive score (memory, problem-solving questions) at the end of intervention ([Bateman 2001](#)). We did not consider end of follow-up data due to the considerable proportions of missing data.

Resistance training (comparisons 3 and 4)

One study showed benefits of short intense training on attention, working memory, information processing, and executive function ([Fernandez-Gonzalo 2016](#)). Some cognition data is incomplete in this study for participants with expressive aphasia or upper limb spasticity.

Mixed training (comparisons 5 and 6)

Two studies (159 participants) showed no statistically significant effect on FIM cognitive score (memory, problem-solving questions) at the end of intervention ([Analysis 5.28](#)), or end of follow-up ([Analysis 6.20](#)).

Two studies (133 participants) used SIS domains of 'communication' and 'memory and thinking' to assess cognitive function. The meta-analyses showed no statistically significant effects at the end of intervention ([Analysis 5.29](#); [Analysis 5.30](#)), or the end of the six-month follow-up ([Analysis 6.21](#); [Analysis 6.22](#)).

- One study showed that mixed training benefited cognitive function assessed by the Korean version of the Montreal Cognitive Assessment but not the Trail Making Test or Stroop test ([Kim 2017a](#)).
- One study showed that mixed training improved cognition measured using the ACE-R tool ([Moore 2015](#)).

'Summary of findings' tables

We have presented the results for the primary outcome measures 'Summary of findings' tables for cardiorespiratory training ([Summary of findings for the main comparison](#)), resistance training ([Summary of findings 2](#)), and mixed training ([Summary of findings 3](#)). In addition we made a post-hoc decision to include domains relating to physical fitness, mobility, and physical function.

DISCUSSION

Summary of main results

Effect of training on primary outcome measures

Death

There were no statistically significant effects on mortality, which suggests that there were no benefits but also that there were no adverse effects on mortality. Although there is low certainty in these analyses, death from any cause was a very uncommon event among the participants. At the end of intervention only 19 out of the total 3617 participants had died and these were restricted to five out of 75 studies. At the end of follow-up 19 out of 1469 participants had died; these were restricted to seven out of 24 studies with follow-up time points.

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, first, because the inclusion criteria of the studies of exercise select participants with milder strokes (most were ambulatory), and reduced risk factors (such as blood pressure ceiling criteria). In other words, those at higher risk of dying were probably systematically excluded due to contraindications to exercise. Second, there may be self-selection by participants who are physically active with higher fitness. Higher physical activity and cardiorespiratory fitness are known to be associated with reduced stroke risk and stroke mortality ([Hooker 2019](#)). In addition, the majority of the training programmes in this review were of short duration (12 weeks or less). A systematic review of the effect of exercise-based cardiac rehabilitation showed reduced cardiovascular mortality in people with coronary heart disease ([Anderson 2016](#)), but the training programmes were longer (median six months) than those in this review. Since many stroke patients have coexisting heart disease, training might influence post-stroke mortality if it contains cardiorespiratory training delivered over long periods of time. With regard to longer-term interventions, currently two small studies of cardiorespiratory training ([Ivey 2010](#); [Ivey 2011](#)), and one of mixed training ([Dean 2018](#)), exist; these used a six-month intervention duration. Current evidence lacks the interventions most likely to influence mortality.

Although higher physical activity and higher cardiorespiratory fitness are linked to the primary prevention of stroke, there is a lack of data on the role of fitness training interventions in the secondary prevention of stroke. This gap in knowledge is currently a research priority and requires investigation ([Pollock 2012](#)).

Death or dependence

There were no data available to allow us 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 a 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. Data using the same scales were limited, which restricted the meta-analyses to the use of standardised mean differences. In addition, a number of methodological issues weakened and biased the available data.

After cardiorespiratory training there was no improvement in Functional Independence Instrument scores ([Analysis 1.2](#)), Barthel Index scores ([Analysis 1.3](#)), or other individually-reported outcomes. However, there was an improvement in Rivermead Mobility Index scores ([Analysis 1.4](#)). Pooling all available disability scale data from different scales showed a moderate beneficial effect (SMD; [Analysis 1.5](#)). This pattern of findings could occur because training influences the physical/mobility items of these various scales; such items dominate the scoring in tools like the Rivermead Mobility Index (eight out of 15 items) whereas they are less influential in more 'global' tools like the Functional Independence Measure (two out of 18 items). Since walking is a common mode of cardiorespiratory exercise, these findings could

be precipitated by improvements in walking and mobility rather than more 'global' effects on disability.

There were too few data to allow for any comment on the effect of resistance training and there was no evidence of intervention effects at the end of follow-up where data existed.

Studies of mixed training used various disability measurement instruments, which individually showed no clear consensus effects. Pooling all available data from different scales showed a small effect at the end of intervention ([Analysis 5.5](#)). Like cardiorespiratory training these significant effects could be driven principally by changes in mobility. Most pooled studies were confounded by additional training time; when these were excluded the benefits vanished. This means that participation in mixed training appeared effective but it is impossible to attribute any benefits to the actual content of the mixed training programmes.

The effects of cardiorespiratory training (moderate-certainty evidence) and mixed training (low-certainty evidence) are similar in magnitude at the end of intervention ([Analysis 7.1](#)). Overall, the findings show that interventions containing cardiorespiratory training, with or without resistance training content (i.e. mixed training), improve global measures of disability after stroke. These effects may be driven by improvements in mobility rather than being indicative of a change in more 'global' disability status. This would agree with the findings among the secondary outcomes (mobility).

Effect of training on secondary outcome measures

Adverse events

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

Risk factors

Few studies reported vascular risk factors, and the variety of outcomes restricted meta-analysis. There were no consensus effects on blood pressure. In individual studies, which reported metabolic measures (glucose tolerance, insulin sensitivity, lipids), there were some beneficial directions of effect but no consensus can be reached. Blood pressure remained an uncommon outcome reported in studies of exercise after stroke and yet it could be an important, plausible benefit. Other recent systematic reviews have examined the effect of exercise on cardiovascular risk factors and reported beneficial effects on systolic blood pressure, fasting glucose and insulin, and HDL cholesterol ([D'Isabella 2017](#)); however, this included a number of studies that did not meet our eligibility criteria. The review of [D'Isabella 2017](#) did not include cardiorespiratory fitness as an outcome.

There was an increase in cardiorespiratory fitness after cardiorespiratory training; this is discussed in the next section below from a functional perspective. However, as well as having functional implications, low VO₂ peak values are associated with increased stroke risk and stroke mortality ([Hooker 2019](#)). An increase in VO₂ peak of 1 MET (equivalent to +3.3 mL/kg/min) equates to a 7% risk reduction in stroke hospitalisation ([Pandey](#)

[2016](#)). We have moderate certainty that our observed effect of +3.40 mL/kg/min (95% CI 2.98 to 3.83) is of similar magnitude to this and this indicates that meaningful risk reduction may be achievable with short cardiorespiratory training interventions either during or after usual care.

Physical fitness

Cardiorespiratory fitness

Cardiorespiratory training significantly improved physiological indicators (VO₂ peak), and performance indicators (exercise tolerance) of cardiorespiratory fitness. This improvement may be beneficial because a low VO₂ 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 [Michael 2007](#) and [Patterson 2007](#)).

A limited 'fitness reserve' caused by a low VO₂ peak coupled with poor walking economy (high oxygen cost of walking) is a common post-stroke problem ([Blokland 2018](#); [Macko 2001](#)). Training to improve either component (VO₂ peak and/or walking economy) could benefit walking performance and exercise tolerance after stroke. Although there were too few data to determine whether economy can be improved, there is clear consensus that VO₂ peak can be improved. This increases the 'fitness reserve', meaning that walking at a given speed is less demanding. Our consensus effect (+3.40 mL/kg/min 95% CI 2.98 to 3.83) is very similar to other recent systematic reviews (+2.2 mL/kg/min 95% CI 1.3 to 3.1; [Boyne 2017](#)).

There were too few other data to draw conclusions on the effects of the other training types or the post-training retention of cardiorespiratory fitness.

Musculoskeletal fitness

Consensus effects using meta-analysis measures of musculoskeletal fitness (muscle strength and power) are difficult to achieve in a meaningful way because there are so many different testing approaches, protocols, outcome dimensions, and muscle groups that can be used. Resistance training and mixed training studies included in this review that measured musculoskeletal fitness did so via a range of outcomes, including not just maximal strength but also other dimensions such as local muscular endurance and maximal explosive power output.

Most resistance training studies individually showed improvements in musculoskeletal fitness and in some cases these were substantial in magnitude and dominated by lower limb muscle groups.

Mixed training studies reported a range of outcomes with most of the examples of a beneficial direction of effect within lower limb rather than upper limb musculature.

In this review update there is evidence of increased interest in resistance training and thus musculoskeletal fitness measures occur more commonly. However, the certainty of the evidence is still low to moderate.

Several studies examine dynamic expressions of musculoskeletal fitness such as explosive power output ([Fernandez-Gonzalo 2016](#); [Mead 2007](#); [Ouellette 2004](#)). 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-investigated.

Mobility

All the meta-analyses of walking performance outcomes are summarised in Table 4 and this shows a clear pattern of findings.

Cardiorespiratory training increased maximal walking speed, preferred walking speed, and walking capacity (6-MWT) at the end of the training period (Analysis 1.12; Analysis 1.13; Analysis 1.14). When these analyses are restricted to studies that have a balanced control group exposure, and that use walking as a mode of exercise, all three magnitudes of beneficial effect increase, suggesting the importance of exercise being task-related. Benefits were retained in both maximum walking speed (Analysis 2.3), and 6-MWT (Analysis 2.5). Benefits to walking performance also emerge when walking in a community setting outside the research environment (Analysis 1.16). There is evidence that suggests that cardiorespiratory training, as well as improving walking speed, may reduce the reliance of stroke survivors on other people to assist with ambulation (Functional Ambulation Categories score; Analysis 1.11). There is high certainty of the evidence for cardiorespiratory training.

Resistance training benefited only walking capacity (6-MWT) and not maximal or preferred walking speed. It is worth noting that most of the resistance training interventions did not incorporate walking as a mode of exercise. Improvements noted 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). In this review it could also be that the intramuscular metabolic adaptations arising from resistance training increased the tolerance of participants to any fatiguing effects of the performance-based 6-MWT. However, there is low certainty of the evidence for this outcome.

Mixed training increased maximal walking speed, preferred walking speed, and walking capacity (6-MWT) at the end of the training period (Analysis 5.14; Analysis 5.15). These effect sizes are all similar in magnitude to those for cardiorespiratory training and they are also of lower certainty (low to moderate). However, these consensus effects are more tenuous because of heterogeneity, some of which can be explained by the fact that all are dominated by imbalanced exposures, which could exaggerate the effects. Benefits were retained only in the 6-MWT performance (Analysis 6.8). Moreover, all studies, except Yang 2006, included specific walking training.

When comparing the effects of the different interventions (comparison 7) it is cardiorespiratory training with or without resistance training (mixed training) that benefits walking speed outcomes. Within this analysis it is clear that the cardiorespiratory element is key and this is most effective when presented via a walking mode of exercise. Resistance training with or without a cardiorespiratory element (mixed) also benefits walking speed but these data are dominated by the effect of mixed training and they are less trustworthy.

Walking speed improvements after training could be connected to an increased fitness reserve (arising from an increased VO₂ peak and/or improved gait economy). Walking-based training interventions dominate the effects of both cardiorespiratory and mixed training and these are by definition 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.

Therefore, on the whole, there is consistent evidence that measures of walking performance improve after both cardiorespiratory training and mixed training, but not after resistance training alone. Although the improvements are clear, one could still question whether they are clinically important. For example, Fulk 2011 concluded that a clinically important increase in preferred walking speed after stroke would be 10.5 m/minute; this is greater than the upper 95% confidence interval (CI) margin of the effect sizes for preferred walking speed in this review. Fulk 2018 suggested that the minimum clinically important difference for 6-MWT is +71 to +130 metres based on patients who are initially fast walkers (≥ 0.4 m/sec); these exceed the effects in this review. Baseline gait speed will remain an important consideration for making judgements about magnitude of effects in walking speed outcomes.

Physical function

A variety of measures to assess motor function were used in the included studies; balance data and Timed Up and Go data could each be pooled and were recorded across all training types.

All three main intervention types collected Berg Balance score data and each showed beneficial effect sizes. Most cardiorespiratory training studies involved walking, and these contributed most of the beneficial effect (moderate certainty). Mixed training data were less trustworthy and possibly affected by confounding (low certainty). Resistance training interventions demonstrated the largest overall effect but were of low certainty. Taken all together interventions involving cardiorespiratory training with or without resistance training (mixed) improved balance. Likewise resistance training with or without cardiorespiratory training (mixed) improved balance. These data suggest that there is more to training balance that just specific 'balance training' interventions as demonstrated by the similar effects of resistance training and of walking-type exercise. Other systematic reviews have examined cardiorespiratory training effects (Pang 2013), and trunk training effects (Cabanas-Valdés 2013; Sorinola 2014), on balance after stroke. Although Sorinola 2014 reported a significant effect of trunk exercise on standing balance (SMD 0.72, 95% CI -0.01 to 1.45; P = 0.05) the balance data as a whole are not convincing and these reviews have different eligibility criteria to the current review. The systematic review of Van Duijnhoven 2016 examined the effects of different exercise therapy interventions and showed that these benefited balance; the overall effect size on the Berg Balance scale was 2.22 points (95% CI 1.26 to 3.17), which is very similar to our data. In addition, Van Duijnhoven 2016 noted that it was specific balance and/or weight-shifting training that gave the largest effect size (3.75 points 95% CI 1.71 to 5.78), whereas in this review, the largest effect was after resistance training and this is of similar magnitude (MD 3.27, 95% CI 2.15 to 4.38).

All three training types appear to give a similar overall effect on Timed Up and Go performance. While there is no clear minimum clinically-important difference established for this outcome, it does

relates to mobility, balance and risk of falls and is therefore relevant to people with stroke.

Health status and quality of life

Data do exist that examine quality-of-life measures; however, studies use a range of different tools to report different subscales and summary statistics, which makes meaningful pooling of these data difficult. Therefore, few conclusions can be drawn on whether training can improve self-perceived health status and quality of life after stroke. Taking into account all the data, there is also no discernible pattern in terms of studies showing or not showing a beneficial direction of effect across physical, mental, or emotional domains of the scales used. In addition, 14 out of 19 studies that included quality-of-life outcomes were confounded for additional intervention time, which means it is difficult to attribute any effects to the content of training. A systematic review of exercise after stroke included quality of life outcomes and also concluded that there was no consistent effect (Pang 2013).

Mood

Few studies of variable methodological quality were available to assess the effects of training on mood. There is no consistent pattern of effects and the pool of studies are at risk of bias due to attrition and confounding due to imbalanced exposures.

A recent systematic review of exercise for depressive symptoms after stroke combined data from 13 studies, with a total of 1022 participants, and showed a small effect at the end of exercise (SMD -0.13, 95% CI -0.26 to 0.01; $P = 0.03$), but not follow-up (Eng 2014). These findings may differ from the current review, since Eng 2014 pooled different exercise types; only five out of 13 RCTs met our eligibility criteria, and we made a methodological decision not to pool the data from Lennon 2008 in our meta-analyses (as this would have involved estimating mean and standard deviation from median and range).

In both reviews small benefits could be exaggerated due to confounded exposure. Also, any lack of effect could arise from the fact that the symptoms of depression are relatively mild; this could be due to confounding by antidepressant medications, which were not reported.

Cognitive function

Only six studies have examined the effect of fitness training interventions on cognitive function outcomes; currently no conclusions can be drawn. There are other systematic reviews that have examined the effects of exercise on cognitive function (Cumming 2012; Garcia-Soto 2013; Zheng 2016). The review of Cumming 2012 showed that physical activity and exercise interventions produced significant improvements in cognitive function at the end of the intervention (SMD 0.20, 95% CI 0.04 to 0.36; $P = 0.015$; nine studies, 716 participants). Although six out of 13 of the studies involved exercise interventions only three out of 13 included studies meet our inclusion criteria (Bateman 2001; Duncan 2003 (cited as Studentski); Mead 2007). Garcia-Soto 2013 reviewed the effects of cardiorespiratory and resistance training interventions on cognitive function after stroke. None of the five included studies met our criteria for inclusion. Likewise, Zheng 2016 examined the effect of cardiorespiratory exercises and none of the 10 included studies met our eligibility criteria.

There is a rationale as to why cognitive function may be improved by fitness training (Heyn 2004), and interventions to improve cognitive function have emerged as the highest rated research priority with regard to life after stroke (Pollock 2012). There are still very few data to determine whether exercise is beneficial, therefore this remains an important knowledge gap.

Factors influencing primary and secondary outcome measures

Performing subgroup analyses is challenging when the number of studies is small; the consequences are reduced power and the influence of characteristics unrelated to the grouping factors.

Dose of training

All the training interventions in this review occurred regularly and were progressive in nature. The interventions differed in the dose of training, quantified in terms of the intensity of the exercise, and overall volume of training time.

With regard to cardiorespiratory training interventions (Table 1), and studies that together reported a clear improvement in cardiorespiratory fitness (Analysis 1.9), nine out of the 10 studies reported exercise intensity as 60% to 80% heart rate reserve, 50% to 85% maximum heart rate, or 30% to 50% maximum effort; rate of perceived exertion was reported as 13 to 15 in two of 10 studies; there is some variation. Likewise, programme length varied from less than 12 weeks in four out of 10 studies to 12 weeks or longer in six out of 10 studies. There is heterogeneity in the analysis of cardiorespiratory fitness but this gives no obvious explanation to magnitude of effects. It is worth noting that all these studies involved cardiorespiratory training, which was regular (mostly 3 to 5 days/week) and progressive. The undeniable tendency is for an improved fitness response across all the studies irrespective of dose, so perhaps precise prescription of intensity is less important compared to being able to engage with exercise, which is regular and progressive; this elicits a physiological adaptation.

With regard to resistance training interventions (Table 2), eight out of 20 studies reported intensity of 70% to 80% maximal strength, and five out of 20 studies stated that a maximum effort was required over a target number of repetitions. Overall, 12 out of 20 studies required six to 15 repetitions of each exercise used; nine out of 20 studies reported that three to six sets of each exercise were performed. Programme length varied from less than 12 weeks in 14 out of 20 studies to 12 weeks or longer in six out of 10 studies. Like cardiorespiratory training, there is variation in overall dose and some studies activated more muscle groups/used differing numbers of exercises than others. Although we synthesised data without meta-analysis, there is a clear pattern of improved muscle strength arising from resistance training interventions. Regular resistance training can stimulate musculoskeletal adaptations in relatively short exercise programmes, and although these vary, they are regular and progressive.

With regard to mixed training interventions (Table 3), where the dose parameters for the cardiorespiratory and resistance training components are reported, these are similar in nature to those described above.

With regard to dose, the reality of progression is that dose is not fixed and should constantly change to drive adaptations. In those who respond more, progression may occur faster whilst being more conservative in those who adapt slower. A 'one-size-fits-all' dose,

particularly in terms of intensity and progression, does not seem realistic and should be instead be personalised. With regard to a starting dose, perhaps this is less important because progression will move things on quickly; just doing something will be a good start and help familiarise patients with what is involved.

Underestimation of benefits may arise if interventions are poorly attended or complied with. Few included studies had full attendance, where interventions occurred partly or completely during inpatient care, were home-based, or were of very short duration (four weeks). Overall, there were no real threats to planned dose among the included studies as a whole. This is a reflection of there being few adverse events and indicates that these interventions are acceptable to those who participated. However, the patient mix of included participants may have restricted generalisability the wider stroke population.

Overestimation of benefits may arise in studies where the intervention group is potentially confounded by increased training time compared with the control group; this is adding an undefined element of 'dose', which may involve physical activity. In these studies with no attention control, additional benefits could arise from non-specific effects of therapist input, psychosocial effects of contact with other participants, and factors such as travel to and from a training location that could amount to a substantial dose of physical activity from which a real training effect could arise.

Although benefits have emerged in programmes less than 12 weeks in length, there is some evidence to suggesting that four- to six-week programmes of physical rehabilitation are less effective than those of eight to 14 weeks (Pollock 2014). There is no reason why longer programmes of fitness training would not be more effective, likewise increased physical activity during the whole of life after stroke could achieve or maintain some of the same benefits as exercise.

Overall, the findings of this systematic review indicate that stroke survivors may successfully participate in, and complete, a variety of short-term training interventions. An 'optimal' dose for the content of training for people with stroke has yet to be established. In reality, this is likely to be highly individual and therefore a personalised, stratified approach to physical fitness training seems more appropriate.

Type of training

We were able to compare the effects of the different types of training on gait speed. Walking speed increased significantly after cardiorespiratory training and 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 specificity, the task-related nature of the training response. In particular, cardiorespiratory fitness (VO₂ peak) improved after interventions including cardiorespiratory training; muscle strength improved after interventions including resistance training; walking performance improved in particular after training interventions based on walking or walking-like modes of exercise.

Balance was improved by gait-containing cardiorespiratory training content but also by resistance training content; the

different stimuli and adaptations reflect the multi-dimensional nature of balance.

Overall, there is no one 'optimal' training type. Most patients are likely to benefit from a mixed programme of cardiorespiratory plus resistance training for secondary prevention, to improve fitness, improve mobility, and improve balance.

Timing of training

All our meta-analyses were divided into 'during usual care' and 'after usual care' subgroups. However, these analyses should be interpreted with caution as for many comparisons only a limited number of studies was available.

Overall completeness and applicability of evidence

We include patient-centred outcomes: still a lack of key outcomes

A priority-setting exercise undertaken in 2012 identified the top 10 research priorities for life after stroke (Pollock 2012). Among the priorities identified by people with stroke and those who care for them are a substantial proportion of areas for which fitness training could be beneficial:

- cognitive function;
- upper limb function;
- mobility, balance and gait; and
- the role of exercise in physical function, quality of life, and secondary stroke prevention (Saunders 2014a).

Apart from mobility, balance, and some aspects of function, there is little evidence relating to the other areas, which patients identified as relevant. In particular, cognitive function lacks investigation despite being ranked the most important research priority.

To measure disability and dependence in stroke is problematic. A variety of disability and assessment scales are usually reported in studies 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 a 'ceiling effect' and to skewed distributions. It would be useful if only well-known, validated scales were used in future studies for the assessment of participants' functional performance and if study investigators would clearly address the problems related to the use of these 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 (e.g. Fried 1996).

Some lack of follow-up data

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 studies assessing the effects 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 (including reduction of sedentary behaviour) and maintaining physical fitness in the long term after stroke.

Functional advantages observed at the end of rehabilitation interventions are known to be transient, disappearing at a later stage (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 studies included in this systematic review assessed possible retention of benefits over time. Those that did were at increased risk of attrition bias. Most of the functional improvements observed at the end of the training period were not sustained at later assessments. We found, however, that cardiorespiratory and mixed training effects on some 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 studies of physical fitness training. Long-term uptake of exercise could benefit from additional behaviour change support rather than just a finite exercise intervention (e.g. eight-week programme).

Interventions are typically short

While programmes of exercise may be finite, patients are likely to benefit from activity (including exercise) during the whole of life after stroke. Other interventions, such as being more physically active and being less sedentary, are, like exercise, also 'energy expending' in nature and may provide some similar benefits to exercise. It is plausible that these approaches may contribute to what exercise can offer and facilitate long-term retention and benefits.

Participant characteristics

Most participants were ambulatory and were higher functioning. Only five out of 75 studies included participants who were non-ambulatory, so there are difficulties in generalising the review findings to people with stroke who cannot walk. Included studies used eligibility criteria relating to contraindications to exercise; this means that participants are more likely have better function and health status. Although this restricts the population, the data are still generalisable to people who are screened as being able to safely participate in exercise interventions. The average age of participants was approximately 62 years. The findings are considered generalisable since two-thirds of all strokes are among those aged under 70 years (Feigin 2017).

Increase in studies including resistance training elements

Compared with previous updates of this systematic review, we have observed an increase in studies with a resistance training element. This means the data about fitness training are now more complete. The increase in interest mirrors that in other areas of public health (Steele 2017).

Nature of control groups: confounding

More than half of the included studies (41/75 studies; 55%) have a design without attention control, meaning that the exposure time is not equivalent. This confounds these data such that the benefits can only be attributed to the whole exposure rather than the content and design of the fitness training itself.

Quality of the evidence

All the data we have reviewed are from RCTs. The main threat concerning conclusions about the content and design of the exercise programmes is due to imbalanced exposure. Our sensitivity analyses identify where this may be happening.

Potential biases in the review process

At the search stage it is possible that some relevant studies were missed. However, we used a very comprehensive search strategy and ensured that every stage of inclusion involved an independent consensus decision by two review authors.

At the study selection stage it is possible that the interventions were misclassified resulting in either exclusion or resulting in misclassification of primary subgroup (cardiorespiratory, resistance, or mixed training). However, we used well-known definitions for fitness training that allowed clear criteria to be used (USDHHS 2018).

At the data extraction stage most included studies did not formally include adverse events as a pre-planned outcome. However, we screened all studies for adverse and serious adverse events.

At the data extraction stage two review authors extracted all study characteristics and 'Risk of bias' items independently and reached a consensus. One review author extracted outcome data but all the analysed data in Review Manager 2014 were double checked by a second review author.

At the data analysis stage missing data from one included study were interpolated before analysis (Bateman 2001). Where heterogeneity was introduced we tested the effect of including this study with a sensitivity analysis.

At the data analysis stage there could be publication bias and small-study biases that affected the conclusions. We did test for evidence of publication bias where a meta-analysis included 10 or more studies. There was no evidence of problematic publication biases.

At the data analysis stage we examined a range of different classes of outcomes; this is a broad review with that aim. However, small feasibility or pilot studies with high risk of bias and multiple outcomes may be more 'visible' in this review as the data may appear in multiple meta-analyses of different outcomes. Conversely, large studies focused on limited numbers of outcomes may be less 'visible'. Small studies with multiple outcome measures

are also more vulnerable to showing positive effects by chance if not adjusted for multiple comparisons.

At the reporting stage we made post hoc decisions about which outcomes to include in the tables of studies. We included the findings for the primary outcomes and we did this for all three training types irrespective of effect. Secondary outcomes that were not included are clearly stated as being incomplete data on which a consensus cannot be reached.

Agreements and disagreements with other studies or reviews

We retrieved 29 systematic reviews relating to exercise after stroke during the searches for this update. On the whole these differ from the architecture of this broad review because most tend to focus on one type of exercise (e.g. cardiorespiratory or resistance training), one mode of exercise (e.g. walking/treadmill), or report a restricted range of types of outcome measures. Therefore, this review is much more comprehensive in terms of capturing both the complexity of intervention and also the range of potential benefits from exercise as a whole.

Outcome by outcome there are some patterns of similarity. These include that cardiorespiratory fitness can be improved (Baldwin 2016; Boyne 2017; Saltychev 2016); balance can be improved by cardiorespiratory, resistance, and mixed training (Chen 2016; Hasan 2016; Iatridou 2018; Tally 2017; Van Duijnhoven 2016; Vloothuis 2016; Wist 2016); and walking/mobility can be improved by mixed and cardiorespiratory training (Baldwin 2016; Bonini-Rocha 2018; Boyne 2017; English 2017; Ilunga Tshiswaka 2018; Jeon 2015; Kendall 2016; Mehrholz 2017), particularly if walking is used as an exercise mode. There are also some shared concerns among other systematic reviews about the benefits of resistance training alone in terms of carry over of functional benefits (Dorsch 2018; Salter 2016; Wist 2016).

There are some differences, with several reviews showing positive effects on cognitive outcomes (Hasan 2016; Oberlin 2017; Vanderbeken 2017; Zheng 2016), whereas our analyses were inconclusive. One reason why our findings and those of other reviews may differ is that some reviews included other co-intervention elements that we would automatically exclude, and they may also have included studies that do not meet our criteria for being defined as exercise. One review author team shared our concerns about inadequate reporting, and the nature and dose of exercise interventions (Ammann 2014).

AUTHORS' CONCLUSIONS

Implications for practice

Cardiorespiratory training alone can improve cardiorespiratory fitness. As well as benefiting functional capacity this may have a risk reduction effect for secondary events.

Cardiorespiratory training alone or combined with a resistance training element (mixed training) improves the speed and capacity of walking when a walking mode of exercise is used; some of these effects are retained

Cardiorespiratory training or resistance training alone or in combination (mixed training) improves indices of balance. The

largest effects relate to resistance training. These effects may reduce risk of falls.

Therefore, for people with stroke who are able to take part in exercise there are good reasons to want to combine different training types in order to maximise benefits directly relating to physical fitness and mobility, and indirectly relating to reduction of risk of falls and secondary prevention.

A range of initiatives including practitioner training, best practice guidelines, and recommendations have been developed worldwide that help facilitate the flow of research information into practice. For example:

- UK (Exercise and Fitness Training after Stroke Instructor course; www.laterlifetraining.co.uk/courses/exercise-for-stroke-instructor/);
- Canada (Canadian Best Practice Recommendations for Stroke Care; www.strokebestpractices.ca/);
- USA (APA Physical Activity and Exercise Recommendations for Stroke Survivors; Billinger 2014).

These initiatives are 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; they can inform service delivery.

There are now a range of service delivery models in place in different countries around the world (Australia, Brazil, Canada, India, Nigeria, Singapore, Sweden, UK, and USA; Van Wijck 2019). The European Stroke Action Plan 2018-2030 gives a clear mandate for implementation of services including fitness training, stating a target for 2030 of "Offering physical fitness programmes to all stroke survivors living in the community" (Norrvig 2018).

The findings of this systematic review update will contribute to evidence-based pathways aimed at improving life after stroke.

Implications for research

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

Future studies should:

- comply with the current CONSORT guidelines for reporting of randomised clinical studies (CONSORT 2010);
- report exercise and control interventions more clearly; intervention reporting guidelines do exist (TIDiER; Hoffmann 2014) including some specific to exercise (CERT Consensus Exercise Reporting Template; Slade 2014);
- 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, for example people with depression or post-stroke fatigue;
- be of longer duration (12 weeks or longer);
- have a long-term follow-up; and
- have some type of attention control to reduce confounding.

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* Indicates the major publication for the study

CHARACTERISTICS OF STUDIES

Characteristics of included studies [ordered by study ID]

Ada 2013

Methods	Design: randomised trial of cardiorespiratory training vs no intervention – after UC
	Randomised: computer-generated randomisation stratified on walking disability by independent researcher
	Allocation concealment: not applicable
	Blinding: assessors blind to group allocation

Physical fitness training for stroke patients (Review)

Ada 2013 (Continued)

	<p>ITT: yes</p> <p>Measurements: end of interventions (2 and 4 months) and 6- and 12-month follow-up</p> <p>Withdrawals: 2 months treadmill training group: 1 participant withdrew; control group: 3 participants withdrew - reasons unclear</p>
Participants	<p>Randomised: 102 participants</p> <p>Intervention: treadmill training 2-month group: 34 participants: 28 men and 6 women; mean age 64 years (SD 12); 20 months post-stroke (SD 15). Treadmill training 4-month group: 34 participants; 24 men and 10 women; mean age 70 years (SD 11); 22 months post-stroke (SD 16)</p> <p>Control: 34 participants; 19 men and 15 women; mean age 63 years (SD 13); 19 months post-stroke (SD 13)</p> <p>Inclusion criteria: within first 5 years post-stroke; MMSE score of > 23; discharged from rehabilitation; community-dwelling; 10-m unaided walking speed > 9 seconds</p> <p>Exclusion criteria: unstable cardiac status; severe cognitive and/or aphasia</p>
Interventions	<p>Intervention group: both 2-month and 4-month treadmill training group received 30 min treadmill walking 3 times/week for 8 or 16 weeks respectively</p> <p>Progressive in nature. Both groups also received overground walking training (20% of intervention during week 1, increasing to 50% at week 8; for those in 4-month group, overground walking reduced to 20% of intervention increasing again to 50% at week 16)</p> <p>Control group: no intervention</p> <p>Setting: rehabilitation centre</p>
Outcomes	<p>Included outcomes: 6-MWT; EuroQol Health Status; Adelaide Activities Profile; walking and falls self-efficacy</p>
Notes	<p>There were 2 intervention groups. The extracted data correspond to:</p> <ul style="list-style-type: none"> group 1 (4-month intervention) end of intervention data were compared with control group data available at 4 months only group 2 (2-month intervention) end of intervention data were compared with control group data available at 2 months only <p>A subgroup analysis was performed (Dean 2014) to examine the effects of the intervention on slower (≤ 4 m/sec) and faster (> 4 m/sec) walkers at baseline</p>

Risk of bias

Bias	Authors' judgement	Support for judgement
Random sequence generation (selection bias)	Low risk	Computer-generated randomisation stratified on walking disability by independent researcher
Allocation concealment (selection bias)	Low risk	Allocation concealment ensured because all available participants allocated in groups of 15 to blocks of 3 after baseline measures recorded
Blinding (performance bias and detection bias) All outcomes	High risk	No attention control
Blinding of outcome assessment (detection bias) All outcomes	Low risk	Assessor blinded

Ada 2013 (Continued)

Incomplete outcome data (attrition bias) End of intervention	Low risk	ITT analysis performed Few (2/102) losses; 2-month treadmill training group: 1 participant withdrew; control group: 3 participants withdrew Reasons and timing unclear
Incomplete outcome data (attrition bias) End of follow-up	Low risk	ITT analysis performed Few losses (2/102); 2-month treadmill training group: 1 participant withdrew; control group: 3 participants withdrew Reasons and timing unclear
Selective reporting (reporting bias)	Low risk	Reported outcomes correspond to trial registry ACTRN12607000227493
Other bias	Low risk	None known
Imbalanced exposure	High risk	Intervention group has uncontrolled exposure

Aidar 2016

Methods	<p>Design: randomised trial of resistance training vs no intervention after UC</p> <p>Randomised mechanism: lottery allocation into groups</p> <p>Allocation concealment: not reported</p> <p>Blinding: assessor blinded to group allocation</p> <p>Measurements: end of intervention (12 weeks)</p> <p>Withdrawals: 3 participants from intervention group during 2nd week of intervention and 2 participants from control group were not assessed at the end of the intervention</p>
Participants	<p>Randomised: 24 participants</p> <p>Intervention: 11 participants; 6 men and 5 women; mean age 51.7 years (SD 8.0); days after stroke unknown (> 1 year)</p> <p>Control: 13 participants; 9 men and 4 women; mean age 52.5 years (SD 7.7); days after stroke unknown (> 1 year)</p> <p>Inclusion criteria: below 'per-capita' income, below minimum wage, medical authorisation 'clinically healthy people', stroke > 1 year ago, clinically stable, presence of hemiplegia or hemiparesis</p> <p>Exclusion criteria: aphasia, no recurrent strokes, asymptomatic with a non-disabling deficit or with severe disabilities</p>
Interventions	<p>Intervention group: resistance training; 12-week intervention, 3 times/week, each session lasting 60 min - conducted in the morning. Minimum of 48 h rest between sessions. Warm-up including 10-15 min walking followed by upper and lower body strengthening exercises: bar-guided squat, machine bench press, horizontal leg press, military press machine, abdominal crunch, front lateral pull downs and bar-guided lunges. 3 sets of 8-10 reps with 2-min rest between sets</p> <p>Control group: no intervention</p> <p>Setting: unclear; community-based project, indoor basketball court</p>

Aidar 2016 (Continued)

Outcomes	Included outcomes: <ul style="list-style-type: none"> • 2012 paper: State-Trait Anxiety Inventory; muscle strength (1-RM kg for various lifts; squat, bench press, leg press, military press, lateral pull downs, lunges) • 2014 paper: depression (BDI), muscle strength • 2016 paper: SF-36
Notes	Two separate publications 2012 and 2016

Risk of bias

Bias	Authors' judgement	Support for judgement
Random sequence generation (selection bias)	Unclear risk	"Lottery" allocation into groups; still unclear exactly what was done
Allocation concealment (selection bias)	Unclear risk	Allocation concealment: not reported
Blinding (performance bias and detection bias) All outcomes	High risk	No attention control
Blinding of outcome assessment (detection bias) All outcomes	Low risk	Blinded outcome assessors
Incomplete outcome data (attrition bias) End of intervention	High risk	2/13 control group not analysed in 2016 paper; no ITT analysis
Selective reporting (reporting bias)	Unclear risk	No protocol available
Other bias	Unclear risk	Self-selection bias may occur as advertisements were used
Imbalanced exposure	High risk	Intervention group has uncontrolled exposure

Aidar 2018

Methods	Design: randomised trial of cardiorespiratory training (aquatic physical exercises) vs no intervention - after UC Randomisation: stated 'random' but no further details provided Allocation concealment: not reported Blinding: not reported ITT: no Measurements: at the end of intervention (12 weeks) Withdrawals: (2007) 1 intervention group participant refused training programme; 2 control participants were not assessed at the end of the intervention
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Aidar 2018 (Continued)

Withdrawals: (2018) 3 intervention group participants dropped out of training programme; 4 control participants were not assessed at the end of the intervention

Participants	<p>Randomised (2007): 31 participants; assessed 28 (15 intervention 13 control)</p> <p>Randomised (2018): 31 + 12 = 43 participants; assessed 36 (19 intervention 17 control)</p> <p>Intervention: (2007) 15 participants; 10 men and 5 women; mean age 50.3 years (SD 9.1)</p> <p>Intervention: (2018) 19 participants; 10 men and 9 women; mean age 51.8 years (SD 8.5)</p> <p>Control: (2007) 13 participants; 9 men and 4 women; mean age 52.5 years (SD 7.7)</p> <p>Control: (2018) 17 participants; 9 men and 8 women; mean age 52.7 years (SD 6.7)</p> <p>Inclusion criteria: ischaemic cerebrovascular accident; hemiplegia or hemiparesis</p> <p>Exclusion criteria: cognitive impairment; significant co-morbidities</p>
Interventions	<p>Intervention group: aquatic physical sessions (e.g. walking activity and physical exercises in the water; swimming) 45-60 min each session; 2 times/week for 12 weeks</p> <p>Control group: no intervention - delayed started of the same programme</p> <p>Setting: community setting</p>
Outcomes	<ul style="list-style-type: none"> • Included outcomes (2007): SF-36 (with 2007 sample size) • Included outcomes (2018): BDI, State Trait Anxiety Inventory (Portuguese version), TUG, maximum walking speed (7.62 m), timed sit to stand, BBS
Notes	<p>Content of the intervention not very detailed. It appears that the Aidar 2018 paper is an extension of this same study published in 2007 with 8 new women participants added and different outcome reported</p>

Risk of bias

Bias	Authors' judgement	Support for judgement
Random sequence generation (selection bias)	Unclear risk	Stated 'random' but no further details provided
Allocation concealment (selection bias)	Unclear risk	Not reported
Blinding (performance bias and detection bias) All outcomes	High risk	No attention control
Blinding of outcome assessment (detection bias) All outcomes	Unclear risk	Not reported
Incomplete outcome data (attrition bias) End of intervention	Unclear risk	1/16 lost from intervention and 2/15 from control group. No ITT analysis
Selective reporting (reporting bias)	Unclear risk	No protocol available
Other bias	Low risk	None known

Aidar 2018 (Continued)

Imbalanced exposure	High risk	Imbalanced exposure
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Arabzadeh 2018

Methods	<p>Design: open-label, randomised clinical trial; task-orientated resistance training (and balance) vs CPT during UC</p> <p>Randomisation: unclear; states that the randomisation procedure was performed by a person who was not involved in the assessment</p> <p>Allocation concealment: independent person prepared sealed envelopes, which were picked up by participants in the order in which they entered the study</p> <p>Blinding: participants in both groups were treated and assessed by the same physiotherapist; bias due to "non blinding" was noted in the studies limitations; participants and assessors may have understood nature of group assignments</p> <p>ITT: not stated</p> <p>Measurements: end of intervention (4 weeks)</p> <p>Withdrawals: not reported</p>
Participants	<p>Randomised: 20 participants were randomised</p> <p>Intervention: 10 participants; 8 men (80%) and 2 women (20%); mean age: 58.9 (SD 26.8); time since stroke onset: 32.80 days (SD 16.71)</p> <p>Control: 10 participants; 7 men (70%) and 3 women (30%); mean age: 59.6 (SD 7.16); time since stroke onset: 32.5 days (SD 15.78)</p> <p>Inclusion criteria: hemiplegia following stroke within 3 months, observational clear asymmetry in weight bearing, ability to walk 10 m independently without an assistive device, and BBS in the range of 30-40</p> <p>Exclusion criteria: impaired vision, neurological or orthopaedic diseases affecting postural function, and other diseases preventing participation</p>
Interventions	<p>Intervention: 10 task-oriented exercises aimed at promoting balance, some of which incorporated strengthening. Progression was achieved by increasing repetitions, height of exercise step and adding weights around ankles; and somatosensory and vision manipulations (open/closed eyes and hard/soft surface). Frequency of intervention: 50 min/session 3 days/week for 4 weeks</p> <p>Control: CPT (mat exercises, range of motion exercises, and walking education). The control group matched the intervention group in terms of time and number of exercises. Frequency of intervention: 50 min/session 3 days/week for 4 weeks</p> <p>Setting: unclear, patients referred from 2 hospital outpatient clinics</p>
Outcomes	<p>Included outcomes: Persian version of BBS</p> <p>Other outcomes: plantar pressure distribution, centre of pressure path length, and the centre of pressure confidence ellipse area</p>
Notes	Trial registry IRCT 2015100224297N1

Risk of bias

Bias	Authors' judgement	Support for judgement
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Arabzadeh 2018 (Continued)

Random sequence generation (selection bias)	Unclear risk	Report states "randomisation procedure" but no further details provided on how order of envelopes was achieved
Allocation concealment (selection bias)	Unclear risk	Performed by an independent person but unclear whether envelopes were opaque and sequentially numbered
Blinding (performance bias and detection bias) All outcomes	Unclear risk	Comparison of 2 different interventions (task-oriented exercise program vs CPT)
Blinding of outcome assessment (detection bias) All outcomes	High risk	Both the article and trial registry indicate that blinding was not used
Incomplete outcome data (attrition bias) End of intervention	Unclear risk	ITT not reported and no information about extent of dropouts or retention
Incomplete outcome data (attrition bias) End of follow-up	Low risk	
Selective reporting (reporting bias)	Low risk	Included outcomes correspond with protocol IRCT2015100224297N1
Other bias	Low risk	None known
Imbalanced exposure	Low risk	Matched exposures

Bale 2008

Methods	<p>Design: randomised trial of resistance training plus % UC vs UC - during UC</p> <p>Sample size calculation reported</p> <p>Randomisation: drawing lots - not clearly described</p> <p>Allocation concealment: unclear</p> <p>Blinding: outcome assessors blinded</p> <p>ITT: planned but no withdrawals</p> <p>Measurements: at the end of intervention (4 weeks)</p> <p>Withdrawals: none</p>
Participants	<p>Randomised: 18 participants</p> <p>Intervention: 8 participants; 3 men and 5 women; mean age 68.0 years (SD 13); time since stroke 49.4 (SD 22.1) days</p> <p>Control: 10 participants; 4 men and 6 women; mean age 64.9 years (SD 8.8); time since stroke 32.0 (SD 18.5) days</p> <p>Inclusion criteria: first onset of stroke with reduced muscle strength in the affected leg; ability to understand verbal information; ability to sit without support</p>

Bale 2008 (Continued)

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	<p>Intervention group: resistance training 50 min/day 3 days/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). 1 set of 10-15 reps to moderate fatigue</p> <p>Control group: UC (Bobath) 50 min/day 3 days/week for 4 weeks, plus UC (other) 50 min/day, 2 days/week for 4 weeks. Total training: 50 min/day 5 days/week for 4 weeks</p> <p>Setting: 2 rehabilitation units</p>
Outcomes	<p>Included outcomes: isometric muscle strength; preferred walking speed; maximal walking speed</p> <p>Other outcomes: maximum weight bearing; 2 items of the MAS; Patient Global Impression of Change tool</p>
Notes	<p>Very small sample size</p> <p>Poor external validity</p>

Risk of bias

Bias	Authors' judgement	Support for judgement
Random sequence generation (selection bias)	Unclear risk	Drawing lots - not clearly described
Allocation concealment (selection bias)	Unclear risk	Poorly reported
Blinding (performance bias and detection bias) All outcomes	Unclear risk	Attention control exposure
Blinding of outcome assessment (detection bias) All outcomes	Low risk	Outcome assessor
Incomplete outcome data (attrition bias) End of intervention	Low risk	ITT planned but no withdrawals
Selective reporting (reporting bias)	Unclear risk	No protocol available
Other bias	Low risk	Unclear
Imbalanced exposure	Low risk	Balanced exposure

Bateman 2001

Methods	Design: multicentre randomised trial of cardiorespiratory training plus UC vs non-exercise intervention plus UC - during UC
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Bateman 2001 (Continued)

Randomisation: mechanism - computer; method - blocks size of 10 participants
 Allocation concealment: numbered, sealed envelopes
 Blinding: investigator blinded; participants encouraged to maintain blinding; efficacy unknown
 ITT: 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; men 20, women 20; age 47.0 years (SD 13.1); 144 days (SD 84) post-stroke Control: 44 participants; men 29, women 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% -80% of age-related HR maximum for up to 30 min/day 3 days/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 (0-20 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 study 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
Random sequence generation (selection bias)	Low risk	Computer-based block (n = 10) randomisation
Allocation concealment (selection bias)	Low risk	Numbered, sealed envelopes
Blinding (performance bias and detection bias) All outcomes	Unclear risk	Attention control
Blinding of outcome assessment (detection bias) All outcomes	Low risk	Investigator blinded; participants encouraged to maintain blinding; efficacy unknown
Incomplete outcome data (attrition bias) End of intervention	High risk	ITT employed 6/84 (7%) lost: intervention group 4; control group 2 Reasons for losses not clear but included exclusion after recruitment and baseline assessments due to discharge Large amounts of missing outcome data
Incomplete outcome data (attrition bias)	High risk	ITT employed

Bateman 2001 (Continued)

End of follow-up		24/85 (29%) total losses; intervention group 8; control group 10
Selective reporting (reporting bias)	Unclear risk	Protocol not available
Other bias	Low risk	None known
Imbalanced exposure	Low risk	Balanced exposure

Buyukvural 2015

Methods	<p>Design: prospective RCT; resistance training + conventional rehabilitation (isokinetic group) vs conventional rehabilitation alone (control group) - during UC</p> <p>A group of healthy controls performed the isokinetic test protocol (healthy controls) only for comparison of healthy vs non-paretic side peak torque measurements pre-treatment (not discussed in this review)</p> <p>Randomisation: not reported</p> <p>Allocation concealment: not reported</p> <p>Blinding: not reported</p> <p>ITT: not reported</p> <p>Measurements: before (baseline) and at the end of intervention (3 weeks)</p> <p>Withdrawals: not reported</p>	
Participants	<p>Randomised: 50 stroke participants. 25 participants were randomised to resistance training, and 25 to the control group</p> <p>Number randomised in comparisons used in this review this review = 50</p> <p>Intervention: 25 participants; 17 men (68%) and 8 women (32%); mean age: 51.3 (SD 12.0); mean months post-stroke: 3 (range 2-8)</p> <p>Control: 25 participants; 16 men (64%) and 9 women (36%); mean age: 55.4 (SD 10.5); mean months post-stroke: 3 (range 2-9)</p> <p>Inclusion criteria: subacute-chronic stroke</p> <p>Exclusion criteria: not co-operative, with a previous history of stroke, concomitant disorders preventing rehabilitation programme such as severe cardiovascular and pulmonary diseases, uncontrolled hypertension, stroke due to tumour or trauma, major sensorimotor aphasia, orthopaedic disorders can affect isokinetic assessments, musculoskeletal pain of lower limbs, and vestibular disorders</p>	
Interventions	<p>Intervention: conventional rehabilitation + isokinetic strengthening. Isokinetic strengthening consisted of maximal concentric isokinetic training to the bilateral knee-ankle muscles according to the following protocols: knee exercise protocol: 5 repetitions at 60°/s, 90°/s, 120°/s, 150°/s angular velocities; 10 s rest period; 10 repetitions at 180°/s</p> <p>Ankle exercise protocol: 5 repetitions at 60°/s, 90°/s, 120°/s angular velocities; 10 s rest period; 10 repetitions at 150°/s angular velocity. Frequency of intervention: 5 days/week for 3 weeks</p> <p>Control: conventional rehabilitation. Frequency of intervention: not reported</p> <p>Setting: hospital</p>	

Buyukvural 2015 (Continued)

Outcomes	Included outcomes: muscle strength; paretic and non-paretic knee peak torque (at 60°/s and 180°/s) and ankle peak torque (at 60°/s and 120°/s), Stroke Specific QoL Scale, timed 10-metre walk test, 6-MWT, stair-climbing test, TUG test, BBI, and RMI Other outcomes: FIM (motor subscale)
Notes	It is unclear what the conventional rehabilitation consisted of, in terms of content and dose No variance/SD data available for outcomes; requested from author. SD of change scores interpolated from P values

Risk of bias

Bias	Authors' judgement	Support for judgement
Random sequence generation (selection bias)	Unclear risk	No information on randomisation procedure. Groups appear balanced
Allocation concealment (selection bias)	Unclear risk	Not reported
Blinding (performance bias and detection bias) All outcomes	High risk	No attention control for amount of exposure therefore no opportunity to conceal purpose etc
Blinding of outcome assessment (detection bias) All outcomes	Unclear risk	Not described
Incomplete outcome data (attrition bias) End of intervention	Unclear risk	Extent of missing outcome data not reported
Selective reporting (reporting bias)	Unclear risk	No trial registry or protocol information
Other bias	Unclear risk	Inadequate reporting makes it difficult to assess other potential biases in this study
Imbalanced exposure	High risk	No attention control

Cooke 2010

Methods	<p>Design: phase I multicentre trial; 4 centres; mixed training plus UC vs UC - during UC - i.e. FST + CPT vs CPT alone and vs CPT + CPT</p> <p>Randomisation: computer-generated random allocation in blocks of 9 per study centre (stratified allocation by baseline scores for visual spatial neglect)</p> <p>Allocation concealment: sequentially numbered, sealed, opaque envelopes</p> <p>Blinding: assessor blinded to group allocation</p> <p>ITT: attempt to measure participants at outcome and follow-up even if they withdrew but analyses were not performed according to ITT principle</p> <p>Measurements: at the end of intervention (6 weeks) and 12 weeks later (follow-up)</p>
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Cooke 2010 (Continued)

Withdrawals: at outcome 7/74 (9%) participants were lost at outcome in the control CPT group (3 unwell, 3 withdrew, 1 moved abroad). At follow-up, a further 21 participants had withdrawn (total 28/74 26%). 14 participants were lost in the CPT group (5 unwell, 4 withdrew, 1 moved abroad, 2 housebound, 2 died) and 7 in the CPT + FST group (5 unwell, 2 withdrew)

Participants	<p>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)</p> <p>Number randomised in comparisons used in this review this review = 74</p> <p>Intervention: FST + CPT = 36 participants; 22 men (61%) and 14 women (39%); mean age: 71.17 (SD 10.6); 33.86 (SD 16.50) days after stroke</p> <p>Control: CPT = 38 participants; 21 men (55%) and 17 women (45%); mean age: 66.37 (SD 13.7); 36.76 (SD 22.41) days after stroke</p> <p>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</p> <p>Exclusion criteria: not reported</p>	
Interventions	<p>Intervention: FST/mixed training + CPT. FST consisted of increasing the amount of body weight the participants needed to move; increasing movement resistance; reducing amount of body weight support during treadmill training. Frequency of intervention: 1 h for 4 days/week for 6 weeks</p> <p>Control: CPT included soft tissue 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 h for 4 days/week for 6 weeks</p> <p>Setting: hospital</p>	
Outcomes	<p>Included outcomes: walking speed; HRQoL measures (e.g. EuroQol)</p> <p>Other outcomes: gait parameters; paretic knee torque force analysis; modified RMI</p>	
Notes	<p>Study authors stated 'strength training' but intervention was actually mixed training</p>	
Risk of bias		
Bias	Authors' judgement	Support for judgement
Random sequence generation (selection bias)	Low risk	Computer-generated random allocation in blocks of 9 per study centre (stratified allocation by baseline scores for visual spatial neglect)
Allocation concealment (selection bias)	Low risk	Sequentially numbered, sealed, opaque envelopes
Blinding (performance bias and detection bias) All outcomes	High risk	Comparison used means no attention control
Blinding of outcome assessment (detection bias) All outcomes	Low risk	Assessor blinded to group allocation
Incomplete outcome data (attrition bias) End of intervention	High risk	Attempt to measure participants at outcome and follow-up even if they withdrew but analyses were not performed according to ITT principle. Imbalanced losses at the end of intervention

Cooke 2010 (Continued)

		7/74 (9%) participants were lost from the control CPT group (3 unwell, 3 withdrew, 1 moved abroad)
Incomplete outcome data (attrition bias) End of follow-up	High risk	Attempt to measure participants at outcome and follow-up even if they withdrew but analyses were not performed according to ITT principle. Imbalanced large losses at the end of follow-up 28/74 (38%) total losses: 14 participants were lost from the CPT group (5 unwell, 4 withdrew, 1 moved abroad, 2 housebound, 2 died) and 7 in the intervention group CPT + FST group (5 unwell, 2 withdrew)
Selective reporting (reporting bias)	Low risk	Reported outcome correspond with those in trial register NCT00322192
Other bias	Low risk	None known
Imbalanced exposure	High risk	Imbalanced exposure (CPT + CPT group although balanced does not meet inclusion criteria)

Coroian 2018

Methods	<p>Design: RCT; resistance training plus UC vs non-exercise (sham) intervention plus UC to compare isokinetic strengthening of elbow and wrist muscles to passive mobilisation of the same joints in a population of chronic stroke</p> <p>Randomisation: randomly assigned in a 1:1 ratio. Randomisation sequence was centralised and computed in permuted blocks of 4 participants by a statistician (using Talena)</p> <p>Allocation concealment: not listed</p> <p>Blinding: physiotherapists and occupational therapists were blinded as to which participants had been included in which group. Provision of upper limb strengthening exercises was provided by a therapist not involved with participant's care</p> <p>ITT: ITT analysis performed but not described</p> <p>Measurements: baseline, end of intervention (variable, between 45 days and 60 days) and follow-up at 3 months and 6 months</p> <p>Withdrawals: intervention group: 2/10 (20%) discontinued after the end of the intervention (2 moved to another region). Control group: 2/10 (20%) discontinued after the 3-month follow-up (gastric ulcer = 1; lost to follow up n = 1)</p>
Participants	<p>Randomised: 20 participants (20 reported in study, intervention n = 10, control n = 10)</p> <p>Intervention: 10 participants; 8 men (80%); mean age 63.6 years; time since stroke 32.2 months</p> <p>Control: 10 participants; 8 men (80%); 63.6 years; time since stroke 29.1 months</p> <p>Inclusion criteria: > 18 years, time since stroke > 6 months, flexion/extension manual muscle testing of the elbow and wrist > 2/5, Modified Ashworth Scale score < 3/5 for the wrist and elbow muscles, no limitations in upper limb range of motion (at shoulder, elbow, metatarsophalangeal joint)</p> <p>Exclusion criteria: cognitive impairment (Boston Aphasia Quotient Score < 4/5), Catherine Bergego Scale > 14/20, MMSE < 22 and participant (or their legal team) refusal to take part in the study</p>
Interventions	<p>Intervention: 18-day rehabilitation programme spread over 6 consecutive weeks (3 days/week). Each day: 2 x 30 min of PT (passive and active mobilisation of upper and lower limbs, balance exercises, manual strengthening of weak muscles, global motor reinforcement, task training, cardiorespiratory and walking training. Plus 1 x 45 min OT (focused on hand grasp). Upper limb isokinetic muscle</p>

Physical fitness training for stroke patients (Review)

Coroian 2018 (Continued)

strengthening exercises using the dynamometer (for 30 min with 6 sets of 8 repetitions) intensity progressing from 40%-70% of maximal baseline torque values

Control: 18-day rehabilitation programme spread over 6 consecutive weeks (3 days/week). Each day: 2 x 30 min of PT (passive and active mobilisation of upper and lower limbs, balance exercises, manual strengthening of weak muscles, global motor reinforcement, task training, cardiorespiratory and walking training. Plus 1 x 45 min OT (focused on hand grasp). Performed only passive mobilisation of the elbow and wrist in the allowed range of motion

Setting: not reported

Outcomes	Included outcomes: upper limb Fugl-Meyer Assessment (sensorimotor impairment), Box and Block test (grasping capacities), Modified Ashworth scale (spasticity), muscle strength of wrist and elbow flexors and extensors (maximum isokinetic reciprocal flexion/extension contractions, plus highest peak torques)
Notes	Clinical Trials Registration Number: NCT01554137

Risk of bias

Bias	Authors' judgement	Support for judgement
Random sequence generation (selection bias)	Low risk	Block randomisation mechanism described
Allocation concealment (selection bias)	Low risk	Centralised system; randomisation sequence likely to be secure
Blinding (performance bias and detection bias) All outcomes	Unclear risk	Attempts to blind those involved in delivering and receiving the interventions and care, to the exact nature of the overall exposures
Blinding of outcome assessment (detection bias) All outcomes	Low risk	Blinded outcome assessment
Incomplete outcome data (attrition bias) End of intervention	Low risk	No dropouts at end intervention (45d). ITT analysis performed
Incomplete outcome data (attrition bias) End of follow-up	Unclear risk	2/10 (20%) lost from intervention at 3 months and 2/10 lost from control at 6 months. Therefore, at final follow-up (6 months) both groups lost 2/10 but ITT analysis used
Selective reporting (reporting bias)	High risk	Only the Fugl Meyer outcome measure was reported on the NCT01554137 trial registry
Other bias	High risk	Anecdotal assessment of fatigue resulted in changes and reluctance to recruit participants
Imbalanced exposure	Low risk	Sham passive mobilisation attention control

Cuviello-Palmer 1988

Methods	Design: randomised trial of cardiorespiratory training plus % UC vs UC - after UC Randomisation: unknown Allocation concealment: unknown
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Physical fitness training for stroke patients (Review)

Cuviello-Palmer 1988 (Continued)

Blinding: unknown
 ITT: no

Measurements: end of intervention (3 weeks)
 Withdrawals: none

Participants	Randomised: 20 participants Intervention: 10 participants; 6 men and 4 women; age 69.5 years (SD 14.1); 20.7 days post-stroke (SD 13.2) Control: 10 participants; 7 men and 3 women; 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 min/day for 5 days/week and 1 x 7 min/day for 1 day/week (total 6 days/week) for 3 weeks progressing to 10 min/session in week 2 and 12 min in week 3 Exercise intensity maintained at a HR of < 20 bpm above resting Control: UC: 2 x 45 min/day for 5 days/week and 1 x 45 min/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), Brunnstrom, 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/min and other biomechanical gait parameters
Notes	—

Risk of bias

Bias	Authors' judgement	Support for judgement
Random sequence generation (selection bias)	Unclear risk	Not reported
Allocation concealment (selection bias)	Unclear risk	Not reported
Blinding (performance bias and detection bias) All outcomes	High risk	Some degree of attention control
Blinding of outcome assessment (detection bias) All outcomes	Unclear risk	Not reported
Incomplete outcome data (attrition bias) End of intervention	Low risk	No withdrawals, no planned ITT
Selective reporting (reporting bias)	Unclear risk	No protocol available
Other bias	Low risk	Not known
Imbalanced exposure	Low risk	Exposure balanced

da Cunha 2002

Methods	Design: randomised trial of cardiorespiratory training plus % UC vs UC - during UC Randomisation mechanism: random number table Allocation concealment: unknown Blinding: unknown ITT: no Measurements: end of intervention (2/3 weeks - until discharge) Withdrawals: none
Participants	Randomised: 15 participants Intervention: 7 participants; 6 men and 1 women; age 57.8 years (SD 5.5); 15.7 days post-stroke (SD 7.7) Control: 8 participants; 7 men and 1 women; 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 m/min; FAC score of 0, 1 or 2); sufficient cognition to participate in training (MMSE ≥ 21); able to stand and take ≥ 1 steps without assistance Exclusion criteria: co-morbidity or disability other than hemiparesis; recent MI; 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 min/day 6 days/week for 2-3 weeks (until discharge); intensity unknown but rapid progression imposed by increasing speed and reducing body weight support; the 20-min training replaced the 20-min gait training component of the control Control: UC 3 h/day for 6 days/week for 2-3 weeks until discharge; included kinesitherapy (1 h/day), OT (1 h/day), and physical therapy (1 h/day); the physical therapist included 20 min 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; BP; FAC; FIM (lower limb); gait speed maximal (5 m); gait endurance (5 min); gait economy Other outcomes: stance symmetry; contact time (s); stride cadence steps/min and other biomechanical gait parameters
Notes	—

Risk of bias

Bias	Authors' judgement	Support for judgement
Random sequence generation (selection bias)	Low risk	Randomisation by using random numbers to pre-assign participants based on recruitment order
Allocation concealment (selection bias)	Unclear risk	Not reported
Blinding (performance bias and detection bias) All outcomes	Unclear risk	Some degree of attention control
Blinding of outcome assessment (detection bias) All outcomes	Unclear risk	Not reported
Incomplete outcome data (attrition bias) End of intervention	Low risk	No withdrawals, no planned ITT

da Cunha 2002 (Continued)

Selective reporting (reporting bias)	Unclear risk	No protocol available
Other bias	Low risk	None known
Imbalanced exposure	Low risk	Balanced exposure

Dean 2018

Methods	<p>Design: 2-group, assessor-blinded, RCT with parallel mixed methods process and economic evaluations. 2 centres in community setting</p> <p>ReTRAIN i.e. mixed training plus UC vs UC alone - after UC (> 1 month post-discharge)</p> <p>Randomisation: the random sequence was computer-generated with minimisation for time since stroke (≤ 3 months vs > 3 months) and level of functional disability (mRS score ≤ 2 vs > 2)</p> <p>Allocation concealment: using a password-protected validated web-based remote randomisation service supported by the Peninsula Clinical Trials Unit. The Trial Manager requested randomisation only after a cohort of participants had been consented</p> <p>Blinding: assessor blinded to group allocation; participants were reminded not to reveal their allocation to assessors but any unblinding was recorded; after assessments assessors were asked to guess participant allocation</p> <p>Participants, trainers providing the intervention and researchers conducting the process and economic evaluations could not be blinded to allocation</p> <p>ITT: missing data were reported but no attempts were made to analyse according to ITT</p> <p>Measurements: baseline, 6-month and 9-month follow-up</p> <p>Withdrawals: before start of intervention 2/23 allocated to ReTRAIN withdrew (1 unwell, 1 family crisis); 2/22 control withdrew before intervention (1 unwell, 1 wanted to be in the experimental group). At 6-month follow-up there were missing data for 1 participant in the control group; none in the experimental group. At 9 months there were no missing data (ReTRAIN n = 21; control n = 20)</p>
Participants	<p>Randomised: 45 participants</p> <p>Intervention: ReTRAIN + UC 23 participants; 16 men (70%) and 7 women (30%); mean age: 70 (SD 12); time since stroke ≤ 3 months n = 1 (4%), > 3 months n = 22 (96%)</p> <p>Control: UC 22 participants; 14 men (67%) and 8 women (33%); mean age: 71 (SD 10); time since stroke ≤ 3 months n = 0 (0%), > 3 months n = 22 (100%)</p> <p>Inclusion criteria: diagnosis of stroke, any time since stroke but at least 1 month since discharge from NHS physical rehabilitation services, able to walk independently indoors with or without mobility aids, but with self-reported difficulty with stairs, slopes or uneven surfaces, willingness to be randomised and attend the training venue and cognitive capacity and communication ability sufficient to participate</p> <p>Exclusion criteria: < 18 years old, currently (or within 1 month of) receiving ARNI training or have contraindications to moderate to vigorous physical activity (adapted from ACSM guidelines)</p>
Interventions	<p>Intervention: ReTRAIN</p> <ol style="list-style-type: none"> 1. an introductory one-to-one session; 2. 10 x twice-weekly group classes (duration 2 h) with up to 2 trainers and 8 clients; 3. a closing one-to-one session (over 3 months), followed by 3 drop-in sessions (once/month over the subsequent 3 months).

Physical fitness training for stroke patients (Review)

Dean 2018 (Continued)

Participants received a bespoke home-based training programme (duration unclear). All participants received treatment as usual.

Control: all participants received treatment as usual. The control group received a UK Stroke Association booklet on exercise after stroke.

Setting: community setting

Outcomes	<p>Included outcomes: RMI, TUG Test, modified Patient-Specific Functional Scale, Stroke QoL, adverse events at 6 and 9 months, SF12, EQ-5D-5L, EQ5 (QoL)</p> <p>Other outcomes: feasibility, acceptability and process outcome, acceptability of randomisation, outcome measurement burden and the intervention assessments). Intervention fidelity, physical activity subjective and objective (accelerometry and a physical activity diary). Stroke Self-Efficacy Questionnaire, Fatigue Assessment Scale, Exercise Beliefs and Self-questionnaires, Carer Burden Index and Health and Social Service use through a Service Receipt Inventory</p>
Notes	<p>ReTRAIN trial</p> <p>NCT02429180</p>

Risk of bias

Bias	Authors' judgement	Support for judgement
Random sequence generation (selection bias)	Low risk	Computer-generated randomisation
Allocation concealment (selection bias)	Low risk	Remote randomisation service
Blinding (performance bias and detection bias) All outcomes	High risk	The control group did not receive an active or sham treatment
Blinding of outcome assessment (detection bias) All outcomes	Low risk	Outcomes were assessed by independent researchers who were blinded to group allocation. Participants were also reminded not to reveal their allocation
Incomplete outcome data (attrition bias) End of intervention	Low risk	Very few dropouts: 2 in each group. Intervention (2/23): reasons 1 unwell, 1 family crisis; control (2/22): 1 unwell, 1 wanted ReTRAIN intervention. At end of intervention data was available for 21/21 in the intervention group and 19/22 in the control. ITT not mentioned
Incomplete outcome data (attrition bias) End of follow-up	Low risk	Outcome data available at 12-month follow-up for 21/23 in the intervention and 20/22 in the control group. ITT not mentioned
Selective reporting (reporting bias)	Low risk	The primary outcomes as reported in the study registration, feasibility, acceptability and fidelity were not mentioned in the study registration (outcomes not included in review)
Other bias	Unclear risk	Exercise after stroke booklet given to control group
Imbalanced exposure	High risk	The intervention received active 'treatment' whereas the control group received UC and this could vary from nothing or could meet or exceed that provided in the intervention

Donaldson 2009

Methods	<p>Design: phase II randomised multicentre trial; 3 centres; mixed training plus UC vs UC - during UC - i.e. FST + CPT vs CPT alone and vs CPT plus CPT</p> <p>Randomisation: computer-generated random allocation. Allocation was stratified by baseline Action Research Arm Test score in blocks of 3 within each stratum</p> <p>Allocation concealment: sequentially numbered, sealed, opaque envelopes held by an independent investigator</p> <p>Blinding: assessor blinded to group allocation</p> <p>ITT: yes</p> <p>Measurements: at the end of intervention (6 weeks) and 12 weeks after (follow-up)</p> <p>Withdrawals: 2 participants were lost at outcome in the CPT group (new stroke = 1; dropped out = 1). A further 11 participants were lost at follow-up. 5 participants in the CPT group (3 unwell, 1 moved abroad, 1 dropped out) and 2 in the CPT + FST group (1 unwell, 1 moved abroad)</p>	
Participants	<p>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, total 20)</p> <p>Intervention: CPT + FST = 10 participants, 3 men and 7 women; mean age: 72.6</p> <p>Control: CPT = 10 participants, 5 men and 5 women; mean age: 72.6</p> <p>Inclusion criteria: inpatients; infarction of the anterior cerebral circulation between 1 week 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</p> <p>Exclusion criteria: not reported</p>	
Interventions	<p>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 h for 4 days/week for 6 weeks</p> <p>Control: CPT included soft tissue mobilisation, facilitation of muscle activity/movement, positioning; joint alignment; tactile and proprioceptive input. Frequency of intervention: 1 h for 4 days/week for 6 weeks</p> <p>Setting: hospital setting</p>	
Outcomes	<p>Included outcomes: upper limb strength (hand grip force, pinch grip force; isometric elbow flexion and extension force); upper limb function (ARAT)</p> <p>Other outcomes: dexterity (i.e. 9-HPT)</p>	
Notes	<p>Not clear how this relates to NCT00322192</p>	
Risk of bias		
Bias	Authors' judgement	Support for judgement
Random sequence generation (selection bias)	Low risk	Computer-generated random allocation Allocation was stratified by baseline ARAT score in blocks of 3 within each stratum

Donaldson 2009 (Continued)

Allocation concealment (selection bias)	Low risk	Sequentially numbered, sealed, opaque envelopes held by an independent investigator
Blinding (performance bias and detection bias) All outcomes	Unclear risk	No attention control in the comparison, however Quote: "The majority of subjects (68%) who completed outcome measures were unsure as to which group they had been allocated (CPT 75%, CPT + CPT 60%, CPT + FST 70%; Table 3). Only 4 of the 28 subjects (14%) correctly identified the treatment they received. Even in the CPT group who had been told that they would receive no extra therapy, only 1 person correctly identified their grouping."
Blinding of outcome assessment (detection bias) All outcomes	Low risk	Assessor blinded to group allocation; efficacy unknown
Incomplete outcome data (attrition bias) End of intervention	Low risk	ITT analysis planned 2/20 (10%) lost at the end of intervention: control CPT group (new stroke = 1; bail = 1)
Incomplete outcome data (attrition bias) End of follow-up	High risk	ITT analysis planned 9/20 (45%) total losses at the end of follow-up: additional 5 participants in the control CPT group (3 unwell, 1 moved abroad, 1 bail) and 2 in the intervention CPT + FST group (1 unwell, 1 moved abroad)
Selective reporting (reporting bias)	Unclear risk	Unclear how the study relates to NCT00322192; outcomes do not correspond
Other bias	Low risk	None known
Imbalanced exposure	High risk	Imbalanced exposure in comparison used CPT vs CPT + FST

Duncan 1998

Methods	Design: randomised trial of mixed training vs UC - after UC (outpatient) Randomisation mechanism: unknown; method: blocks of 10 Allocation concealment: third party involvement Blinding: unclear ITT: yes Measurements: end of intervention (12 weeks) Withdrawals: none
Participants	Randomised: 20 participants Intervention: 10 participants; number of men and women unknown; age 67.3 years (SD 9.6); 66 days post-stroke Control: 10 participants; number of men and women unknown; age 67.8 years (SD 7.2); 56 days post-stroke Inclusion criteria: 30-90 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 that compromised outcome assessment or prevented fitness training; MMSE score < 18 or receptive aphasia

Duncan 1998 (Continued)

Interventions	<p>Intervention: mixed training, performed approximately 90 min/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</p> <p>Control: usual outpatient care, physical and OT as advised by the patient's physician, averaging 44 min/day, 3.25 days/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%)</p> <p>Setting: home-based, therapist-supervised for first 8 weeks</p>
Outcomes	<p>Included outcomes: BI; Lawton ADL; gait endurance (6-MWT); BBS; gait preferred speed (data lack variance measures)</p> <p>Other outcomes: SF-36 (non-standard pooling of data), Jebsen Hand Test; Fugl Meyer (upper and lower extremity)</p>
Notes	—

Risk of bias

Bias	Authors' judgement	Support for judgement
Random sequence generation (selection bias)	Unclear risk	Block randomisation used (blocks of 10), method unknown
Allocation concealment (selection bias)	Unclear risk	Third party involvement
Blinding (performance bias and detection bias) All outcomes	High risk	Degree of attention control
Blinding of outcome assessment (detection bias) All outcomes	Unclear risk	Not reported
Incomplete outcome data (attrition bias) End of intervention	Low risk	Planned ITT; no losses
Selective reporting (reporting bias)	Unclear risk	Protocol not available
Other bias	Low risk	None known
Imbalanced exposure	High risk	Imbalanced exposure

Duncan 2003

Methods	<p>Design: randomised trial of mixed training vs UC - after UC (outpatient)</p> <p>Randomisation mechanism: unknown; method: blocks of 6</p> <p>Allocation concealment: sealed envelopes</p> <p>Blinding: investigator; participants asked to maintain blinding</p> <p>ITT: yes</p> <p>Measurements: end of intervention (12/14 weeks) and 6-month follow-up</p>
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Duncan 2003 (Continued)

Withdrawals: intervention (10 participants: 6 before (1 renal insufficiency, 1 subclavian steal syndrome, 1 chose withdrawal, 3 recurrent stroke), 4 after the 3-month follow-up (1 died, 1 hospital, 2 recurrent stroke); control (11 participants: 2 before (1 withdrew, 1 non-return), 9 after 3-month follow-up (2 died, 2 hospital, 5 withdrew)

Participants	Randomised: 100 participants Intervention: 50 participants; 23 men and 27 women; age 68.5 years (SD 9.0); 77.5 days post-stroke (SD 28.7) Control: 50 participants; men and 27 women 23; age 70.2 years (SD 11.4); 73.5 days post-stroke (SD 27.1) Inclusion criteria: 30-150 days post-stroke; independent ambulation for 25 feet; Fugl-Meyer scores 27-90; Orpington Prognostic Scale 2.0-5.2; 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 min/day 3 days/week for 12-14 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 PT and OT for participants who needed. All controls received 30-min 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); 6-MWT; community ambulation (> 0.8 m/s) Other outcomes: Stroke Impact Scale; cycle duration; Fugl Meyer scores	
Notes	Some outcomes reported as change from baseline scores, others reported as means at the end of 6-month follow-up	
Risk of bias		
Bias	Authors' judgement	Support for judgement
Random sequence generation (selection bias)	Unclear risk	Block randomisation used (blocks of 6), method unknown
Allocation concealment (selection bias)	Unclear risk	Sealed envelopes
Blinding (performance bias and detection bias) All outcomes	High risk	Degree of attention control
Blinding of outcome assessment (detection bias) All outcomes	Low risk	Investigator blinded; participants asked to maintain blinding
Incomplete outcome data (attrition bias) End of intervention	Unclear risk	ITT used 8/100 (8%) losses before outcome assessment Intervention 6 (1 renal insufficiency, 1 subclavian steal syndrome, 1 chose withdrawal, 3 recurrent stroke) Control 2 (1 withdrew, 1 non-return)
Incomplete outcome data (attrition bias)	High risk	ITT used

Duncan 2003 (Continued)

End of follow-up		21/100 (21%) total losses at the end of follow-up Intervention 4 (1 died, 1 hospital, 2 recurrent stroke) Control 9 (2 died, 2 hospital, 5 withdrew)
Selective reporting (reporting bias)	Unclear risk	Protocol not available
Other bias	Low risk	None known
Imbalanced exposure	High risk	Imbalanced exposure

Eich 2004

Methods	Design: randomised trial of cardiorespiratory training plus UC vs UC - during UC Randomisation mechanism: picking envelopes; method: restricted Allocation concealment: sealed envelopes Blinding: investigator; efficacy was compromised ITT: 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 men and 8 women; age 62.4 years (SD 4.8); 43 days post-stroke (SD 15) Control: 25 participants; 16 men and 9 women; age 64 years (SD 9); 44 days post-stroke (SD 18) Inclusion criteria: aged 50-75 years; first stroke; time since stroke < 6 weeks; walk 12 m with/without assistance; BI score 50-80; 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 min/day 5 days/week for 6 weeks; progressive treadmill training with either no or minimal support of body weight; intensity was 60% of HR reserve Control: both groups received UC comprising individual PT 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 m); gait endurance (6-MWT) Other outcomes: RMA (non-normal data); walking quality scale (non-normal data)
Notes	—

Risk of bias

Bias	Authors' judgement	Support for judgement
Random sequence generation (selection bias)	Low risk	Restricted randomisation; independent person picking one of (initially) 50 sealed envelopes
Allocation concealment (selection bias)	Unclear risk	Sealed envelopes; opaque and numbered unknown
Blinding (performance bias and detection bias) All outcomes	High risk	No suitable attention control

Eich 2004 (Continued)

Blinding of outcome assessment (detection bias) All outcomes	High risk	Quote: "one could not fully exclude the possibility that the outcome observers were not totally blind"
Incomplete outcome data (attrition bias) End of intervention	Low risk	ITT planned Only 1/50 (2%) lost: intervention 1 participant (refusal) after the 6-week training
Incomplete outcome data (attrition bias) End of follow-up	Unclear risk	ITT planned Only 1/50 (2%) lost overall
Selective reporting (reporting bias)	Unclear risk	Protocol not available
Other bias	Low risk	None known
Imbalanced exposure	High risk	Imbalanced exposure

Fernandez-Gonzalo 2016

Methods	<p>Design: RCT of resistance training vs no intervention (usual routines). Study commenced after UC</p> <p>Randomisation: computerised block randomisation</p> <p>Allocation concealment: unclear</p> <p>Blinding: blinded outcome assessment for MRI and cognitive function; no blinded outcome assessment stated for force, power, function and dual task outcomes</p> <p>ITT: not done; per protocol analysis</p> <p>Measurements: baseline and end of intervention (12 weeks)</p> <p>Withdrawals: intervention group n = 2 (unrelated medical issue); control group n = 1 (unrelated medical issue)</p>
Participants	<p>Randomised: total 32 participants (n = 29 reported in study; intervention n = 14; control n = 15)</p> <p>Intervention: 14 participants; 11 men (79%) and 3 women (21%); mean age 61.2 (SD 9.8) years; 3.5 (SD 3.6) years after stroke</p> <p>Control: 15 participants; 11 men (73%) and 4 women (27%); mean age 65.7 (SD 12.7) years; 4.3 (SD 4.9) years after stroke</p> <p>Inclusion criteria: stroke confirmed by CT or MRI, age > 40 years, ≥ 6 months post-stroke, able to walk 20 m with/without assistive device, ability to perform closed-chain exercise using the prescribed training device</p> <p>Exclusion criteria: unstable angina, congestive heart failure, severe arterial disease, major depression, dementia (< 24 on the MMSE), failure to understand instructions, chronic pain</p>
Interventions	<p>Intervention: unilateral explosive resistance training of the more affected leg; real time feedback was given to participants. 4 sets of 7 maximal repetitions of the hip and leg extensors whilst seated on a fly-wheel-resisted leg press device. Each repetition included a resisted concentric and eccentric phase. Training occurred 2 days/week for 12 weeks</p> <p>Peak power during sessions progressively increased throughout the 12 weeks</p>

Fernandez-Gonzalo 2016 (Continued)

Control: maintain usual routines

Setting: unclear

Outcomes	Included outcomes: muscle volume and cross-sectional area (MRI); maximal unilateral isometric force, maximal unilateral dynamic force, peak power output; BBS; TUG; cognitive function; QoL SF-36 'physical functioning' (PF) and 'mental health' (MH) scales Other outcomes: dual task performance
Notes	NCT02120846

Risk of bias

Bias	Authors' judgement	Support for judgement
Random sequence generation (selection bias)	Low risk	Computerised block randomisation to either a training group or control group
Allocation concealment (selection bias)	Unclear risk	Unclear, no detail
Blinding (performance bias and detection bias) All outcomes	High risk	No attention control
Blinding of outcome assessment (detection bias) All outcomes	Unclear risk	Mix of blind (MRI and cognition) and unblinded assessment (strength and power)
Incomplete outcome data (attrition bias) End of intervention	Low risk	No ITT analysis (per protocol analysis) but only 2/14 and 1/15 losses
Incomplete outcome data (attrition bias) End of follow-up	Low risk	
Selective reporting (reporting bias)	Low risk	Fidelity with NCT02120846
Other bias	Low risk	None known
Imbalanced exposure	High risk	Control group followed their usual routines; no attention control

Flansbjerg 2008

Methods	Design: randomised trial of resistance training vs no training - after UC 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; participants were not blinded but were told not to disclose group assignment
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Flansbjerg 2008 (Continued)

ITT: yes

Measurements: at the end of intervention (10 weeks), 5-month follow-up, and a 4-year follow-up

Withdrawals: 1 participant dropped out from the intervention group due to an accident unrelated to strength training. 2 participants were unable to perform follow-up assessments due to new illness, 4 participants did not wish to continue at follow-up stage (but were reported in general good health)

Participants	<p>Randomised: total 25 participants</p> <p>Intervention: 15 participants (16 randomised), 9 men and 6 women; mean age 61 (SD 5) years; time since stroke 18.9 (SD 7.9) months</p> <p>Control: 9 participants, 5 men and 4 women; mean age 60 (SD 5) years; time since stroke 20.0 (SD 11.6) months</p> <p>Inclusion criteria: age 40-70 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 60°/s); walk unsupervised for 200 m 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</p> <p>Exclusion criteria: not reported</p>
Interventions	<p>Intervention group: 10 weeks of dynamic and isokinetic knee muscle strength training. Each training session started with a warm-up of 5 min of stationary cycling, 5 repetitions without resistance and 5 repetitions at 25% of maximum load. The participants then performed 6-8 repetitions at about 80% of their maximum load with a 2-min rest between each set. The participants performed as many repetitions as possible. The load was adjusted every 2 weeks to remain at 80% of their maximum load. Each training session lasted about 90 min but the actual progressive strength training time was < 6 min</p> <p>Control group: participants were encouraged to continue daily activities and training but not to engage in any progressive strength training</p> <p>Setting: community dwelling; training in hospital</p>
Outcomes	<p>Included outcomes: dynamic and isokinetic muscle strength; 3 m TUG; maximum walking speed; 6-MWT; SIS - Swedish version; muscle tone assessed with the MAS</p> <p>Other outcomes: none</p>
Notes	<p>Maximum walking speed data obtained from study authors. The physiotherapist that supervised the resistance training was the same that assessed dynamic strength and muscle tone outcomes</p> <p>4-year follow-up data available in secondary publication</p>

Risk of bias

Bias	Authors' judgement	Support for judgement
Random sequence generation (selection bias)	Low risk	Stratified by gender unequal randomisation (2:1)
Allocation concealment (selection bias)	High risk	Non-sealed envelopes
Blinding (performance bias and detection bias) All outcomes	High risk	No attention control
Blinding of outcome assessment (detection bias)	High risk	Physiotherapists who assessed isokinetic strength and gait performance outcomes were blinded to group assignment but the physiotherapist who as-

Flansbjerg 2008 (Continued)

All outcomes		<p>sessed dynamic strength and muscle tone outcomes was not blinded; participants were not blinded but were told not to disclose group assignment</p> <p>Therapists not blinded at 4-year follow-up</p>
Incomplete outcome data (attrition bias) End of intervention	Low risk	<p>ITT analysis</p> <p>1/25 (4%) losses; 1 participant dropped out from the intervention group due to an accident unrelated to strength training</p>
Incomplete outcome data (attrition bias) End of follow-up	High risk	<p>1/25 (4%) total losses at the end of 5-month follow-up, ITT analysis used</p> <p>7/25 (28%) total losses at the end of 4-year follow-up and no ITT analysis used. 2 participants were unable to perform follow-up assessments due to new illness, 4 participants did not wish to continue at follow-up stage (but were reported in general good health)</p>
Selective reporting (reporting bias)	Unclear risk	No study protocol available
Other bias	Low risk	None known
Imbalanced exposure	High risk	Imbalanced exposure

Furnari 2014

Methods	<p>Design: single-blinded RCT; mixed training (aquatic exercise) plus conventional physical therapy vs conventional physical therapy alone - during UC</p> <p>Randomisation: stratified randomisation; stratification based on age and gender</p> <p>Allocation concealment: not reported, unclear</p> <p>Blinding: assessor blinded to group allocation; participants may have understood nature of group assignments</p> <p>ITT: not stated, withdrawals not outlined - unclear if analyses were performed according to ITT principle</p> <p>Measurements: end of intervention (8 weeks)</p> <p>Withdrawals: none reported</p>
Participants	<p>Randomised: 40 participants</p> <p>Intervention: 8-week hydrokinesitherapy (aquatic therapy) and conventional physical therapy = 20 participants; 10 men (50%) and 10 women (50%); mean age: 68 (SD 3); time since stroke onset: 7 months (SD 1.6)</p> <p>Control: 8-week conventional physical therapy = 20 participants; 10 men (50%) and 10 women (50%); mean age: 72 (SD 5); time since stroke onset: 6 months (SD 1.4)</p> <p>Inclusion criteria: paresis and spasticity secondary to a first stroke, clinically stable, absence of previous MI, ability to stand up without assistance for at least 51.2 s with closed eyes, ability to walk 10 m (with or without assistive device), time since stroke of at least 30 days, serological negativity to hepatitis B, hepatitis C and HIV, absence of infectious diseases, absence of pressure ulcers, absence of urinary and/or faecal incontinence, and MMSE \geq 24</p> <p>Exclusion criteria: previous vascular accident, muscle contractures of the lower limb joints, previous treatment with botulinum toxin, phenol or alcohol nerve blocks or motor point injections for low-</p>

Furnari 2014 (Continued)

er limb spasticity, de novo treatment with anti-spasticity drugs, additional neurological and/or orthopaedic deficits that impaired ambulation or heart failure

Interventions	<p>Intervention: aquatic therapy consisted of a 10-min light warming up in the water 15 min of Halliwick method (sagittal rotation control; transverse rotation control) and combined rotation control (a combination of transverse sagittal and longitudinal rotations), 15 min of rounding and balancing exercises according to the Ai Chi method focused on weight bearing on the more affected side, 10 min of lower-limb strength exercises using water resistance and 10 min of light cooling down (walking). Degree of difficulty was reviewed weekly to ensure participants made progress at their own pace. Frequency of intervention: aquatic therapy: 1 h, 3 times/week for 8 weeks and conventional physical therapy: 1 h, 3 times/ week for 8 weeks</p> <p>Control: conventional physical therapy programme consisting of general conditioning exercises, including 10 min of warming up (e.g. calf, shoulder and hand passive range of motion exercises), 20 min of lower and upper extremity strengthening, 20 min of postural control exercise, including maintenance of standing and shifting the weight loads to the paretic side, and 10 min of gait training for the same amount of time as the aquatic therapy group spent in the pool. Exercises in this programme were designed with gradual increments to meet the capabilities of each participant. Frequency of intervention: 1 h, 6 times/week for 8 weeks</p> <p>Setting: hospital</p>
Outcomes	<p>Included outcomes: baropodometric outcomes: postural stability and spatio-temporal gait parameters</p> <p>Other outcomes: clinical data for baseline only (Modified Ashworth Scale, BI, FIM, Tinetti Test)</p>
Notes	<p>No pre-published trial registry entry</p> <p>Study author confirmed that control exposure is UC</p>

Risk of bias

Bias	Authors' judgement	Support for judgement
Random sequence generation (selection bias)	Unclear risk	Stated 'randomised' but no further details provided
Allocation concealment (selection bias)	Unclear risk	Not reported
Blinding (performance bias and detection bias) All outcomes	Unclear risk	Balanced exposure dose
Blinding of outcome assessment (detection bias) All outcomes	Low risk	Assessor blinded
Incomplete outcome data (attrition bias) End of intervention	Unclear risk	No indication of whether dropouts occurred or what analytical approach to this was used
Incomplete outcome data (attrition bias) End of follow-up	Low risk	
Selective reporting (reporting bias)	Unclear risk	No trial registry entry available

Furnari 2014 (Continued)

Other bias	Low risk	None known
Imbalanced exposure	Low risk	Control group received conventional physical therapy of equal time, frequency and duration

Galvin 2011

Methods	<p>Design: randomised trial of mixed FAME plus UC vs UC - during (and after UC)</p> <p>Randomised mechanism: independent person using computer-generated random numbers</p> <p>Allocation concealment: sealed envelopes</p> <p>Blinding: assessor not blinded to group allocation</p> <p>ITT: all randomised participants analysed using LOCF</p> <p>Measurements: end of intervention (8 weeks) and at follow-up (3 months)</p> <p>Withdrawals: 2 participants in the intervention group before outcome assessment (MI and stroke). In the control group 1 withdrew before outcome assessment (1 unwell), 2 died before follow-up assessment</p>
Participants	<p>Randomised: 37 participants</p> <p>Intervention: 19 participants; 7 men and 13 women; mean age 69.95 years (SD 11.7)</p> <p>Control: 18 participants; 13 men and 7 women; mean age 63.15 years (SD 13.3)</p> <p>Inclusion criteria: 2 weeks after stroke onset; diagnosed as first unilateral stroke; > 18 years of age; participating in a PT programme; medically stable family member willing to participate in the programme</p> <p>Exclusion criteria: impairment of cognition, < 18 years</p>
Interventions	<p>Intervention group: individualised FAME programmes daily for 35 min for 8 weeks aiming to improve stability, gait velocity, and lower limb strength plus UC (CPT)</p> <p>Control group: UC (CPT)</p> <p>Setting: rehabilitation unit</p>
Outcomes	Included outcome: lower limb Fugl-Meyer Assessment; MAS; BBS; 6-MWT
Notes	—

Risk of bias

Bias	Authors' judgement	Support for judgement
Random sequence generation (selection bias)	Low risk	Independent person using computer-generated random numbers
Allocation concealment (selection bias)	Unclear risk	Sealed envelope; whether opaque and numbered unknown
Blinding (performance bias and detection bias) All outcomes	High risk	No attention control

Galvin 2011 (Continued)

Blinding of outcome assessment (detection bias) All outcomes	High risk	Assessor not blinded to group allocation
Incomplete outcome data (attrition bias) End of intervention	Low risk	ITT used; all randomised participants analysed using LOCF 3/37 (8%) lost from intervention group 2 (MI and stroke); control group 1 (1 unwell), 2 died before follow-up assessment
Incomplete outcome data (attrition bias) End of follow-up	Unclear risk	ITT used; all randomised participants analysed using LOCF 5/37 (14%) total losses; control group 2 (died)
Selective reporting (reporting bias)	Low risk	Reported outcomes correspond to protocol NCT00666744
Other bias	Low risk	None known
Imbalanced exposure	High risk	Imbalanced exposure

Glasser 1986

Methods	Design: randomised trial of cardiorespiratory training plus % UC vs UC - during UC Randomisation: unknown Allocation concealment: unknown Blinding: unknown ITT: no withdrawals Measurements: end of intervention (10 weeks) Withdrawals: none	
Participants	Randomised: 20 participants Intervention: 10 participants; 4 men and 6 women Control: 10 participants; 6 men and 4 women All participants age 40-75 years and were 3-6 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/week for 10 weeks; the intensity was maintained at 50-100 psi and duration of each session progressed from 10-30 min over the first 5 weeks Control: therapeutic exercise and gait training 1 h/session 2 sessions/day, 5 days/week for 5 weeks Setting: physical therapy department	
Outcomes	Included outcomes: gait speed maximal (6 m) Other outcomes: FAPS	
Notes	—	
Risk of bias		
Bias	Authors' judgement	Support for judgement

Glaser 1986 (Continued)

Random sequence generation (selection bias)	Unclear risk	Not reported
Allocation concealment (selection bias)	Unclear risk	Not reported
Blinding (performance bias and detection bias) All outcomes	High risk	Some attention control
Blinding of outcome assessment (detection bias) All outcomes	Unclear risk	Not reported
Incomplete outcome data (attrition bias) End of intervention	Low risk	No losses
Selective reporting (reporting bias)	Unclear risk	No protocol available
Other bias	Low risk	None known
Imbalanced exposure	Unclear risk	Some attention control; may be a balanced exposure

Globas 2012

Methods	<p>Design: randomised, cross-over, controlled trial of high-intensity cardiorespiratory training plus UC vs UC - after UC</p> <p>Randomised mechanism: computer-based pseudo-random number generator and Moses-Oakford assignment algorithm to perform stratified block allocation scheme (3 blocks, allocation 1:1)</p> <p>Allocation concealment: not reported</p> <p>Blinding: not blinded to participants; unknown if blinded to assessors</p> <p>Measurements: end of intervention (3 months); follow-up data (12 months) not used</p> <p>Withdrawals: 2 participants in the intervention group, 1 due to recurrent stroke, 1 due to transport problems. Other dropouts were reported but these occurred after the cross-over part of the study began and are therefore uncontrolled</p>
Participants	<p>Randomised: 36 participants completed endpoint investigation, 32 participants completed 12-month follow-up</p> <p>Intervention: 18 participants; 14 men and 4 women; mean age 68.6 years (SD 6.7)</p> <p>Control: 18 participants; 15 men and 3 women; mean age 68.7 years (SD 6.1)</p> <p>Inclusion criteria: > 6 months post-stroke, confirmed diagnosis of ischaemic stroke via CT and/or MRI scans; hemiparetic gait as evaluated by a neurologist; at least 1 clinical sign for paresis, spasticity, or circumduction during gait; ability to treadmill walk at > 0.3 km/h for 3 min</p> <p>Exclusion criteria: unstable angina pectoris; heart failure; haemodynamically significant valvular dysfunction; peripheral arterial occlusive disease; dementia; aphasia; major depression; already performing aerobic exercise training (> 20 min/day, > 1 day/week)</p>

Globas 2012 (Continued)

Interventions	<p>Intervention group: 39 sessions of 30-50 min of treadmill training 3 times/week for 3 months. Training intensity was 60%-80% maximum HR. Treadmill training was progressed as tolerated by 1-5 min/week and by 0.1-0.3 km/h every 1-2 weeks. Treadmill inclination was 0°</p> <p>Control group: UC PT included passive, muscle tone-regulating exercises for upper and lower limbs with element of balance training. Performed for 1 h for 1-3 times/week. Control group also completed cross-over period of treadmill training, which was similar in protocol except for 2° inclination</p> <p>Setting: outpatients rehabilitation clinic</p>
Outcomes	Included outcome: peak exercise capacity (VO ₂ peak); 6-MWT; 10 m timed walks; 5-chair rise test; BBS; RMI; SF-12
Notes	Cross-over part of the study not included Advertisements used for recruitment

Risk of bias

Bias	Authors' judgement	Support for judgement
Random sequence generation (selection bias)	Low risk	Computer-based, stratified, block randomisation
Allocation concealment (selection bias)	Unclear risk	Not reported
Blinding (performance bias and detection bias) All outcomes	High risk	No attention control
Blinding of outcome assessment (detection bias) All outcomes	High risk	Outcome assessment not blinded
Incomplete outcome data (attrition bias) End of intervention	Low risk	ITT (LOCF) used 2/36 (6%) dropouts from intervention group (1 recurrent stroke, 1 transportation problems)
Selective reporting (reporting bias)	Unclear risk	No protocol available
Other bias	High risk	May be self-selection bias due to use of newspaper adverts
Imbalanced exposure	Unclear risk	Some attention control but time appears not to be balanced

Gordon 2013

Methods	<p>Design: RCT of aerobic (walking) training vs massage - after UC</p> <p>Randomisation: block randomised</p> <p>Allocation concealment: unclear</p> <p>Blinding: blinded assessor</p> <p>ITT: completed</p> <p>Measurements: 6 weeks and 12 weeks (end of intervention)</p> <p>Withdrawals: 7 participants from the intervention and 5 participants from the control dropped out</p>
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Gordon 2013 (Continued)

Participants	Randomised: total 128 participants; 64 participants were randomised to intervention, 64 to control Intervention: 64 participants; 29 men (45.3%) and 35 women (54.7%); mean age: 63.4 (SD 9.4); 384 (SD 108) days after stroke Control: 64 participants; 29 men (45.3%) and 35 women (54.7%); mean age: 64.9 (SD 11.1); 354 (SD 108) days after stroke Inclusion criteria: ≥ 40 years of age, community-dwelling, 6-24 months post-stroke, able to walk with or without an assistive device Exclusion criteria: not currently in rehabilitation or regular exercise programme, not having any disorder that would compromise exercise training such as unstable cardiovascular diseases, not having any cognitive deficits	
Interventions	Intervention: cardiorespiratory walking training. Participants were supervised by trained instructors to walk briskly along a prescribed course for 15 min, 3 times/week, for 12 weeks, initially progressing by 5 min over week up to 30 min in their home or community. Target HR was 60%-85% of age-predicted maximum HR (220-age). Training progression was also carried out by increasing speed Control: light massage to the affected limbs for 25 min, 3 times/week, for 12 weeks, at home Setting: community/home	
Outcomes	Included outcomes: Physical and Mental Component Summary scores of the Medical Outcomes Survey, SF-36, BI, Instrumental ADL dimension of the Older Americans Resources and Services Questionnaire; 6-MWT Other outcomes: resting HR, lower limb Motricity Index	
Notes	Study author provided details of dropouts and withdrawals	
Risk of bias		
Bias	Authors' judgement	Support for judgement
Random sequence generation (selection bias)	Unclear risk	Described as "block randomised" but with no further information on how this was achieved
Allocation concealment (selection bias)	Unclear risk	Not reported in paper
Blinding (performance bias and detection bias) All outcomes	High risk	No blinding of participants or deliverers of intervention or control programmes
Blinding of outcome assessment (detection bias) All outcomes	Low risk	Assessor blinded to group allocation
Incomplete outcome data (attrition bias) End of intervention	Low risk	Missing data have been imputed using appropriate methods 12/128 (9.4%) total losses: <ul style="list-style-type: none"> • 7 participants were lost from the intervention group; death (2), recurrent stroke (2), intervening comorbidity (1), programme too difficult (1), did not like group assignment (1) • 5 in the control group; death (2), intervening comorbidity (2), or violence in community (1)
Selective reporting (reporting bias)	Unclear risk	Trial register or protocol not available. "Trial was not registered as enrolment commenced before 2005"
Other bias	Low risk	None known

Gordon 2013 (Continued)

Imbalanced exposure	Low risk	Balanced exposure: intervention and control groups were exposed to the same frequency and duration of treatment
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Inaba 1973

Methods	Design: randomised trial of resistance training plus UC vs UC - during UC Randomisation: unknown Allocation concealment: unknown Blinding: outcome assessor - unclear ITT: no Measurements: end of intervention (4-8 weeks) and 2-month follow-up Withdrawals: unclear: 101/177 participants lost to follow-up across the control and both intervention groups; 54 participants completed the control vs 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 men and 17 women; age 55.6 years; < 3 months post-stroke Control: 26 participants; 15 men and 11 women; 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/day for 4-8 weeks; extension of the affected lower limb from 90° 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: UC: conventional functional training, including stretching, 4-8 weeks until discharge Setting: rehabilitation centre
Outcomes	Included outcomes: leg strength (10-RM) lacked variance measures number of participants able to perform 10 ADL
Notes	—

Risk of bias

Bias	Authors' judgement	Support for judgement
Random sequence generation (selection bias)	Unclear risk	Not reported
Allocation concealment (selection bias)	Unclear risk	Not reported
Blinding (performance bias and detection bias) All outcomes	High risk	No attention control
Blinding of outcome assessment (detection bias) All outcomes	Unclear risk	Unclear

Inaba 1973 (Continued)

Incomplete outcome data (attrition bias) End of intervention	High risk	Large numbers of undocumented losses and no ITT analysis Unclear: 101/177 participants lost to follow-up across the control and both intervention groups; 54 participants completed the control vs strength training comparison; estimated dropouts approximately 60 1 reason given for dropouts was discharge before end of the study
Incomplete outcome data (attrition bias) End of follow-up	High risk	Large numbers of undocumented losses and no ITT analysis Unclear: 101/177 participants lost to follow-up across the control and both intervention groups; 54 participants completed the control vs strength training comparison; estimated dropouts approximately 60 1 reason given for dropouts was discharge before end of the study
Selective reporting (reporting bias)	Unclear risk	No protocol available
Other bias	Low risk	None known
Imbalanced exposure	High risk	Imbalanced exposure

Ivey 2010

Methods	<p>Design: randomised trial of cardiorespiratory training vs UC - after UC</p> <p>Randomised: blocked allocation schema and computer-based pseudo-random number generator</p> <p>Allocation concealment: not reported</p> <p>Blinding: assessors not blinded</p> <p>ITT: no</p> <p>Measurements: end of intervention (6 months)</p> <p>Withdrawals: intervention group 10 participants and control group 17 participants lost to follow-up, 7 in both groups due to medical reasons unrelated to study procedures; 3 and 10 respectively due to general compliance issues</p>
Participants	<p>Randomised: 53 participants</p> <p>Intervention: 29 participants; 18 men and 11 women; mean age 62 years (SD 8)</p> <p>Control: 24 participants; 11 men and 13 women; mean age 60 years (SD 8)</p> <p>Inclusion criteria: chronic hemiparetic stroke (> 6 months); completed all conventional UC</p> <p>Exclusion criteria: history of vascular surgery; vascular disorders of the lower limb; symptomatic peripheral arterial occlusive disease</p>
Interventions	<p>Intervention group: treadmill training for 40 min 3 times/week for 6 months at a target intensity of 60%-70% HR reserve, initially started with discontinuous training, which progressed to continuous</p> <p>Control group: UC: 13 targeted active and passive supervised stretching movements of the upper and lower body for 30-40 min 3 times/week for 6 months</p> <p>Setting: rehabilitation unit</p>
Outcomes	Included outcome: peak aerobic capacity during treadmill protocol

Ivey 2010 (Continued)

Other outcomes: resting and reactive hyperaemic calf blood flow in both paretic and non-paretic legs

Notes —

Risk of bias

Bias	Authors' judgement	Support for judgement
Random sequence generation (selection bias)	Low risk	Blocked allocation schema and computer-based pseudo-random number generator
Allocation concealment (selection bias)	Unclear risk	Not reported
Blinding (performance bias and detection bias) All outcomes	High risk	Participants described as not blinded, although there was matched exposure to staff
Blinding of outcome assessment (detection bias) All outcomes	High risk	Outcome assessors not blinded
Incomplete outcome data (attrition bias) End of intervention	High risk	ITT not reported 27/53 (51%) losses; intervention group 10 and control group 17 due to medical reasons unrelated to study procedures; 3 and 10 respectively due to general compliance issues
Selective reporting (reporting bias)	Unclear risk	Relationship to trial register entries unclear
Other bias	Low risk	None known
Imbalanced exposure	Low risk	Matched exposure

Ivey 2011

Methods	Design: randomised trial of cardiorespiratory training vs UC - after UC Randomised: mechanism unknown Allocation concealment: unknown Blinding: unknown ITT: no Measurements: end of intervention (6 months) Withdrawals: 13 participants withdrew at the end of intervention, reasons unknown
Participants	Randomised: 38 participants completed study; 51 may have been randomised Intervention: 19 participants; mean age 61 years (SD 8) Control: 19 participants; mean age 62 years (SD 10) Inclusion criteria: chronic hemiparetic stroke with mild to moderate hemiparetic gait; completed all conventional UC; still present with residual hemiparetic gait deficits > 6 months post-stroke

Physical fitness training for stroke patients (Review)

Ivey 2011 (Continued)

Exclusion criteria: inability for insonation of the middle cerebral artery bilaterally

Interventions	<p>Invention group: treadmill training for 40 min 3 times/week for 6 months at a target intensity of 60%-70% HR reserve, initially started with discontinuous training, which progressed to continuous</p> <p>Control group: UC: 13 targeted active and passive supervised stretching movements of the upper and lower body for 30-40 min 3 times/week for 6 months</p> <p>Setting: rehabilitation unit</p>
Outcomes	<p>Included outcomes: 6-MWT, peak aerobic capacity during treadmill protocol</p> <p>Other outcomes: middle cerebral artery blood flow velocity bilaterally during normocapnia and hypercapnia (6% CO₂)</p>
Notes	—

Risk of bias

Bias	Authors' judgement	Support for judgement
Random sequence generation (selection bias)	High risk	Mechanism not described, number randomised not clear
Allocation concealment (selection bias)	Unclear risk	Not reported
Blinding (performance bias and detection bias) All outcomes	High risk	Attention control was included
Blinding of outcome assessment (detection bias) All outcomes	Unclear risk	Not reported
Incomplete outcome data (attrition bias) End of intervention	High risk	ITT analysis not reported There may have been losses after randomisation; up to 13/51 (25%)
Selective reporting (reporting bias)	Unclear risk	Relationship to trial register entries unclear
Other bias	Low risk	None known
Imbalanced exposure	Low risk	Matched exposure

Ivey 2017

Methods	<p>Design: prospective RCT; resistance training (intervention group) vs stretching (control group) - after UC</p> <p>Randomisation: blocked allocation schema and a computer-based pseudorandom number generator. Separate blocked randomisations were performed according to age (< 65 vs ≥ 65 years) and ratio of leg press 1-RM strength in the paretic leg to 1-RM strength in the non-paretic leg (< 0.64 vs ≥ 0.64)</p>
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Ivey 2017 (Continued)

Randomisation was confounded toward the end of the study to achieve more even final group numbers and account for an uneven discontinuation rate during the study. The entire final group of participants (n = 4) were assigned to the resistance training group.

Allocation concealment: not reported

Blinding: outcome assessments not blinded

ITT: not reported; appears to be a per-protocol analysis

Measurements: before (baseline) and at the end of intervention (12 weeks)

Withdrawals: 25 participants withdrew prior to randomisation; eight (n = 8) participants assigned to resistance training withdrew due to medical reasons (n = 4) or other (i.e. compliance issues: n = 4). No participants from the control group withdrew.

Participants

Randomised: 38 stroke participants. 22 participants were randomised to resistance training, and 16 to the control group.

Number analysed = 30

Intervention: 14 participants; 10 men (71%) and 4 women (29%); mean age: 57 (SD 14) years; mean years post-stroke: 5 (SD 4)

Control: 16 participants; 11 men (69%) and 5 women (31%); mean age: 55 (SD 9); mean years post-stroke: 6 (SD 5)

Inclusion criteria: chronic hemiparesis (> 6 months post-stroke)

Exclusion criteria: participants with signs indicating myocardial ischaemia during baseline exercise testing or other contraindications for participating in exercise training

Interventions

Intervention: bilateral resistance training of the lower extremities, 45 min/day for 3 days/week for 12 weeks. Leg extension, leg curl and leg press were trained on a pneumatic resistance device. Participants performed 2 sets of 20 repetitions on each leg and each machine (20 x 2 x 3 = 120 repetitions/session). Resistance was initially set at 10-15-RM and then incrementally lowered within each set such that the full set of 20 repetitions could be completed.

Control: 45 min of supervised, passive and active stretching primarily aimed at the lower extremity musculature. Frequency of intervention: not reported, but the control and intervention groups were matched for level of research staff attention.

Setting: outpatient

Outcomes

Included outcomes: muscle endurance; maximum number of paretic and non-paretic leg press repetitions at 70% 1-RM at a fixed cadence (60 bpm, 0°-90°). Muscle strength; paretic and non-paretic leg press 1-RM. 6-MWT, peak oxygen consumption (VO₂ peak) during a graded treadmill exercise test, Timed 10-metre walking speed test (self-selected walking speed and fastest comfortable walking speed)

Notes

It is unclear what the conventional rehabilitation consisted of, in terms of content and dose.

Risk of bias
Bias
Authors' judgement
Support for judgement

Random sequence generation (selection bias)

High risk

Computer-based block pseudo-randomisation; unpredictable enough to be considered random. Non-random allocation of 4/38 participants to intervention group to compensate for dropouts; 4/14 of the intervention group.

Ivey 2017 (Continued)

Allocation concealment (selection bias)	Low risk	Randomisation based on baseline data so allocation concealment not an issue
Blinding (performance bias and detection bias) All outcomes	Unclear risk	Attention control will compensate for the fact that blinding participants not possible
Blinding of outcome assessment (detection bias) All outcomes	High risk	Open unblinded assessment
Incomplete outcome data (attrition bias) End of intervention	High risk	8/22 (36%) dropout rate from intervention group; no dropouts from control group. No ITT analysis
Selective reporting (reporting bias)	Unclear risk	No available pre-published protocol or trial registry entry
Other bias	Low risk	None known
Imbalanced exposure	Low risk	Matched exposures

James 2002

Methods	<p>Design: randomised trial of mixed training vs no intervention - after UC Randomisation mechanism: computer; method: blocks of 4 Allocation concealment: sealed envelopes Blinding: investigator ITT: yes</p> <p>Measurements: end of intervention (4 weeks) Withdrawals: control group 2 dropped out (neurological problems)</p>
Participants	<p>Randomised: 20 participants Intervention: 10 participants; 4 men and 6 women; age 76.1 years (SD 12.33); 1826 days post-stroke Control: 10 participants; 2 men and 8 women; 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 that could limit participation</p>
Interventions	<p>Intervention: mixed training, performed 90-120 min/day 3 days/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 HR reserve, increasing total distance walked, and increasing step height and repetition number Control: no intervention Setting: participants' homes</p>
Outcomes	<p>Included outcomes: gait speed preferred (5 m with mixed surfaces and a dead turn at 2.5 m) Other outcomes: functional walking ability questionnaire; upright motor control test; SF-36 - older version</p>

James 2002 (Continued)

Notes Unpublished thesis

Risk of bias

Bias	Authors' judgement	Support for judgement
Random sequence generation (selection bias)	Low risk	Block randomisation (groups of 4) using computer software
Allocation concealment (selection bias)	Unclear risk	Sealed envelopes; opaque and numbered unknown
Blinding (performance bias and detection bias) All outcomes	High risk	No attention control
Blinding of outcome assessment (detection bias) All outcomes	Unclear risk	Investigator blinded
Incomplete outcome data (attrition bias) End of intervention	Low risk	ITT analysis used 2/20 (10%) losses; 2/10 in control group (neurological problems)
Selective reporting (reporting bias)	Unclear risk	Protocol not available
Other bias	Low risk	None known
Imbalanced exposure	High risk	Imbalanced exposure

Jin 2013

Methods	Design: RCT of progressive aerobic cycling training vs control Randomisation: stratified randomisation; stratification based on age, gender and deficit severity Allocation concealment: information not included Blinding: "single blind" but does not outline in the paper who was blinded ITT: not completed Measurements: 12 weeks (end of intervention) Withdrawals: before randomisation
Participants	Randomised: total 128 participants. 65 participants were randomised to intervention, 63 to control Intervention: 65 participants; 46 men (71%) and 19 women (29%); mean age: 57.6 (SD 6.6); 561 (SD 156) days after stroke Control: 63 participants; 45 men (71%) and 18 women (29%); mean age: 56.3 (SD 6.5); 537 (SD 144) days after stroke Inclusion criteria: 42-68 years, Chinese Han population, first ischaemic stroke (< 6 months), independent mobility with or without an assistive device Exclusion criteria: haemorrhagic stroke, brainstem lesions and/or bilateral signs, diabetes mellitus or other concomitant nervous system disorders, cardiac or pulmonary disease possibly affecting the autonomic nervous system, any clinically relevant arrhythmia, heart failure, renal failure, unstable angina, uncontrolled hypertension, peripheral arterial occlusive disease, aphasia, dementia, untreated major depression, and other medical conditions that precluded participation in exercise training and conventional treatment

Jin 2013 (Continued)

Interventions	<p>Intervention: cardiorespiratory training: cycling training for 40 min/day, 5 times/week, target intensity of 50%-70% for 12 weeks. The training was started at a low intensity (40%-50% HR reserve) for 10-20 min and increased by approximately 5 min every 2 weeks as tolerated. Aerobic intensity was similarly progressed by 5% HR reserve every 2 weeks. Participants pedaled for 6-10 min in each task condition, and 2-3 min of rest were provided between each task</p> <p>Control: matched duration of conventional therapy including supervised stretching movements lasting 35 min and 5-min low-intensity over-ground walking training at 20%-30% HR reserve, 5 times/week</p> <p>Setting: rehabilitation centre</p>
Outcomes	<p>Included outcomes: peak VO₂ (L/min), peak VO₂, mL/kg/min, resting SBP, resting DBP, BMI, 6 min Walk Distance, BBS, spasticity (modified Ashworth Scale), paretic knee strength, non-paretic knee strength</p> <p>Other outcomes: resting HR, peak HR, peak SBP, peak DBP</p>
Notes	—

Risk of bias

Bias	Authors' judgement	Support for judgement
Random sequence generation (selection bias)	Low risk	Quote: "After baseline testing, the subjects were stratified according to age, gender and deficit severity, then, randomly assigned to either an aerobic cycling training group or a control group by drawing lots."
Allocation concealment (selection bias)	Unclear risk	Not reported in paper
Blinding (performance bias and detection bias) All outcomes	Unclear risk	Not clear who was blinded; exposure was balanced
Blinding of outcome assessment (detection bias) All outcomes	Unclear risk	Not reported in paper
Incomplete outcome data (attrition bias) End of intervention	Unclear risk	No information on dropouts or incomplete outcome data after randomisation and at end of intervention. ITT not carried out
Selective reporting (reporting bias)	Unclear risk	Trial register or protocol not available
Other bias	Low risk	None known
Imbalanced exposure	Low risk	Balanced exposure: matched duration of treatment exposure between intervention and control groups

Kang 2012

Methods	<p>Design: randomised trial of cardiorespiratory training plus UC vs non-exercise intervention plus UC - after UC</p> <p>Randomised: picking sealed envelopes</p> <p>Allocation concealment: sealed envelopes</p>
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Kang 2012 (Continued)

Blinding: assessor blinded to group allocation

ITT: not reported

Measurements: end of intervention (4 weeks)

Withdrawals: intervention group 1 participant due to lack of participation

Participants	Randomised: 21 participants Intervention: 10 participants; 6 men and 4 women, mean age 56.3 (SD 7.6); 13.5 days post-stroke (SD 4.0) Control: 10 participants; 6 men and 4 women, mean age 56.1 (SD 7.8); 15.1 days post-stroke (SD 7.4) Inclusion criteria: hemiparetic stroke 6 months after diagnosis; ability to walk for 15 min; without visual disabilities; MMSE score of ≥ 21 ; Brunnstrom stage > 4 Exclusion criteria: cardiovascular problems, orthopaedic, and other neurological diseases except stroke for influencing gait
Interventions	Intervention group: treadmill training for 30 min/day 3 times/week for 4 weeks, progressed by 0.1 km/h each time stable walking for 20 s was achieved Control group: non-exercise intervention of general stretching added range of motion exercises plus UC Setting: rehabilitation centre
Outcomes	Included outcomes: TUG; Functional Reach Test; 10-metre maximal walk test; 6-MWT
Notes	1 arm of this 3-group RCT was not used (treadmill with optic flow intervention) 10-metre maximal walk test data converted from m/sec into m/min

Risk of bias

Bias	Authors' judgement	Support for judgement
Random sequence generation (selection bias)	Low risk	Independent person picking sealed envelopes
Allocation concealment (selection bias)	Unclear risk	Sealed envelopes; whether opaque or numbered unknown
Blinding (performance bias and detection bias) All outcomes	Unclear risk	Attention control was included
Blinding of outcome assessment (detection bias) All outcomes	Low risk	Blinded outcome assessors
Incomplete outcome data (attrition bias) End of intervention	Low risk	ITT not reported 1/21 (5%) losses; intervention group 1 participant (lack of participation)
Selective reporting (reporting bias)	Unclear risk	No protocol available
Other bias	Low risk	None known

Kang 2012 (Continued)

Imbalanced exposure	Low risk	Balanced exposure
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Katz-Leurer 2003

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

Risk of bias

Bias	Authors' judgement	Support for judgement
Random sequence generation (selection bias)	Unclear risk	Block randomisation based on side of lesion; mechanism not reported
Allocation concealment (selection bias)	Unclear risk	Not reported
Blinding (performance bias and detection bias) All outcomes	Unclear risk	No attention control
Blinding of outcome assessment (detection bias) All outcomes	Low risk	Investigator blinded; efficacy unknown

Katz-Leurer 2003 (Continued)

Incomplete outcome data (attrition bias) End of intervention	Low risk	ITT not reported 2/96 (2%) lost at the end of intervention Intervention: no losses, control: 2 discontinued (1 acute MI, 1 deep vein thrombosis)
Incomplete outcome data (attrition bias) End of follow-up	Unclear risk	ITT not reported 13/96 (14%) total losses at the end of 6-month follow-up Intervention: 5 (4 not located, 1 died); control 6 (3 not located, 1 died, 2 recurrent stroke)
Selective reporting (reporting bias)	Unclear risk	Protocol not available
Other bias	Low risk	None known
Imbalanced exposure	Unclear risk	Unclear

Kim 2001

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

Kim 2001 (Continued)

Other outcomes:

Notes Data reported as change scores

Risk of bias

Bias	Authors' judgement	Support for judgement
Random sequence generation (selection bias)	Low risk	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). Likely that software was used to achieve this complexity.
Allocation concealment (selection bias)	Unclear risk	Not reported
Blinding (performance bias and detection bias) All outcomes	Unclear risk	Attention control used; participants blinded to purpose of interventions
Blinding of outcome assessment (detection bias) All outcomes	Low risk	Investigator blinded; efficacy unknown
Incomplete outcome data (attrition bias) End of intervention	Low risk	ITT not reported No losses
Selective reporting (reporting bias)	Unclear risk	Protocol not available
Other bias	Low risk	None known
Imbalanced exposure	Low risk	Balanced exposure

Kim 2014

Methods	Design: randomised trial of community walking training programme plus UC vs UC (conventional PT and OT) during UC Randomisation: sealed envelopes prepared in advance Allocation concealment: sealed envelopes Blinding: outcome assessment ITT: no Measurements: end of intervention (4 weeks) Withdrawals: 4 dropouts - 2 from intervention group and 2 from control group
Participants	Randomised: total 26 participants; 13 to intervention and 13 to control Intervention: 11 participants; 6 male, 5 women; mean age: 50.18 years (SD 10.29); 109 days post-stroke (SD 108) Control: 11 participants; 7 male, 4 women; mean age 50.73 years (SD 7.24); 273 days post-stroke (SD 108) Inclusion criteria: hemiparesis from single stroke occurring at least 6 months previously; sufficient cognition to comprehend study purpose; gait speed < 0.8 m/s; ability to walk 10 m independently without device; no musculoskeletal condition that could potentially affect ability to walk safely; no hemispatial neglect

Kim 2014 (Continued)

Exclusion criteria: participation in other studies or rehabilitation programmes; severe heart disease or other uncontrolled hypertension or pain

Interventions	<p>Intervention: cardiorespiratory training, walking programme, 30 min/day 5 times/week for 4 weeks</p> <p>Week 1 – 200 m route, walking near hospital</p> <p>Week 2 – 300 m route, outside hospital/uneven ground</p> <p>Week 3 – 400 m route, uneven ground, gradual slope, unpaved road, obstacles</p> <p>Week 4 – walking around shopping centre</p> <p>Control: conventional PT and OT</p> <p>Setting: community-based intervention delivered during inpatient care</p>
Outcomes	<p>Included outcomes: walking function measured using 10-metre walk test, 6-MWT and 'community walking assessment' (300 m route, different terrains and gradients)</p> <p>Other outcomes: social participation measured with SIS</p>
Notes	Change from baseline scores reported and used

Risk of bias

Bias	Authors' judgement	Support for judgement
Random sequence generation (selection bias)	Unclear risk	Sealed envelopes marked on the inside with an "O or X". Unclear how this was administered
Allocation concealment (selection bias)	High risk	Unclear whether sealed envelopes were numbered, opaque, or opened sequentially. Also the envelopes were "... marked on the inside with an O or X". Therefore concealment may be threatened
Blinding (performance bias and detection bias) All outcomes	High risk	No attention control
Blinding of outcome assessment (detection bias) All outcomes	Low risk	"... the assessor was blinded"
Incomplete outcome data (attrition bias) End of intervention	High risk	<p>ITT analysis not used</p> <p>4/26 (15%) losses; 2 participants lost from each group</p> <p>Due to health, personal reasons or discharge; distribution between groups unknown</p>
Selective reporting (reporting bias)	Unclear risk	No study protocol available
Other bias	Low risk	None known
Imbalanced exposure	High risk	Imbalanced exposure

Kim 2016a

Methods	<p>Design: single-centre randomised trial: mixed circuit training plus % UC (excluding PT) to conventional PT based on neurodevelopmental treatment plus UC (excluding PT) - during UC (inpatient)</p> <p>Randomisation: participants were randomised allocated in a 1:1 ratio, no further details were provided regarding methods of randomisation</p> <p>Allocation concealment: no details provided</p> <p>Blinding: assessor blinded to group allocation</p> <p>ITT: 20 patients were randomised and analysed; the study authors did not explicitly report on dropouts, or missing data or ITT</p> <p>Measurements: at the end of intervention (4 weeks)</p> <p>Withdrawals: not reported; 20 participants were randomised and 20 were analysed</p>
Participants	<p>Randomised: 20 participants; 10 to the circuit class and 10 to conventional PT</p> <p>Intervention: circuit training 10 participants; 6 men (60%) and 4 women (40%); mean age: 65.2 (SD 10.1); 30.1 (SD 21.8) days after stroke</p> <p>Control: CPT 10 participants; 7 men (70%) and 3 women (30%); mean age: 66.0 (SD 8.8); 29.9 (SD 20.3) days after stroke</p> <p>Inclusion criteria: a clinical diagnosis of a first stroke confirmed by neuroimaging (CT or MRI); a hemiparesis; a time interval between stroke and recruitment of ≤ 3 months; the ability to comprehend the instructions for the testing procedures; and mild to moderate walking deficit, as indicated by FAC between 3 and 4</p> <p>Exclusion criteria: a severe cognitive impairment (Korean-MMSE ≤ 10) or aphasia; previous stroke history; not independent 'sit to stand' activity (BBS score < 18); acute systemic illness or infection; a significant orthopaedic condition or pain that limited participation in exercise; and visual impairment or vestibular system deficit that caused balance impairment</p>
Interventions	<p>Intervention: circuit training; mixed training plus UC 90-min circuit-training classes, 5 times/week for 4 weeks. Training consisted of a 5-min warm-up period, 5 classes of 15-min duration of complex exercises interspersed by 1-min rest, and a 5-min cool-down period. The 5 categories were: trunk exercise and active sitting practice, sit-to-stand practice, standing and walking practice, aerobic treadmill training and lower-limb strength training (TheraBand). Treadmill speed and gradient were progressed and TheraBand repetitions and resistance progressed</p> <p>Control: individual CPT for 30 min twice a day (total 60 min), 5 days a week for the 4 weeks. The content of the individual PT sessions was based on neurodevelopmental treatment for motor recovery</p> <p>Setting: inpatient rehabilitation</p>
Outcomes	<p>Included outcomes: motor function lower limb (lower limb score Fugl-Meyer assessment), gait endurance (6-MWT), balance (BBS), ADL function (Korean version of the Modified BI)</p> <p>Other outcomes: none</p>
Notes	
Risk of bias	
Bias	Authors' judgement Support for judgement
Random sequence generation (selection bias)	Unclear risk Randomised in a 1:1 ratio, evenly matched via sealed envelope technique but no further information provided

Kim 2016a (Continued)

Allocation concealment (selection bias)	Unclear risk	Randomisation was performed using a sealed envelope technique, unclear if envelopes were opaque
Blinding (performance bias and detection bias) All outcomes	High risk	There was no description provided regarding information participants received about the aim of the study and no sham control was provided
Blinding of outcome assessment (detection bias) All outcomes	Low risk	The outcome assessor was blinded to allocation
Incomplete outcome data (attrition bias) End of intervention	Low risk	All participants who were randomised were analysed no details on dropouts or missing data was reported
Incomplete outcome data (attrition bias) End of follow-up	Low risk	
Selective reporting (reporting bias)	Unclear risk	All outcomes specified in the methods were reported in detail, the study protocol was not published and no reference was made to registration of the study
Other bias	Low risk	None known
Imbalanced exposure	High risk	No attention control; imbalanced exposure doses

Kim 2017a

Methods	Design: randomised trial of mixed training plus UC vs UC only - during UC Randomisation: no description of method used Allocation concealment: not described Blinding: not described ITT: not described; per-protocol analysis Measurements: baseline and end of intervention (6 weeks) Withdrawals: 1 dropout from exercise group (discharged home)
Participants	Randomised: total 30 participants (15 intervention, 15 control) Intervention: 14 participants (9 men), mean age 50.71 years (14.81) and time since stroke 12.79 (7.34) months Control: 15 participants (10 men), mean age 51.87 years (17.42) and time since stroke 11.73 (8.02) months Inclusion criteria: at least 3 months post-stroke, cognitive ability allowed research instructions to be followed, Korean-MMSE score ≥ 10 points, ability to walk ≥ 10 m independently, and adequate vision for study tests Exclusion criteria: bilateral stroke or previous stroke affecting the other side, insufficient gait ability for using treadmill, risk of epilepsy, and use of anti-epileptics
Interventions	Intervention: handgrip strength training; progressive 15 min grasping training with power web exerciser and digi-flex devices. Walking speed cardiorespiratory treadmill training (15 min) with 5% body mass

Physical fitness training for stroke patients (Review)

Kim 2017a (Continued)

loading of the unaffected side. Speed of treadmill increased in increments each week. Total exercise dose 30 min/day, 3 x week for 6 weeks

Conventional therapy alone. Involved joint movements, mat movements and walking exercises 10 min each. 60 min/session, 2 sessions/day, 5 days/week for 6 weeks

Control: conventional therapy alone. Involved joint movements, mat movements and walking exercises 10 min each. 60 min/session, 2 sessions/day, 5 days/week for 6 weeks

Setting: hospital

Outcomes	Included outcomes: cognitive function test (Korean version of Montreal Cognitive Assessment, trail making test and Stroop test, handgrip strength test, 10 metre walking test, TUG
Notes	Uncertainty on exercise frequency; sessions/day or/week

Risk of bias

Bias	Authors' judgement	Support for judgement
Random sequence generation (selection bias)	Unclear risk	No mechanism described
Allocation concealment (selection bias)	Unclear risk	No information provided
Blinding (performance bias and detection bias) All outcomes	High risk	No description of who ran the intervention, unbalanced intervention between groups
Blinding of outcome assessment (detection bias) All outcomes	Unclear risk	No information available
Incomplete outcome data (attrition bias) End of intervention	Low risk	Analysed per protocol but only 1/15 dropped out in intervention group
Incomplete outcome data (attrition bias) End of follow-up	Low risk	
Selective reporting (reporting bias)	Unclear risk	No trial registration information
Other bias	Low risk	Muscle strength should be maximum value not an average of triplicate measures; but overall no substantive issues noted
Imbalanced exposure	High risk	No attention control

Knox 2018

Methods	Design: single-blinded, RCT with 2 intervention groups <ul style="list-style-type: none"> • mixed training (task-oriented circuit gait training) vs no exercise (control) - after UC • resistance training vs no exercise (control) - after UC
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Knox 2018 (Continued)

Randomisation: stratified randomisation; stratification based on comfortable gait speed mild (≥ 0.8 m/s), moderate (≥ 0.4 m/s and < 0.8 m/s), and severe (< 0.4 m/s) and then randomised into the 3 intervention arms using computer-generated random numbers

Allocation concealment: envelopes; unclear whether sequentially numbered, sealed or opaque

Blinding: outcome assessor blinded; participants may have understood nature of group assignments

ITT: analyses were not performed according to ITT principle

Measurements: 12 weeks post-intervention and at follow-up a further 12 weeks later

Withdrawals: 12 weeks post-intervention: task group: 6/51 (11%) participants from task group (3 deceased, 2 moved away, 1 return to work), 5/45 (11%) participants from strength group (1 deceased, 2 no transport, 2 moved away), 5/48 (10%) participants from control group (1 deceased, 2 no transport, 1 return to work, 1 private healthcare)

Follow-up after a further 12 weeks: 10/51 (20%) participants from task group (2 moved away, 1 second stroke, 1 no transport), 6/45 (13%) participants from strength group (1 deceased), 8/48 (17%) participants from control group (1 returned to work, 1 deceased, 1 no transport)

Participants	<p>Randomised: 144 participants randomised</p> <p>Mixed training group 51 participants; 25 men (49%) and 26 women (51%); mean age: 51 (SD 15); time since stroke: 10 weeks (SD 8)</p> <p>Resistance training group = 45 participants, 25 men (56%) and 20 women (44%); mean age: 51 (SD 12); time since stroke: 9 weeks (SD 7)</p> <p>Control: 48 participants, 22 men (46%) and 26 women (54%); mean age: 48 (SD 14); time since stroke 8 weeks (SD 7)</p> <p>Inclusion criteria: between 20–79 years of age, < 6 months after the onset of a first stroke, medically stable (people who were HIV+ but on antiretroviral treatment and stable), and who could walk at least 10 m at < 1.1 m/s without assistance but with the use of assistive devices or supervision, if needed, able to understand and follow instructions, and live near enough to attend sessions in the hospital with the help of caregivers</p> <p>Exclusion criteria: medical, neurological, or orthopaedic conditions that could interfere with their post-stroke recovery such as active HIV status, neurological disorders, or musculoskeletal injuries interfering with gait rehabilitation</p>
Interventions	<p>Mixed training group: (task group) 6 exercises focused on improving strength, balance, and task performance while standing and walking, and included an endurance walking station. Exercises were progressed by reducing the use of supports and increasing the complexity of the tasks. Participants' caregivers attended to give the correct assistance to the participant in the execution of the tasks and were directed to assist the participant in working on a progressively more difficult structured walking programme at home between the formal therapy sessions. Frequency of intervention: 6 sessions of 1 h each over a 12-week period</p> <p>Resistance training group: (strength group) 3 sets of 10 repetitions; 10 exercises performed while sitting and lying, which targeted the major muscles in the lower extremities. Exercise progressed as per the participants' performance and feedback. Resistance was provided with gravity, free weights, elastic bands, and balls. Frequency of intervention: 6 sessions of 1 h each over a 12-week period</p> <p>Control: 90-min educational session on stroke management that included 20 min of exercises, provided by an occupational or physiotherapist. Frequency of intervention: one 90-min session. Single session so not a training intervention</p> <p>Setting: hospital</p>
Outcomes	<p>Included outcomes: walking endurance- six-min walk test, comfortable and fast gait speeds, 10 m gait speed, balance function, mobility</p>

Knox 2018 (Continued)

Other outcomes:

Notes Trial registered retrospectively (9 years after study start date): PACTR201802003054396

Risk of bias

Bias	Authors' judgement	Support for judgement
Random sequence generation (selection bias)	Low risk	Stratified by comfortable gait speed and randomised with computer-generated random numbers
Allocation concealment (selection bias)	Unclear risk	Computer-generated sequence was used by a physiotherapist blinded to group allocation. However, the study authors outline that "stratification envelopes" were used but it is unclear whether they were sequentially numbered, sealed or opaque
Blinding (performance bias and detection bias) All outcomes	High risk	No attempt was made to blind participants to group assignment.
Blinding of outcome assessment (detection bias) All outcomes	Low risk	Outcome assessor blinded
Incomplete outcome data (attrition bias) End of intervention	Low risk	Participants with missing outcome data were not excluded. Participants with missing follow-up data were not excluded. Small, balanced number of dropouts (11% task group, 11% strength group, and 10% control group).
Incomplete outcome data (attrition bias) End of follow-up	Low risk	Balanced attrition across 3 groups post-intervention, $\leq 20\%$ attrition in all groups
Selective reporting (reporting bias)	High risk	Reported outcomes correspond to protocol PACTR201802003054396; however, protocol published retrospectively
Other bias	Low risk	None known
Imbalanced exposure	High risk	No attempt to account for imbalanced exposure in experimental arms (both 6 x 1-h sessions over 12 weeks) and control arm (1 x 90-min session over 12 weeks)

Kuys 2011

Methods

Design: randomised, single-blind trial of cardiorespiratory plus UC vs UC - during UC

Randomised: independent researcher generated random sequence in blocks of 4 using computer-generated random number sequence

Allocation concealment: consecutively numbered envelopes

Blinding: outcome assessors

ITT: yes

Measurements: end of intervention (6 weeks) and 3-month follow-up

Kuys 2011 (Continued)

Withdrawals: intervention group (2 participants before end of intervention (1 withdrew, 1 due to fall); 2 participants before follow-up (1 moved, 1 medical condition)); control group (3 participants before follow-up (1 unable to be contacted, 1 medical condition, 1 moved))

Participants	<p>Randomised: 30 participants</p> <p>Intervention: 15 participants; 7 men and 8 women; mean age 63 years (SD 14); 52 days post-stroke (SD 32)</p> <p>Control: 15 participants; 7 men and 8 women; mean age 72 years (SD 17); 49 days post-stroke (SD 30)</p> <p>Inclusion criteria: first stroke diagnosed via CT; referred for PT rehabilitation; scored ≤ 2 MAS; medically stable; MMSE score of at least 24</p> <p>Exclusion criteria: normal gait speed (> 1.2 m/s); cardiovascular problems</p>
Interventions	<p>Intervention group: treadmill walking for 30 min 3 times/week for 6 weeks at 40%-60% HR reserve (initially starting at 40% HR reserve, progressing by 5%-10% increase each week until 60% reached)</p> <p>Control group: CPT care</p> <p>Setting: 2 rehabilitation units</p>
Outcomes	<p>Included outcomes: 10-metre walk test; comfortable walking speed; 6-MWT</p> <p>Other outcomes: walking kinematic data</p>
Notes	—

Risk of bias

Bias	Authors' judgement	Support for judgement
Random sequence generation (selection bias)	Low risk	Independent researcher generated random sequence in blocks of 4 using computer-generated random number sequence
Allocation concealment (selection bias)	Unclear risk	Consecutively numbered envelopes; not reported whether these were sealed and opaque
Blinding (performance bias and detection bias) All outcomes	High risk	No attention control
Blinding of outcome assessment (detection bias) All outcomes	Low risk	Blinded outcome assessors
Incomplete outcome data (attrition bias) End of intervention	Low risk	ITT analysis used 2/30 (7%) losses Intervention group 2 (1 withdrew, 1 due to fall)
Incomplete outcome data (attrition bias) End of follow-up	High risk	ITT analysis used 7/30 (23%) total losses Intervention group 2 (1 moved, 1 medical condition); control group 3 (1 unable to be contacted, 1 medical condition, 1 moved)
Selective reporting (reporting bias)	Low risk	All included outcomes were described in trial registry ACTRN12607000412437. Planned oxygen uptake measures not reported

Kuys 2011 (Continued)

Other bias	Low risk	None known
Imbalanced exposure	High risk	Imbalanced exposure

Langhammer 2007

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

Risk of bias

Langhammer 2007 (Continued)

Bias	Authors' judgement	Support for judgement
Random sequence generation (selection bias)	Low risk	Use of dice (uneven numbers vs even numbers). In addition, randomisation was stratified according to gender and hemisphere lesion (minimisation) Randomisation was performed by an investigator not involved with the participants or the treatment
Allocation concealment (selection bias)	Unclear risk	Unclear; protocol was sealed for 1.5 years from the start of the study
Blinding (performance bias and detection bias) All outcomes	High risk	Some unstructured attention control "The amount of training was equal in the two groups". However, the control intervention was not given on a regular basis
Blinding of outcome assessment (detection bias) All outcomes	Low risk	Experienced investigator, blinded to group allocation
Incomplete outcome data (attrition bias) End of intervention	Low risk	ITT analysis 8/75 (11%) losses at the end of intervention; 3 participants in the intensive exercise group at discharge (1 dead and 2 withdrawals) and 5 (3 dead and 2 withdrawals) in the control group at discharge
Incomplete outcome data (attrition bias) End of follow-up	Low risk	ITT analysis 12/75 (16%) losses at the end of follow-up; 1 dead and 1 withdrawal at 3 months and 2 dead at 6 months in the control group
Selective reporting (reporting bias)	Unclear risk	Protocol not available
Other bias	Low risk	None known
Imbalanced exposure	Unclear risk	Imbalanced exposure

Lee 2013a

Methods	<p>Design: randomised trial of close kinetic chain resistance exercise vs open kinetic chain resistance exercise vs no intervention</p> <p>Randomisation: unclear Allocation concealment: information not included Blinding: information not included ITT: no ITT but no losses</p> <p>Measurements: end of intervention (6 weeks)</p> <p>Withdrawals: none</p>
Participants	<p>Randomised: total 33 participants. 11 to close kinetic chain exercise (CKC), 11 to open kinetic chain exercise (OKC) and 11 to control</p> <p>Intervention 1 CKC: 11 participants; 7 men, 4 women; mean age: 59.3 (SD 8.87); months post-stroke 19.9 (SD 7.59)</p> <p>Intervention 2 OKC 11 participants; 7 men, 4 women; mean age 58.8 (SD 6.81); months post-stroke 20.3 (SD 8.13)</p> <p>Control: 11 participants: 6 men, 5 women; mean age 60.10 (SD 7.01); months post-stroke 19.70 (SD 9.42)</p>

Physical fitness training for stroke patients (Review)

Lee 2013a (Continued)

Inclusion criteria: age 30-65 years; stroke occurring at least 6 months before start of study; sufficient cognition to comprehend study purpose; one-sided hemiparesis of lower extremity

Exclusion criteria: severe cognitive, communicative, perceptual or sensory problems preventing understanding of study purpose; other neurologic or psychiatric problems causing difficulties in following programme; unstable cardiovascular/ventilatory problems

Interventions	<p>Resistance training 5 times/week for 6 weeks</p> <p>Warm-up – 4 reps at 25% of 1-RM followed by 3 sets (8-10 reps) at 70% of 1-RM adjusted weekly</p> <p>Intervention 1 CKC: seated, paretic foot on pedal of a leg press machine with pneumatic resistance, extend leg and slowly flex</p> <p>Intervention 2 OKC: sat in chair, back facing leg press exercise machine, knee maintained at 90° of flexion with free distal extremity. Extend and slowly flex knee</p> <p>Control: no intervention (maintained routine activity)</p> <p>Setting: unclear</p>
Outcomes	<p>Included outcomes: balance (postural sway)</p> <p>Other outcomes: muscle activation (limb muscle electromyography recordings)</p>
Notes	Very similar to Lee 2013b

Risk of bias

Bias	Authors' judgement	Support for judgement
Random sequence generation (selection bias)	Unclear risk	Not reported in paper
Allocation concealment (selection bias)	Unclear risk	Not reported in paper
Blinding (performance bias and detection bias) All outcomes	High risk	Imbalanced exposure
Blinding of outcome assessment (detection bias) All outcomes	Unclear risk	Not reported in paper
Incomplete outcome data (attrition bias) End of intervention	Low risk	No losses
Selective reporting (reporting bias)	Unclear risk	Protocol not available
Other bias	Low risk	None known
Imbalanced exposure	High risk	Imbalanced exposure between control group and both intervention groups

Lee 2013b

Methods	<p>Design: randomised trial of close kinetic chain resistance exercise vs open kinetic chain resistance exercise vs no intervention</p> <p>Randomisation: unclear Allocation concealment: information not included Blinding: information not included ITT: no ITT but no losses</p> <p>Measurements: end of intervention (6 weeks)</p> <p>Withdrawals: none</p>
Participants	<p>Randomised: total 39 participants. 13 to close kinetic chain exercise (CKC), 13 to open kinetic chain exercise (OKC) and 13 to control</p> <p>Intervention 1 CKC: 13 participants; 8 men, 5 women; mean age: 49.3 (SD 8.87); months after stroke 14.9 (SD 9.59)</p> <p>Intervention 2 (OKC): 13 participants; 8 men, 5 women; mean age 50.8 (SD 6.81); months post-stroke 15.7 (SD 8.13)</p> <p>Control: 13 participants; 9 men, 4 women; mean age 49.10 (SD 7.01); months after stroke 15.10 (SD 8.73)</p> <p>Inclusion criteria: hemiparesis secondary to single onset unilateral stroke; ability to ambulate independently over 10 m (with/without device); absence of significant lower extremity joint pain and major sensory deficits; absence of significant lower limb contractures; no significant cardiovascular or respiratory symptoms contradictory to walking</p> <p>Exclusion criteria: none stated</p>
Interventions	<p>Resistance training 5 times/week for 6 weeks</p> <p>Warm-up – 4 reps at 25% of 1-RM followed by 3 sets (8-10 reps) at 70% of 1-RM adjusted weekly</p> <p>Intervention 1 CKC: seated, paretic foot on pedal of a leg press machine with pneumatic resistance, extend leg and slowly flex</p> <p>Intervention 2 OKC: sat in chair, back facing leg press exercise machine, knee maintained at 90° of flexion with free distal extremity. Extend and slowly flex knee</p> <p>Control: no intervention (maintained routine activity)</p> <p>Setting: unclear</p>
Outcomes	<p>Included outcomes: none</p> <p>Other outcomes: barefoot plantar pressure distributions</p>
Notes	<p>Very similar to Lee 2013b</p>

Risk of bias

Bias	Authors' judgement	Support for judgement
Random sequence generation (selection bias)	Unclear risk	Not reported in paper
Allocation concealment (selection bias)	Unclear risk	Not reported in paper
Blinding (performance bias and detection bias) All outcomes	High risk	Imbalanced exposure

Lee 2013b (Continued)

Blinding of outcome assessment (detection bias) All outcomes	Unclear risk	Not reported in paper
Incomplete outcome data (attrition bias) End of intervention	Low risk	No losses
Selective reporting (reporting bias)	Unclear risk	Protocol not available
Other bias	Low risk	None known
Imbalanced exposure	High risk	Imbalanced exposure between control group and both intervention groups

Lennon 2008

Methods	<p>Design: pilot randomised study of cardiorespiratory training vs UC - after UC. Sample size calculation reported</p> <p>Randomisation: stratified randomisation (by age and sex) into 4 blocks of 6 using a sequence generator by an independent party</p> <p>Allocation concealment: opaque envelopes</p> <p>Blinding: single-blinded; unclear who was blinded</p> <p>ITT: no but only 1 participant dropped out in the control group</p> <p>Measurements: end of intervention (10 weeks)</p> <p>Withdrawals: 1 participant (refusal) in the control group</p>
Participants	<p>Randomised: total 48 participants. Participants were recruited from the Stroke Rehabilitation Database (Dublin). Volunteers contacted the research team for initial screening</p> <p>Intervention: 24 participants; 14 men (58%) and 10 women (42%); mean age 59.0 years (SD 10.3); mean number of weeks from stroke 237.3 (SD 110.7)</p> <p>Control: 24 participants; 14 men (58%) and 10 women (42%); mean age 60.5 years (SD 10.0); mean number of weeks from stroke 245.3 (SD 169.8)</p> <p>Inclusion criteria: > 1 year post-ischaemic stroke and > 18 years of age; participants were recruited irrespective of their ability to ambulate independently</p> <p>Exclusion criteria: O₂ dependence, angina, unstable cardiac conditions, uncontrolled diabetes mellitus, major medical conditions, claudication, cognitive impairment, or beta blocker medication</p>
Interventions	<p>Intervention: the Cardiac Rehabilitation Programme consisted of cycle ergometry training using either the upper or lower limbs. Exercise load was set at 50%-60% of the participants' maximal HR. Resistance and speed were adjusted daily to ensure progression. Frequency: participants trained twice weekly for 30 min each time, for 10 weeks. Measurements performed at week 1 and re-assessment at week 10. All sessions were supervised by a physiotherapist</p> <p>Control: CPT and OT; no therapy contained an aerobic exercise component; measurements at week 1 and re-assessment at week 10. No further details provided</p> <p>Setting: outpatient rehabilitation</p>

Lennon 2008 (Continued)

Outcomes	Included outcomes: VO ₂ ; BMI; maximum cycle workload; resting SBP; resting DBP; total cholesterol; FAI; HADS Other outcomes: resting HR; cardiac risk score; RPE
Notes	The study 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
Random sequence generation (selection bias)	Low risk	Stratified randomisation (by age and sex) into 4 blocks of 6 using a sequence generator by an independent party
Allocation concealment (selection bias)	Unclear risk	Opaque envelopes; sealed and numbered unknown
Blinding (performance bias and detection bias) All outcomes	High risk	Control group did not receive the comparable non-exercise related attention to the intervention group
Blinding of outcome assessment (detection bias) All outcomes	Unclear risk	Unclear who was blinded
Incomplete outcome data (attrition bias) End of intervention	Low risk	No ITT analysis 1/48 (2%) participant dropped out 1 (refusal) in the control group
Selective reporting (reporting bias)	Unclear risk	Protocol not available
Other bias	Low risk	None known
Imbalanced exposure	High risk	Imbalanced exposure

Letombe 2010

Methods	Design: randomised trial of mixed training plus UC vs UC Randomisation: information not included Allocation concealment: information not included Blinding: information not included ITT: not completed Measurements: before and end of intervention (4 weeks) Withdrawals: none reported
Participants	Randomised: total 18 participants: 9 participants were randomised to intervention, 9 to control Intervention: 9 participants; 5 men, 4 women; mean age: (combined men and women) 59.1 years (SD 9.4); mean height: unknown; mean weight: unknown; type of stroke: ischaemic 5, haemorrhagic 4; paretic side: right 4, left 5; time since stroke onset: 20 days Control: 9 participants; 6 men, 3 women: mean age: (combined men and women) 60.6 years (SD 8.2); mean height: unknown; mean weight: unknown; type of stroke: ischaemic 5, haemorrhagic 4; paretic side: right 4, left 5; time since stroke onset: 20 days

Letombe 2010 (Continued)

Inclusion criteria: right or left hemiplegia following ischaemic or haemorrhagic hemispheric stroke; a full set of aetiological data (CT and/or MRI scans, Holter ECG, Doppler, cardiac ultrasound); a stable clinical state; well-balanced treatment (particularly in terms of antihypertensives and anticoagulants)

Exclusion criteria: existence of disorders associated with hemiplegic motor damage, such as cognitive and memory disorders; hemisensory neglect; the existence of an intercurrent affection or unstable brain lesions

Interventions	<p>Intervention: participants in the training group (n = 9) received conservative physical therapy for 3 h/day, 5 days/week, for a period of 4 weeks. Conservative physical therapy consisted of gait exercises, stance exercises, the treatment of orthopaedic disorders, balance work (with a view to subsequently withdrawing gait aids), use of support stockings and braces and maintenance of the freedom of movement of the proximal-distal limb joints. In addition general exercise training was implemented, with cardiorespiratory exercise (monitored by a HR monitor), muscle strengthening, gait exercises, and work focused on executive functions, lasting for between 40 and 60 min/day, 4 times a week. Aerobic exercise was included in the form of steady exercise on a semi-recumbent cycle ergometer (with both feet pedaling) was performed at between 70% and 80% of maximum power</p> <p>Control: participants in the control group (n = 9) received conservative physical therapy for 3 h/day, 5 days/week, for a period of 4 weeks. Conservative physical therapy consisted of gait exercises, stance exercises, the treatment of orthopaedic disorders, balance work (with a view to subsequently withdrawing gait aids), use of support stockings and braces and maintenance of the freedom of movement of the proximal-distal limb joints</p> <p>Setting: hospital setting</p>
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Outcomes	Included outcomes: triangular maximal aerobic power test using a cycle ergometer
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Notes	—
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Risk of bias

Bias	Authors' judgement	Support for judgement
Random sequence generation (selection bias)	Unclear risk	Described only as "randomized into two groups"
Allocation concealment (selection bias)	Unclear risk	Not reported
Blinding (performance bias and detection bias) All outcomes	High risk	Not reported; not attention control
Blinding of outcome assessment (detection bias) All outcomes	Unclear risk	Not reported
Incomplete outcome data (attrition bias) End of intervention	Low risk	ITT not reported No participant losses
Selective reporting (reporting bias)	Unclear risk	Trial register or protocol not available
Other bias	Low risk	None known
Imbalanced exposure	High risk	Imbalanced exposure

MacKay-Lyons 2013

Methods	<p>Design: randomised trial of BWSTT (cardiorespiratory) vs control (UC)</p> <p>Randomisation: computer-generated blocked randomisation.</p> <p>Allocation concealment: yes</p> <p>Blinding: yes</p> <p>ITT: yes</p> <p>Measurements: end of intervention (12 weeks), 6 months, 12 months</p> <p>Withdrawals: 5 withdrawals by end of intervention - 3 from intervention and 2 from control; 3 more withdrawals by 6-month follow-up - 1 from intervention, 2 from control; 5 more withdrawals by 12-month follow-up - 3 from intervention, 2 from control</p>
Participants	<p>Randomised: total 50 participants: 45 of these completed the exercise programme</p> <p>24 randomised to intervention (22 completed intervention)</p> <p>26 randomised to control (23 completed)</p> <p>Intervention: 24 participants; 15 men, 9 women; mean age: 61.5 (SD 15.4); days after stroke 23.3 (SD 5.7)</p> <p>Control: 26 participants; 14 men, 12 women; mean age 59.0 (SD 12.7); days after stroke 23.1 (SD 4.4)</p> <p>Inclusion criteria: > 18 years, within 1 month of first ischaemic stroke confirmed by neuroimaging, in-patients in stroke rehabilitation centre, able to walk 5 m with or without ambulatory aids, ankle orthoses, or stand-by assistance</p> <p>Exclusion criteria: contraindications to maximal exercise stress testing; musculoskeletal or cognitive limitations that could preclude participation in the programme, involvement in other pharmacological or physical intervention studies</p>
Interventions	<p>Intervention: 60 min, 5 days/week for 6 weeks then 3 days/week for 6 weeks</p> <p>5-10 min active/passive stretching; 10-15 min upper extremity training (active exercises and stretching); 10-15 min lower extremity training (active exercises and stretching)</p> <p>25-30 min treadmill gait training (initially treadmill speed 80%-90% of self-paced overground speed with 20%-30% body weight supported for ambulatory-independent participants and 70%-80% of overground speed with 40% body weight supported for ambulatory-dependent participants)</p> <p>Control: 60 min, 5 days/week for 6 weeks then 3 days/week for 6 weeks</p> <p>5-10 min active/passive stretching; 10-15 min upper extremity training (active exercises and stretching); 10-15 min lower extremity training (active exercises and stretching)</p> <p>5-10 min of pre-gait activities in standing followed by 20-25 min overground walking at comfortable self-selected speeds</p> <p>Setting: stroke rehabilitation unit</p>
Outcomes	<p>Included outcomes: cardiovascular fitness (VO₂ peak); 6-MWT; comfortable walking speed; BBS</p> <p>Other outcomes: Chedoke-McMaster stages of Recovery Leg and Foot; participant satisfaction with programme</p>
Notes	12-month follow-up data used in meta-analyses of end-of-retention time point
Risk of bias	
Bias	Authors' judgement Support for judgement

MacKay-Lyons 2013 (Continued)

Random sequence generation (selection bias)	Low risk	Computer-generated, permuted block randomisation stratified by ambulatory status
Allocation concealment (selection bias)	Low risk	Quote: "A person not involved in the study prepared and safeguarded individual, opaque sealed envelopes containing group and physiotherapist allocation, which were opened after completion of the baseline assessment"
Blinding (performance bias and detection bias) All outcomes	Unclear risk	There was a similar dose of exposure across both groups. Participants were informed they would be allocated to 1 of 2 'intervention' groups. The groups were kept separate
Blinding of outcome assessment (detection bias) All outcomes	Low risk	Blinded outcome assessment. Participants instructed not to discuss their intervention with outcome assessor. A test of blinding was also performed and analysed statistically to demonstrate no significant unblinding
Incomplete outcome data (attrition bias) End of intervention	Low risk	ITT analysis 5/50 (10%) total losses 2 lost from BSWTT (1 moved, 1 for medical reasons) 3 lost from UC group (2 for medical reasons, 1 dropped out as disinterested) Quote: "All analyses were conducted on an intention-to treat basis, carrying the last observation forward for those lost to follow-up"
Incomplete outcome data (attrition bias) End of follow-up	High risk	ITT analysis (LOCF) 11/50 (22%) total losses 6-month follow-up: 3 did not complete: 1 from intervention (1 refused); 2 from control (1 refused; 1 lost to follow-up) 12-month follow-up: 5 did not complete; 3 from intervention (2 lost to follow up, 1 refused); 2 from control (1 for medical reasons, 1 lost to follow-up)
Selective reporting (reporting bias)	Unclear risk	Not clear whether a protocol exists
Other bias	Low risk	None known
Imbalanced exposure	Low risk	Balanced exposure

Mao 2015

Methods	<p>Design: single hospital centre RCT. Cardiorespiratory training (BWSTT) plus UC vs conventional over-ground walking training plus UC (BWSTT replaces part of UC) - during UC</p> <p>Randomisation: no details provided</p> <p>Allocation concealment: no details provided</p> <p>Blinding: baseline and end of intervention outcome measures completed by examiner blinded to group allocation</p> <p>ITT: dropouts reported, no attempt to measure participants at outcome. No ITT reported</p> <p>Measurements: baseline, at the end of intervention (3 weeks)</p>
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Mao 2015 (Continued)

Withdrawals: after baseline but prior to outcome 3/15 (20%) participants were lost in the intervention group (1 cardiovascular instability, 2 early discharged). After baseline but prior to outcome 2/14 (14%) participants were lost in the control group (2 early discharged)

Participants	<p>Randomised: total 29 participants. 15 participants were randomised to intervention, data from 12 were presented and analysed. 14 participants were randomised to control group, data from 12 were presented and analysed</p> <p>Intervention: BWSST plus UC = 12 participants; 2 men (17%) and 10 women (83%); mean age: 59.55 (SD 9.23) years; mean body mass 65.17 (SD 10.26) kg; 49.25 (SD 19.51) days after stroke</p> <p>Control: conventional overground walking training plus UC = 12 participants; 3 men (25%) and 9 women (75%); mean age: 60.82 (SD 10.7) years; mean body mass 65.25 (SD 11.42) kg; 47.67 (SD 16.78) days after stroke</p> <p>Inclusion criteria: stroke confirmed by CT or MRI; unilateral hemiparesis for no more than 3 months resulting from first stroke; residual gait impairment, defined by an abnormal 10 m walk time according to age (age < 60 = ≥ 10 s or 1 m/s; age 60-69: ≥ 12.5 s or 0.8 m/s; age ≥ 70: ≥ 16.6 s, < 0.6 m/s); and adequate mental and physical capacity to attempt the tasks as instructed (MMSE score ≥ 27, average modified Ashworth Scale score at hip, knee, and ankle ≤ 2)</p> <p>Exclusion criteria: presence of significant medical complications or unstable vital signs that precluded participation in the study</p>
Interventions	<p>Intervention: BWSST plus UC. Standardised BWSST consisted of 30%-40% assisted body support treadmill walking. Progressive programme in which assisted body support was decreased and treadmill speed increased separately. No further detail for percentage assisted body support was provided. Frequency of intervention: initial at 0.5 miles per hour (0.8 km/h) treadmill speed for 20 min, 5 days/week for 3 weeks progressing to 2.5 miles per hour (4 km/h) for 40 min, 5 days/week for 3 weeks</p> <p>Control: conventional overground walking training plus UC. Individualised overground gait training based on the principles of neurodevelopmental therapy (Bobath method). Frequency of control: 30 min, 5 days/week for 3 weeks</p> <p>UC for both intervention and control groups consisted of 20-40 min, 5 days/week for 3 weeks of therapeutic exercises (range of movement; strengthening exercises; as well as facilitation techniques to recruit muscle activity on the paretic extremity. UC also consisted of 60 min, 5 days/week for 3 weeks of OT session (functional stimulation and self-exercise programme). No further specific details were provided</p> <p>Setting: hospital</p>
Outcomes	<p>Included outcomes: Brunel Balance Assessment; Fugl-Meyer Lower Extremity Assessment; self-selected walking speed</p> <p>Other outcomes: 3-D motion analysis at self-selected walking speed (cadence, stride time and length, step time and length; kinematic and kinetic data included joint angles and moments)</p>
Notes	
Risk of bias	
Bias	Authors' judgement Support for judgement
Random sequence generation (selection bias)	Unclear risk Randomly assigned to the groups, no further details provided
Allocation concealment (selection bias)	Unclear risk Not reported

Mao 2015 (Continued)

Blinding (performance bias and detection bias) All outcomes	Unclear risk	Active attention control compensates for lack of blinding
Blinding of outcome assessment (detection bias) All outcomes	Low risk	Assessor blinded to group allocation
Incomplete outcome data (attrition bias) End of intervention	High risk	Overall dropout rate 20% in intervention and 14% in control groups. No ITT analysis
Incomplete outcome data (attrition bias) End of follow-up	Low risk	
Selective reporting (reporting bias)	Unclear risk	No trial registration details accessible
Other bias	Low risk	None known
Imbalanced exposure	Low risk	Attention control

Mead 2007

Methods	<p>Design: explanatory randomised trial of mixed training vs non-exercise intervention - after UC</p> <p>Randomisation mechanism: internet application; minimisation dichotomised on sex; FIM score (120); age (70 years)</p> <p>Allocation concealment: sequence generation and allocation occurred simultaneously</p> <p>Blinding: investigator; participants encouraged to maintain blinding</p> <p>ITT: yes</p> <p>Measurements: end of intervention (12-14 weeks) and 4-month follow-up</p> <p>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)</p>
Participants	<p>Randomised: 66 participants</p> <p>Intervention: 32 participants; 18 men and 14 women; age 72.0 years (SD 10.4); median 171 (IQR 55 to 287) days post-stroke</p> <p>Control: 34 participants; 18 men and 16 women; age 71.7 years (SD 9.6); median 147.5 (IQR 78.8 to 235.5) days post-stroke</p> <p>Inclusion criteria: independently ambulatory; living within central or south Edinburgh</p> <p>Exclusion criteria: dysphasia or confusion severe enough to prevent informed consent or impair safety in exercise classes; medical contraindications to exercise training</p>
Interventions	<p>Intervention: mixed training: group circuit training performed 40-75 min/day 3 days/week for 12-14 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 triceps extension using TheraBand, lifting a weighted pole, a sit-to-stand exercise); progression in duration, repetition number, speed, mass of objects and resistance of TheraBand whilst maintaining a RPE (6-20 scale) of 13-60</p> <p>Control: non-exercise intervention; seated relaxation involving deep breathing and progressive muscular relaxation; no muscle contractions were involved</p> <p>Setting: rehabilitation hospital</p>

Mead 2007 (Continued)

Outcomes Included outcomes: FIM; NEADL; RMI; functional reach; TUG; sit-to-stand time; SF-36 - version 2; HADS; gait preferred speed; gait economy (VO₂ 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
Random sequence generation (selection bias)	Low risk	Internet software-based minimisation dichotomised on sex; FIM score (120); age (70 years)
Allocation concealment (selection bias)	Low risk	Not applicable; sequence generation and allocation occurred simultaneously
Blinding (performance bias and detection bias) All outcomes	Unclear risk	Suitable attention control Quote: "Patients were blinded to the underlying hypothesis by reiterating the possible benefits of both interventions"
Blinding of outcome assessment (detection bias) All outcomes	Low risk	Outcome assessor blinded Quote: "Outcome assessors were blinded by asking patients not to discuss their allocated intervention"
Incomplete outcome data (attrition bias) End of intervention	Low risk	ITT analysis 1/66 (2%) lost at the end of intervention; intervention 0; control 1
Incomplete outcome data (attrition bias) End of follow-up	Low risk	ITT analysis 4/66 (6%) total losses at the end of follow-up; intervention 0; control group (1 stroke-related illness, 1 fall, 1 recurrent stroke)
Selective reporting (reporting bias)	Low risk	Reported outcome correspond to proposal; Chief Scientist Office of the Scottish Executive (CZB/4/46)
Other bias	Low risk	None known
Imbalanced exposure	Low risk	Balanced exposure

Moore 2010

Methods Design: randomised, cross-over trial of cardiorespiratory training vs no intervention - after UC - (i.e. intensive locomotor training - including treadmill training - vs delayed cardiovascular training)

 Randomisation: stratified randomisation according to severity of gait impairment

 Allocation concealment: sealed envelopes

 Blinding: investigators were not blinded

 ITT: not reported

 Measurements: end of intervention (4 weeks)

Moore 2010 (Continued)

Withdrawals: none reported

Participants	<p>Randomised: 20 participants; mean age 50 years (SD 15); men 14, women 6; duration of post-stroke symptoms 13 months (SD 8); moderate/severe gait limitations 13/7</p> <p>Intervention: the number of participants randomised to the immediate locomotor training group was not clearly reported</p> <p>Control: the number of participants randomised to the delayed locomotor training group was not clearly reported</p> <p>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 m overground without physical assistance and medical clearance</p> <p>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</p>
Interventions	<p>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 motorised treadmill while wearing an overhead harness attached to a safety system. Frequency: 2-5 days/week for 4 weeks. Intensity: highest tolerable speed with velocity increased in 0.5 km/h increments until participants reached 80%-85% of predicted maximum HR or until the participants' RPE 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</p> <p>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</p> <p>Setting: rehabilitation centre</p>
Outcomes	Included outcomes: preferred gait speed; fastest gait speed; 12-MWT; O ₂ cost; peak treadmill speed; VO ₂ peak, TUG; BBS
Notes	We used only data at the end of the first cross-over period for analyses

Risk of bias

Bias	Authors' judgement	Support for judgement
Random sequence generation (selection bias)	Low risk	Stratified randomisation according to severity of gait impairment
Allocation concealment (selection bias)	Unclear risk	Sealed envelopes; opaque, numbered is unknown
Blinding (performance bias and detection bias) All outcomes	High risk	No attention control
Blinding of outcome assessment (detection bias) All outcomes	High risk	Investigators were not blinded

Moore 2010 (Continued)

Incomplete outcome data (attrition bias) End of intervention	Low risk	ITT not reported No dropouts
Selective reporting (reporting bias)	Unclear risk	Protocol not available
Other bias	Low risk	None known
Imbalanced exposure	High risk	Imbalanced exposure

Moore 2015

Methods	<p>Design: single-blind RCT. Mixed training vs attention control - after UC</p> <p>Randomisation: randomised using computer software; method unclear</p> <p>Allocation concealment: independent administrator used</p> <p>Blinding: outcome assessors blinded to group allocation and hypotheses</p> <p>ITT: no pre-planned ITT described</p> <p>Measurements: at the end of intervention (19 weeks)</p> <p>Withdrawals: 0 withdrawals</p>
Participants	<p>Randomised: 40 participants were randomised</p> <p>Intervention: 20 participants; 18 men (90%) and 2 women (10%); mean age: 68 (SD 8); 21 (SD 34) months after stroke</p> <p>Control: 20 participants; 16 men (80%) and 4 women (20%); mean age: 70 (SD 11); 16 (SD 12) months after stroke</p> <p>Inclusion criteria: age > 50 years, > 6 months after stroke onset, could complete 6-MWT, living at home, completed CPT and were not undertaking moderate exercise \geq 3 days/week</p> <p>Exclusion criteria: absolute/relative contraindications to exercise, type 1 diabetes, non-stroke neurological disorders, pain on walking, inability to follow commands, untreated depression, contraindications to MRI</p>
Interventions	<p>Intervention: mixed training. Group classes including warm-up, stretching, functional strengthening (increasing load and repetitions; 2 sets of 5 to 3 sets of 10), balance, agility and cardiorespiratory training (40% -50% maximum HR increasing to 70%-80%). Frequency of intervention: 40-60 min/day for 3 days/week for 19 weeks</p> <p>Control: home-based stretching. 10 seated stretches for the upper and lower body. Frequency of intervention: 40-60 min/day for 3 days/week for 19 weeks</p> <p>Setting: community leisure centre (intervention) and home (control)</p>
Outcomes	<p>Included outcomes: risk factors (BP, glucose control, lipid profile, body composition), cognition, mobility (10-MWT, 6-MWT), balance, QoL, physical fitness (peak oxygen consumption and peak work rate)</p> <p>Other outcomes: brain atrophy and metabolism</p>
Notes	ISRCTN41026907

Moore 2015 (Continued)

Risk of bias

Bias	Authors' judgement	Support for judgement
Random sequence generation (selection bias)	Low risk	Online tool used by independent administrator; method unknown
Allocation concealment (selection bias)	Low risk	Randomisation and allocation performed independently and remotely after consent
Blinding (performance bias and detection bias) All outcomes	Unclear risk	Attention control used
Blinding of outcome assessment (detection bias) All outcomes	Low risk	Outcome assessors were blinded to the study hypotheses and group assignment
Incomplete outcome data (attrition bias) End of intervention	Low risk	No losses
Selective reporting (reporting bias)	Unclear risk	Trial registry mentions a physical activity and a stroke impairment outcome which are not present in the publications
Other bias	High risk	Intervention is leisure-centre based, the control is home-based - there would be 3 x 2 x 19 = 114 journeys to and from the intervention which is potentially a lot of un-quantified physical activity
Imbalanced exposure	Low risk	Stretching was provided to the control - study authors list that stretching does not lower metabolic factors while other such as yoga does

Mudge 2009

Methods	<p>Design: randomised trial of cardiorespiratory training vs non-exercise intervention training - after UC (circuit-based rehabilitation vs social and educational sessions); power calculation reported</p> <p>Randomisation: computer-generated random numbers by an individual not associated with the study</p> <p>Allocation concealment: not reported</p> <p>Blinding: assessor blinded (unmasking of the independent assessor occurred in 3 cases who inadvertently stated or implied their group allocation)</p> <p>ITT: yes</p> <p>Measurements: end of intervention (4 weeks) and 3-month follow-up</p> <p>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</p>
Participants	<p>Randomised: 58 participants; median age 71.5 years (range 39.0-89.0 years); median 3.9 years after stroke (range 0.5-18.7 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 study</p>

Mudge 2009 (Continued)

Intervention: 31 participants were randomised to circuit training; 19 men and 12 women; median age 76.0 (range 39.0-89.0); median onset of stroke 3.33 years (range 0.6-13.3)

Control: 27 participants were randomised to social and educational sessions; 13 men and 14 women; median age 71.0 (range 44.0-86.0); median onset of stroke 5.8 years (range 0.5-18.7)

Inclusion criteria: participants with ≥ 1 strokes > 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 < 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, > 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/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 that 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 min including stretching. Measurements performed post-intervention and at 3-month follow-up

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 min. 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 ADL 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 study 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
Random sequence generation (selection bias)	Low risk	Computer-generated random numbers by an individual not associated with the study
Allocation concealment (selection bias)	Unclear risk	Not reported
Blinding (performance bias and detection bias) All outcomes	Unclear risk	Attention control incorporated but not equivalent
Blinding of outcome assessment (detection bias) All outcomes	Unclear risk	Assessor blinded; unmasking of the independent assessor occurred in 3 cases, who inadvertently stated or implied their group allocation

Mudge 2009 (Continued)

Incomplete outcome data (attrition bias) End of intervention	Low risk	ITT reported 3/58 (5%) lost at the end of intervention: 1 participant in the intervention group (disinterest) and 2 participants in the control group (too busy) withdrew at the end of intervention
Incomplete outcome data (attrition bias) End of follow-up	Low risk	ITT reported 8/58 (14%) lost overall at the end of follow-up: 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)
Selective reporting (reporting bias)	Unclear risk	Protocol not available
Other bias	Low risk	None known
Imbalanced exposure	Unclear risk	Attention control used but there is not an equivalent exposure

Ouellette 2004

Methods	<p>Design: randomised trial of resistance training vs non-exercise intervention - after UC</p> <p>Randomisation: unknown</p> <p>Allocation concealment: unknown</p> <p>Blinding: investigator</p> <p>ITT: yes</p> <p>Measurements: end of intervention (12 weeks)</p> <p>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)</p>
Participants	<p>Randomised: 42 participants</p> <p>Intervention: 21 participants; number of men and women unknown; age 65.8 years (SD 11.5); 968 days post-stroke (SD 460)</p> <p>Control: 21 participants; number of men and women unknown; age 66.1 years (SD 9.62); 779 days post-stroke (SD 558)</p> <p>Inclusion criteria: age ≥ 50 years; 6 months-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</p>
Interventions	<p>Intervention: progressive resistance training of both lower limbs performed 3 days/week for 12 weeks comprising 3 sets of 8-10 repetitions at 70% of 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</p> <p>Control: non-exercise: bilateral range of motion and upper body flexibility exercises 3 days/week for 12 weeks</p> <p>Setting: exercise laboratory</p>
Outcomes	<p>Included outcomes: muscle strength (bilateral lower limb extension force); muscle strength (unilateral knee extension, ankle dorsiflexion and ankle plantarflexion); gait endurance (6-MWT), preferred speed (10 m) and maximal speed (10 m); chair rise time (5 repetitions); stair climb time (10 steps); late life function and disability instrument scale; SF-36 physical function subscale</p> <p>Other outcomes: muscle power - bilateral lower limb extension and unilateral knee extension; geriatric depression scale (data not reported); sickness impact profile; Ewerts self efficacy scale</p>

Ouellette 2004 (Continued)

Notes Variance reported as standard error and converted to standard deviation

Risk of bias

Bias	Authors' judgement	Support for judgement
Random sequence generation (selection bias)	Unclear risk	Not reported
Allocation concealment (selection bias)	Unclear risk	Not reported
Blinding (performance bias and detection bias) All outcomes	Unclear risk	Attention control incorporated
Blinding of outcome assessment (detection bias) All outcomes	Low risk	Investigator blinded; efficacy unknown
Incomplete outcome data (attrition bias) End of intervention	Low risk	ITT 5/42 (12%) lost at the end of intervention: 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)
Selective reporting (reporting bias)	Unclear risk	Protocol not available
Other bias	High risk	Newspaper advert recruitment
Imbalanced exposure	Low risk	Balanced exposure

Park 2011

Methods	Design: randomised, single-blind trial of cardiorespiratory training plus UC vs UC - during UC Randomisation mechanism: participants blindly pick 1 of 2 cards Allocation concealment: envelopes used Blinding: outcome assessor blind to group allocation ITT: not reported Measurements: end of intervention (4 weeks) Withdrawals: 2 participants (1 from both intervention and control groups) not regularly participating
Participants	Randomised: 27 participants Intervention: 14 participants; 7 men and 6 women; mean age 59.4 years (SD 8.5) Control: 13 participants; 5 men and 7 women; mean age 56.9 years (SD 7.8) Inclusion criteria: 6 months to 5 years post-first stroke; walking speed < 0.7 m/s

Park 2011 (Continued)

Exclusion criteria: auditory or visual deficits; no orthopaedic or cardiovascular conditions; cognitive impairment (> 25 MMSE score)

Interventions	Intervention group: 4-phased walking training programme (progressing 150 m-200 m-300 m-500 m) 1 h 3 times/week for 4 weeks Control group: CPT care 1 h daily based on Bobath concept Setting: community based
Outcomes	Included outcomes: 10-metre walk test; 6-MWT; Community Walk test Other outcomes: walking ability questionnaire; activities-specific balance confidence scale
Notes	—

Risk of bias

Bias	Authors' judgement	Support for judgement
Random sequence generation (selection bias)	Unclear risk	Participants drew 1 of 2 cards from an envelope
Allocation concealment (selection bias)	Unclear risk	Envelopes used; nature of concealment unclear
Blinding (performance bias and detection bias) All outcomes	High risk	No attention control
Blinding of outcome assessment (detection bias) All outcomes	Low risk	Person assessing outcome and analysing data blinded
Incomplete outcome data (attrition bias) End of intervention	Low risk	ITT analysis not reported 2/27 (7%) lost at the end of intervention: 1 from intervention and 1 from control groups (not regularly participating)
Selective reporting (reporting bias)	Unclear risk	No protocol available
Other bias	Low risk	None known
Imbalanced exposure	High risk	Imbalanced exposure

Pohl 2002

Methods	Design: randomised trial of cardiorespiratory training plus % UC vs UC - during UC Randomisation mechanism: unknown; method: equal block based on gait speed Allocation concealment: unknown Blinding: investigator; efficacy unknown ITT: no Measurements: end of intervention (4 weeks) Withdrawals: none
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Pohl 2002 (Continued)

Participants	<p>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)</p> <p>Intervention: STT group = 20 participants; 14 men, 6 women; age 57.1 years (SD 13.9); 16.8 (20.5) weeks post-stroke. LTT group = 20 participants; 16 men, 4 women; age 58.2 years (SD 10.5); 16.2 (16.4) weeks post-stroke</p> <p>Control: 20 participants; 13 men, 7 women; age 61.6 years (SD 10.6); 16.10 (SD 18.5) weeks post-stroke</p> <p>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 m walk time > 5 s and < 60 s; 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 SBP and absence of ventricular tachycardia during exercise</p> <p>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</p>
Interventions	<p>Intervention:</p> <p>Group 1: STT; 30 min/day 3 days/week for 4 weeks; minimal body weight support (10%) for first 3 sessions; speed was increased progressively to the highest speed at which the participant could walk safely. The maximum-achieved speed was held for 10 s followed by a recovery period. Each time the participant successfully completed 10 s of walking at the set speed, the speed was increased during the next phase by 10%. Treadmill was run at 0% incline</p> <p>Group 2: LTT; 30 min/day 3 days/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</p> <p>Both intervention groups also received CPT 45 min/day 2 days/week for 4 weeks (included some gait training); total 12 h of treatment</p> <p>Control: conventional gait training that comprised post neuromuscular facilitation and Bobath techniques; 30 min/day 3 days/week for 4 weeks. The control group also received CPT 45 min/day 2 days/week for 4 weeks (included some gait training); total 15 h of treatment</p> <p>Setting: rehabilitation centre</p>
Outcomes	<p>Included outcomes: gait maximum speed; FAC</p> <p>Other outcomes: stride cadence (steps/min); stride length (m)</p>
Notes	<p>The control group (20 participants) was divided between the 2 relevant comparisons to avoid exaggeration of overall participant numbers in the analyses</p>

Risk of bias

Bias	Authors' judgement	Support for judgement
Random sequence generation (selection bias)	Unclear risk	Mechanism unknown; randomised to equal blocks based on gait speed
Allocation concealment (selection bias)	Unclear risk	Not reported
Blinding (performance bias and detection bias) All outcomes	Unclear risk	Attention control used, but not equivalent
Blinding of outcome assessment (detection bias) All outcomes	Unclear risk	Investigator; efficacy unknown

Pohl 2002 (Continued)

Incomplete outcome data (attrition bias) End of intervention	Low risk	ITT no reported No losses
Selective reporting (reporting bias)	Unclear risk	No protocol available
Other bias	Low risk	None known
Imbalanced exposure	Unclear risk	Imbalanced exposure favouring training (control 15 h > intervention 12 h)

Potempa 1995

Methods	Design: randomised trial of cardiorespiratory training vs non-exercise intervention - after UC Randomisation: unknown Allocation concealment: unknown Blinding: unknown ITT: no Measurements: end of intervention (10 weeks) Withdrawals: none
Participants	Randomised: 42 participants Intervention: 19 participants; 8 men and 11 women Control: 23 participants; 15 men and 8 women All participants aged 43-70 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 min/day 3 days/week for 10 weeks; intensity 30%-50% of maximal effort increasing to maximum sustainable over first 4 weeks Control: non-exercise intervention: passive range of motion exercises for 30 min/day 3 days/week for 10 weeks Setting: unknown
Outcomes	Included outcomes: BP; maximum cycling work rate (watts) Other outcomes: HR 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
Random sequence generation (selection bias)	Unclear risk	Not reported
Allocation concealment (selection bias)	Unclear risk	Not reported
Blinding (performance bias and detection bias)	Unclear risk	Attention control

Potempa 1995 (Continued)

All outcomes

Blinding of outcome assessment (detection bias) All outcomes	Unclear risk	Not reported
Incomplete outcome data (attrition bias) End of intervention	Low risk	ITT not reported No losses
Selective reporting (reporting bias)	Unclear risk	Protocol not available
Other bias	Low risk	None known
Imbalanced exposure	Low risk	Balanced exposure

Richards 1993

Methods	Design: randomised trial of mixed training plus UC vs UC - during UC Randomisation mechanism: unknown; method: stratified on BI scores Allocation concealment: unknown Blinding: investigator; efficacy unknown ITT: no Measurements: end of intervention (5 weeks) Withdrawals: control group 3 (1 refusal, 2 unknown)
Participants	Randomised: 18 participants Intervention: 10 participants; 5 men and 5 women; age 69.6 years (SD 7.4 years); 8.3 days post-stroke (SD 1.4) Control: 8 participants; 2 men and 6 women; age 67.3 years (SD 11.2); 8.8 days post-stroke (SD 1.5) Inclusion criteria: within 50 km of treatment centre; men and women aged 40-80 years; 0-7 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 that used a tilt table, resisted exercises using a Kinetron, and treadmill walking, 104 min/day 5 days/week for 5 weeks; progression achieved via velocity and resistance (Kinetron) increments Control: traditional neurophysical techniques 109 min/day 5 days/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	We did not use a second control group of early conventional therapy for comparison since it differed from the institution UC; it commenced earlier than usual during hospital care and had substantially longer contact time.

Risk of bias

Bias	Authors' judgement	Support for judgement
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Richards 1993 (Continued)

Random sequence generation (selection bias)	Unclear risk	Stratified randomisation based on BI scores
Allocation concealment (selection bias)	Unclear risk	Not reported
Blinding (performance bias and detection bias) All outcomes	Unclear risk	Suitable attention control
Blinding of outcome assessment (detection bias) All outcomes	Low risk	Investigator blinded; efficacy unknown
Incomplete outcome data (attrition bias) End of intervention	High risk	No ITT analysis 3/18 (17%) total losses at the end of intervention: intervention 0; control group 3 (1 refusal, 2 unknown)
Selective reporting (reporting bias)	Unclear risk	Protocol not available
Other bias	Low risk	None known
Imbalanced exposure	Low risk	Balanced exposure

Richards 2004

Methods	<p>Design: randomised trial of mixed training plus % UC vs UC - during UC</p> <p>Randomisation mechanism: unknown; method: variable blocks stratified on time since stroke, disability, and age</p> <p>Allocation concealment: unknown</p> <p>Blinding: investigator; efficacy unknown</p> <p>ITT: yes</p> <p>Measurements: end of intervention (8 weeks) and 3-month follow-up</p> <p>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)</p>
Participants	<p>Randomised: 63 participants</p> <p>Intervention: 32 participants; 22 men and 10 women; age 62.9 years (SD 12); 52 days post-stroke (SD 22)</p> <p>Control: 31 participants; 21 men and 10 women; age 60.7 years (SD 12); 52.8 days post-stroke (SD 18)</p> <p>Inclusion criteria: first or second stroke; men or women aged 30-89 years; impaired walking; follow verbal instructions; Barthel ambulation score ≥ 10; gait speed of 10-60 cm/s</p> <p>Exclusion criteria: cerebral and subarachnoid haemorrhage; major medical problems (cancer, heart conditions, diabetes); receptive or expressive aphasia; lower extremity musculoskeletal disorders affecting gait</p>
Interventions	<p>Intervention: mixed training: task-oriented gait training programme that used a limb-load monitor, resisted exercises using a Kinetron, and treadmill walking, intervention occurred during PT sessions of 60 min/day 5 days/week for 8 weeks, progression achieved via velocity and resistance (Kinetron) increments</p> <p>Control: PT sessions of 60 min/day 5 days/week for 8 weeks not including the task-oriented gait training content above</p> <p>Setting: 2 rehabilitation units</p>

Richards 2004 (Continued)

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
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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
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Risk of bias

Bias	Authors' judgement	Support for judgement
Random sequence generation (selection bias)	Unclear risk	Unclear; randomisation based on variable blocks stratified on time since stroke, disability, and age
Allocation concealment (selection bias)	Unclear risk	Not reported
Blinding (performance bias and detection bias) All outcomes	Unclear risk	Suitable attention control
Blinding of outcome assessment (detection bias) All outcomes	Low risk	Investigator blinded
Incomplete outcome data (attrition bias) End of intervention	Low risk	ITT analysis 5/63 (8%) losses at the end of intervention; intervention (2 discontinued intervention: 1 hip fracture, 1 cardiac problem); control (1 withdrew from intervention)
Incomplete outcome data (attrition bias) End of follow-up	High risk	ITT analysis 17/63 (27%) total losses at the end of follow-up; intervention (5 not available); control (7 not available)
Selective reporting (reporting bias)	Unclear risk	Protocol not available
Other bias	Low risk	None known
Imbalanced exposure	Low risk	Balanced exposure

Salbach 2004

Methods	Design: randomised trial of cardiorespiratory training vs non-exercise intervention - after UC 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) ITT: yes Measurements: end of intervention (6 weeks)
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Salbach 2004 (Continued)

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	<p>Randomised: 91 participants</p> <p>Intervention: 44 participants; 26 men and 18 women; age 71 years (SD 12); 239 days post-stroke (SD 83)</p> <p>Control: 47 participants; 30 men and 17 women; age 73 years (SD 8); 217 days post-stroke (SD 73)</p> <p>Inclusion criteria: first or recurrent stroke; gait deficit from recent stroke; mental competency; independently ambulatory for 10 m +/- aids or supervision; ability to comprehend instructions; resident in community; discharged from rehabilitation; recent stroke ≤ 1 year</p> <p>Exclusion criteria: neurological deficit caused by metastatic disease; gait function (6-MWT) equivalent to healthy norms; discharged to permanent care; comorbidity preventing participation in either intervention</p>
Interventions	<p>Intervention: cardiorespiratory training: task-oriented circuit training, performed 55 min/day 3 days/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</p> <p>Control: functional practice, whilst seated, of writing, keyboard use, and manipulating cards; some practice encouraged at home. 3 days/week for 6 weeks</p> <p>Setting: 2 rehabilitation centres or hospitals</p>
Outcomes	<p>Included outcomes: gait endurance 6-MWT; gait comfortable speed; gait maximal speed; TUG; BBS</p> <p>Other outcomes: activity-specific balance confidence scale</p>
Notes	—

Risk of bias

Bias	Authors' judgement	Support for judgement
Random sequence generation (selection bias)	Low risk	Computer-based randomisation stratified on gait speed
Allocation concealment (selection bias)	Unclear risk	Not reported
Blinding (performance bias and detection bias) All outcomes	Unclear risk	Suitable attention control
Blinding of outcome assessment (detection bias) All outcomes	High risk	Investigator blinded initially Unblinding occurred during assessment of intervention group (18/42) and control group (16/43)
Incomplete outcome data (attrition bias) End of intervention	Low risk	ITT analysis 7/91 (8%) losses at the end of intervention assessment 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
Selective reporting (reporting bias)	Unclear risk	Protocol not available
Other bias	Low risk	None known

Salbach 2004 (Continued)

Imbalanced exposure Low risk Balanced exposure

Sandberg 2016

Methods Design: RCT. Cardiorespiratory training vs no intervention - after UC

Randomisation: shuffling sealed envelopes

Allocation concealment: sealed envelopes

Blinding: cycle ergometer test stated as blind at baseline but blinding unclear for other outcome

ITT: no pre-planned ITT described

Measurements: at the end of intervention (12 weeks)

Withdrawals: 2/27 (7%) withdrew from control group; 1 due to recurrent stroke, 1 unknown reason

Participants Randomised: 56 participants were randomised (n = 53 in second publication)

Intervention: 29 participants; 14 men (52%) and 15 women (52%); mean age: 73.1 (SD 7); 22.2 (SD 10.1) days after stroke (earlier for some outcomes)

Control: 27 participants; 14 men (52%) and 13 women (48%); mean age: 70.4 (SD 8.1); 22.8 (SD 10.8) days after stroke (earlier for some outcomes)

Inclusion criteria: age ≥ 50 years, could walk > 5 m, understand instructions, stroke diagnosis

Exclusion criteria: medical or neurological diseases that were a risk or prevented delivery of training programme

Interventions Intervention: cardiorespiratory training

Part 1: warm-up 15 min light to moderate (11-14 RPE); sitting, standing and walking

Part 2: cycle ergometry 8 min (14-15 RPE; 75% maximum oxygen consumption; 80% max HR)

Part 3: low-intensity exercises (10 min); flexibility while sitting, standing and walking

Part 4: cycle ergometry 8 min (14-15 RPE; 75% maximum oxygen consumption; 80% max HR)

Part 5: cool-down 15 min; in different positions

4 min to move between stations

Frequency of intervention: 60 min/day for 2 days/week for 12 weeks

Control: only advice about exercise and physical activity (usual practice in this setting)

Setting: unclear

Outcomes Included outcomes: peak work rate (watts), 6-MWT, 10-metre walk test, TUG, balance (single leg stance test), QoL (EQ-5D)

Other outcomes: SIS domains: 8 (participation) and 9 (recovery); BP response to exercise

Notes NCT02107768

Risk of bias

Bias	Authors' judgement	Support for judgement
Random sequence generation (selection bias)	Low risk	Physical method probably adequate

Sandberg 2016 (Continued)

Allocation concealment (selection bias)	Unclear risk	Not clear whether envelopes had sufficient safeguards (opaque etc)
Blinding (performance bias and detection bias) All outcomes	High risk	No attention control and intervention delivered by 2 of the study authors
Blinding of outcome assessment (detection bias) All outcomes	Unclear risk	Some outcomes were not assessed by blind personnel and blinding seemed to be applied differently at baseline and follow-up
Incomplete outcome data (attrition bias) End of intervention	Unclear risk	2/27 (7%) dropouts in 2016 paper (n = 56 total) from control group plus no ITT analysis. Partner paper (2017) indicated 3 participants in the control group (reducing this to n = 24) were missing BP data and were not included. Exact effects uncertain
Incomplete outcome data (attrition bias) End of follow-up	Low risk	2/27 lost in control group due to unknown reasons and recurrent stroke. Not likely attributed to intervention received
Selective reporting (reporting bias)	Low risk	BP (2017 paper) was not in the pre-published protocol so might be questioned
Other bias	Low risk	None known
Imbalanced exposure	High risk	No attention control for exposure

Shin 2011

Methods	Design: randomised trial of mixed training vs UC Randomisation: information not included Allocation concealment: information not included Blinding: information not included ITT: not completed Measurements: before and end of intervention (4 weeks) Withdrawals: none reported
Participants	Randomised: total 21 participants. 11 participants were randomised to intervention, 10 to control Intervention: 11 participants; 5 men, 6 women; mean age: (combined men and women) 58.1 years (SD 4.6); mean height: 160.6 cm (SD 6.6); mean weight: 65.2 kg (SD 8.3); type of stroke: unknown; paretic side: right 8, left 3; time since stroke onset: between 6 months and 5 years Control: 10 participants; 3 men, 7 women; mean age: (combined men and women) 57.3 years (SD 4.4); mean height: 164.5 cm (SD 7.1); mean weight: 65.0 kg (SD 7.5); type of stroke: unknown; paretic side: right 5, left 5; time since stroke onset: between 6 months and 5 years Inclusion criteria: 6 months to 5 years post-stroke with lower limb hemiplegia Exclusion criteria: unable to ride a bicycle or perform functional exercise due to arthritis, low-back pain or degenerative joint disease; receiving treatment for other symptoms; unable to follow instructions due to low perceptive abilities, cognitive or communication disorder
Interventions	Intervention: participants in the training group (n = 11) received a total of 60 min/day combined exercise training, consisting of 30 min of functional strength training and 30 min of aerobic exercise 5 days/week for 4 weeks. Functional strength training included bridging, stepping and stair exercises. Aerobic exercise was completed using a cycle ergometer and treadmill for 15 min each at < 40% HR reserve based on age matched maximum HR

Shin 2011 (Continued)

Control: participants in the control group (n = 10) received conservative physical therapy for 60 min/day, 5 days/week, for 4 weeks. Conservative physical therapy consisted of balance, postural control, and gait exercises

Setting: community setting

Outcomes	Included outcomes: static and dynamic balance (force platform measurements), BBS (eyes open and eyes closed)
Notes	—

Risk of bias

Bias	Authors' judgement	Support for judgement
Random sequence generation (selection bias)	Unclear risk	Described only as "randomly allocated"
Allocation concealment (selection bias)	Unclear risk	Not reported
Blinding (performance bias and detection bias) All outcomes	Unclear risk	Not reported but there was an attention control
Blinding of outcome assessment (detection bias) All outcomes	Unclear risk	Not reported
Incomplete outcome data (attrition bias) End of intervention	Low risk	ITT not reported No participant losses
Selective reporting (reporting bias)	Unclear risk	Trial register or protocol not available
Other bias	Low risk	None known
Imbalanced exposure	Low risk	Balanced exposure

Sims 2009

Methods	<p>Design: pilot randomised study of resistance training vs no intervention (i.e. a waiting list comparison group) - after UC. Sample size calculation reported</p> <p>Randomisation: computer-generated block randomisation by an independent investigator - blocks of 6 stratified by gender</p> <p>Allocation concealment: unclear</p> <p>Blinding: unclear</p> <p>ITT: yes</p> <p>Measurements: at the end of the training programme (10 weeks) and at 6-month follow-up</p>
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Sims 2009 (Continued)

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	<p>Randomised: 45 participants; 27 men and 18 women; mean age 67.13 years (SD 15.23), average time since stroke 13.2 months (SD 4.95)</p> <p>Intervention: 23 participants were allocated to the progressive resistance training group. 21 participants completed the 10-week programme (2 people became medically ineligible)</p> <p>Control: 22 participants were allocated to the waiting list control group</p> <p>Inclusion criteria: stroke survivors with depressive symptoms</p> <p>Exclusion criteria: < 18 years; stroke < 6 months ago; inability to walk a distance of at least 20 m independently with or without a gait assistive device; Prime-MD Patients Health Questionnaire 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</p>
Interventions	<p>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. Resistance was increased when participants were able to complete 3 sets of 10 repetitions of an exercise</p> <p>Control: the waiting list controls received UC and were asked not to do any resistance-type exercise (content of the 'usual care' intervention not specified)</p> <p>Setting: community-based setting</p>
Outcomes	<p>Included outcomes: CES-D; AQoL SF-12</p> <p>Other outcomes: SIS; SWLS; LOT-R; Self Esteem Scale; RLOC</p>
Notes	<p>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</p> <p>The participants in the control group received more attention than simply UC as they received a 10-week strength assessment</p>

Risk of bias

Bias	Authors' judgement	Support for judgement
Random sequence generation (selection bias)	Low risk	Quote: "Following the baseline assessments participants were randomly allocated to the intervention or comparison group by a centrally located independent person using a computer generated block randomisation list, with blocks of six, stratified by gender."
Allocation concealment (selection bias)	Low risk	Not applicable as participants allocated in blocks after recruitment and baseline assessment
Blinding (performance bias and detection bias) All outcomes	High risk	No attention control (waiting list comparison)
Blinding of outcome assessment (detection bias) All outcomes	Unclear risk	Unclear

Sims 2009 (Continued)

Incomplete outcome data (attrition bias) End of intervention	Low risk	ITT analysis 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
Incomplete outcome data (attrition bias) End of follow-up	Low risk	ITT analysis 43/45 participants completed the 6-month survey assessment
Selective reporting (reporting bias)	Unclear risk	Included outcomes correspond with protocol ACTRN12605000613606
Other bias	High risk	At baseline the intervention group had significantly lower depression scores than the comparison group
Imbalanced exposure	High risk	Imbalanced exposure

Smith 2008

Methods	<p>Design: randomised trial of cardiorespiratory training vs non-exercise intervention - after UC (i.e. treadmill gait training vs weekly telephone calls - the main purpose of the study was to explore the potential additional benefits of treadmill training)</p> <p>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?)</p> <p>Allocation concealment: unclear</p> <p>Blinding: clinical assessor not blinded</p> <p>ITT: not reported, but no withdrawals</p> <p>Measurements: at the end of the intervention (4 weeks) and then 6 weeks later</p> <p>Withdrawals: none</p>
Participants	<p>Randomised: 20 participants; age range 42-72 years</p> <p>Intervention: 10 participants, 8 men and 2 women; mean age 57.8 years (SD 7.0); time from stroke: 8 participants < 1 year and 2 participants ≥ 1 year < 2 years</p> <p>Control: 10 participants, 4 men and 6 women; mean age 56 years (SD 8.3); time from stroke: 8 participants < 1 year and 2 participants ≥ 1 year < 2 years</p> <p>Inclusion criteria: stroke in the middle cerebral artery territory > 3 months but < 2 years prior to enrolling in the study; walking slower than pre-stroke</p> <p>Exclusion criteria: cognitive impairment; unable to ambulate; concomitant pathology that prevented walking on a treadmill</p>
Interventions	<p>Intervention: participants in the intervention group received 12 sessions of treadmill training (20 min each session) over 4 weeks plus weekly calls from the investigator enquiring about the quality of their week and encouraging them to keep a QoL log. They wore a standard gait belt on the treadmill and had a practice session prior to the start of the study. The starting speed on the treadmill was the speed at which the participant could walk during the practice session for 5 min with a RPE ≤ 13. The speed was increased by 0.2 mph each time the participant walked for 10 consecutive min with a RPE ≤ 13</p>

Smith 2008 (Continued)

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 QoL log only

Setting: community-based setting

Outcomes	Included outcomes: depression (BDI), mobility Other outcomes: social participation (SIS 3.0 subscales)
Notes	Very small sample size. Fitness outcomes not considered

Risk of bias

Bias	Authors' judgement	Support for judgement
Random sequence generation (selection bias)	Unclear risk	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 (selection bias)	Unclear risk	Not reported
Blinding (performance bias and detection bias) All outcomes	High risk	No suitable attention control
Blinding of outcome assessment (detection bias) All outcomes	High risk	Clinical assessor not blinded
Incomplete outcome data (attrition bias) End of intervention	Low risk	ITT analysis not reported No withdrawals
Incomplete outcome data (attrition bias) End of follow-up	Low risk	ITT analysis not reported No withdrawals
Selective reporting (reporting bias)	Unclear risk	Protocol not available
Other bias	Low risk	None known
Imbalanced exposure	High risk	Imbalanced exposure

Son 2014

Methods	Design: randomised trial of resistance training plus UC vs sham training (no resistance) plus UC (most likely after discharge from usual hospital care approximately 18 months post-stroke) Randomisation: software used to randomise participants Allocation concealment: information not included Blinding: information not included ITT: not completed but no losses Measurements: before and end of intervention (6 weeks)
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Son 2014 (Continued)

Withdrawals: none reported

Participants	<p>28 participants randomised: 14 to intervention, 14 to control</p> <p>Intervention: 14 participants; 8 men, 6 women; mean age: (combined men and women) 57.4 years (SD not given); type of stroke: ischaemic 7, haemorrhagic 7; paretic side: right 6, left 8; time since stroke onset: 17.9 months</p> <p>Control: 14 participants; 7 men 7 women: mean age: (combined men and women) 56.6 years (SD not given); type of stroke: ischaemic 8, haemorrhagic 6; paretic side: right 7, left 7; time since stroke onset: 18.7 months</p> <p>Inclusion criteria: a Brunnstrom \geq stage 3, ability to independently walk 10 m with or without supervision or an aid or orthosis, and a minimum score of 20 on the Korean-MMSE</p> <p>Exclusion criteria: joint contracture, pain, or fracture of the musculoskeletal system, and hemianopia</p>
Interventions	<p>Intervention: participants in the training group (n = 14) received lower-limb resistance training for 30 min, 5 times/week for 6 weeks. Warm-up included 1 set of 4 reps of resisted knee extension at 25% 1-RM, followed by 3 sets of 8-10 reps of resisted knee extension at 70% 1-RM. Resistance load was progressed weekly via reassessment of 1-RM</p> <p>Control: participants in the control group (n = 14) received sham lower limb training with no resistance for 30 min, 5 times/week for 6 weeks. Warm-up included 1 set of 4 reps of knee extension at no resistance, followed by 3 sets of 8-10 reps of knee extension at no resistance</p> <p>All participants received conservative physical therapy for 30 min/day, 5 days/week, for a period of 6 weeks. Conservative physical therapy consisted of joint mobilisation, muscle strengthening, and balance training</p> <p>Setting: unclear; community-based project</p>
Outcomes	Included outcomes: balance outcomes including antero-posterior (A-P), medio-lateral (M-L) sway distances, and the BBS; TUG times
Notes	—

Risk of bias

Bias	Authors' judgement	Support for judgement
Random sequence generation (selection bias)	Low risk	Software-generated randomisation
Allocation concealment (selection bias)	Unclear risk	Not reported
Blinding (performance bias and detection bias) All outcomes	Unclear risk	Not reported although there was a suitable attention control
Blinding of outcome assessment (detection bias) All outcomes	Unclear risk	Not reported
Incomplete outcome data (attrition bias) End of intervention	Low risk	All 3 criteria for ITT analysis have not been met - methods suggest a per-protocol analysis; however there were no losses
Selective reporting (reporting bias)	Unclear risk	Trial register or protocol not available

Son 2014 (Continued)

Other bias	Low risk	None known
Imbalanced exposure	Low risk	Balanced exposure (sham training)

Takami 2010

Methods	<p>Design: randomised trial of cardiorespiratory training plus % UC vs UC - during UC</p> <p>Randomised: envelope method</p> <p>Allocation concealment: unknown</p> <p>Blinding: unknown</p> <p>ITT: not reported</p> <p>Measurements: end of intervention (3 weeks)</p> <p>Withdrawals: 2 participants from backward walking group and 1 participant from forward walking group due to family reasons</p>
Participants	<p>Randomised: 36 participants</p> <p>Intervention 1: 12 participants in backward walking group; 6 men and 6 women; mean age 66.1 years (SD 6.3); 13.2 days post-stroke (SD 8.4)</p> <p>Intervention 2: 12 participants in forward walking group; 9 men and 3 women; mean age 71.1 years (SD 10.6); 14.7 days post-stroke (SD 8.1)</p> <p>Control: 12 participants; 5 men and 7 women; mean age 66.9 years (SD 10.6); 13.7 days post-stroke (SD 8.9)</p> <p>Inclusion criteria: ability to walk 10 m using aids; post-stroke period of < 5 weeks; FIM-Locomotion score of ≤ 5; perfect BBS and RMI scores</p> <p>Exclusion criteria: unknown</p>
Interventions	<p>Intervention groups: BWSTT for 30 min then 10 min of either: backward or forward walking 6 times/week for 3 weeks</p> <p>Treadmill speed was progressed each week (0.8, 1.0, and 1.3 km/h)</p> <p>Control group: conventional training overground walking (150-200 m) for 40 min 6 times/week for 3 weeks</p> <p>Setting: rehabilitation unit and community settings</p>
Outcomes	<p>Included outcomes: BBS; RMI; 10-metre maximum walking speed; walking ratios during 10 metre forward walking and 5 metre backward walking; Motricity Index; FIM-Locomotion</p>
Notes	—

Risk of bias

Bias	Authors' judgement	Support for judgement
Random sequence generation (selection bias)	Unclear risk	Described only as "envelope method"

Takami 2010 (Continued)

Allocation concealment (selection bias)	Unclear risk	Nature of envelopes not described
Blinding (performance bias and detection bias) All outcomes	Unclear risk	Attention control is incorporated
Blinding of outcome assessment (detection bias) All outcomes	Unclear risk	Not reported
Incomplete outcome data (attrition bias) End of intervention	Unclear risk	ITT not reported 3/36 (8%) losses at the end of intervention; 2 participants from backward walking training group and 1 participant from forward walking training group due to family reasons
Selective reporting (reporting bias)	Unclear risk	Protocol not available
Other bias	Low risk	Not known
Imbalanced exposure	Low risk	Balanced exposure

Taylor-Pilliaie 2014

Methods	<p>Design: community-based RCT, 3 groups; Tai Chi, 'SilverSneakers' group exercise, or non-exercise intervention</p> <p>Only Silversneakers and control groups were included giving strength training vs non-exercise intervention - after UC</p> <p>Randomisation: simple randomisation; participants drew a slip of paper from a non-transparent container</p> <p>Allocation concealment: allocation was concealed; participants were handed an opaque, sealed envelope matching the slip of paper taken from the container, and instructed to open the envelope when they returned home</p> <p>Blinding: assessor blinded to group allocation</p> <p>ITT: ITT analyses were used</p> <p>Measurements: baseline and end of intervention (12 weeks)</p> <p>Withdrawals: intervention n = 6 (refuse group allocation n = 5, lack of time n = 1); control n = 3 (refuse group allocation n = 3)</p>
Participants	<p>Randomised: n = 92: intervention (Silversneakers mixed training) n = 44; control group n = 48. N = 145 randomised to study as a whole</p> <p>Intervention: 44 participants; 20 men (45.5%) and 24 women (54.5%); mean age: 69.6 (SD 9.4); days after stroke not reported</p> <p>Control: 48 participants; 23 men (47.9%) and 25 women (52.1%); mean age: 68.2 (SD 10.3); days after stroke not reported</p> <p>Inclusion criteria: based on pre-screening using standardised tests: functional disability (mRS), physical function (Short Physical Performance Battery), cognitive impairment (MMSE)</p>

Taylor-Pilliae 2014 (Continued)

Exclusion criteria: no disability (e.g. no post-stroke sequela), severe disability (e.g. bedridden), or a serious medical condition (e.g. active cancer treatment) that would interfere with study participation

Interventions	<p>Intervention: SilverSneakers is a national fitness programme for older adults offering different types of group-based exercise classes (e.g. aerobics, strength and range of movement, water aerobics, yoga). In this particular intervention muscular strength and range of movement classes were taught by a certified instructor at local community fitness centres. 1 h/day, 3 days/week for 12 weeks. Each class approximately consisted of a 10-min warm-up period, 40-min of exercise, and a 10-min cool-down period</p> <p>Control: received resources encouraging participation in community-based physical activity plus a weekly phone call about their health</p> <p>Setting: community setting</p>
Outcomes	<p>Included outcomes: physical function (SPBB including balance using timed balance test, gait speed using 4-metre walk test, lower body strength using chair stand test), patient-reported fall rates, aerobic endurance (2-min step test), QoL (SF-36) physical health and mental health composite scores, depressive symptoms (Center for Epidemiologic Studies Depression Scale)</p> <p>Other outcomes: sleep quality (Pittsburgh Sleep Quality Index)</p>
Notes	<p>The study author indicated that the 'SilverSneakers Classic' intervention was used, which is focused on muscular strength and range of motion exercises, and this has no substantive cardiorespiratory training</p>

Risk of bias

Bias	Authors' judgement	Support for judgement
Random sequence generation (selection bias)	Unclear risk	Simple randomisation; the study authors reference Taylor-Pilliae 2012 in which the following was reported "subjects drew a slip of paper from a non-transparent container"
Allocation concealment (selection bias)	Unclear risk	Concealed allocation identified, no further details provided
Blinding (performance bias and detection bias) All outcomes	High risk	No specific details provided. Study staff supervised intervention groups. Unlikely blinding for performance bias. Participants dropped out after knowing group allocation; no participant blinding as such and no balanced attention control dose
Blinding of outcome assessment (detection bias) All outcomes	Low risk	Assessor blinded to allocation of group
Incomplete outcome data (attrition bias) End of intervention	Low risk	Dropouts; Intervention 6/44 (14%) control 3/48 (7%) , ITT analysis employed
Incomplete outcome data (attrition bias) End of follow-up	Low risk	
Selective reporting (reporting bias)	Unclear risk	No trial registry details available
Other bias	Unclear risk	Range of motion (passive) exercises included in strength intervention
Imbalanced exposure	High risk	Attention control exposure not matched for dose

Teixeira 1999

Methods	<p>Design: randomised trial of mixed training vs no intervention - after UC</p> <p>First iteration only of a lag control design; participants randomly allocated to immediate or delayed - participants allocated delayed intervention initially received no intervention</p> <p>Randomisation mechanism: unknown; method: unclear ("balanced blocks")</p> <p>Allocation concealment: unknown</p> <p>Blinding: unknown</p> <p>ITT: no</p> <p>Measurements: end of intervention (10 weeks)</p> <p>Withdrawals: none</p>
Participants	<p>Randomised: 13 participants</p> <p>Intervention: 6 participants; 1 man and 5 women; age 65.9 years (SD 10.2); 9.15 years post-stroke (SD 12.7)</p> <p>Control: 7 participants; 1 man and 6 women; age 69.4 years (SD 8.85); 6.4 years post-stroke (SD 6.2)</p> <p>All participants had unilateral stroke resulting in residual weakness or abnormal muscle tone or both</p> <p>Inclusion criteria: at least 9 months post-stroke; independently ambulatory with or without walking aids; no comprehensive aphasia</p> <p>Exclusion criteria: non-stroke-related disability</p>
Interventions	<p>Intervention: mixed training: cardiorespiratory and lower extremity strength training 60-90 min/day 3 days/week for 10 weeks; cardiorespiratory training: graded walking plus stepping or cycling progressing from 10-20 min/day and from 50%-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 (TheraBand), each performed as 3 x 10 repetitions and progressing from 50%-80% of 1-RM; warm-up and warm-down 10-20 min/day</p> <p>Control: no intervention</p> <p>Setting: unclear</p>
Outcomes	<p>Included outcomes: gait preferred speed (22 m); Adjusted Activity Score; NHP</p> <p>Other outcomes: insufficient data to compare lower limb muscle strength (peak torque Nm); muscle tone assessment; and stair climbing</p>
Notes	—

Risk of bias

Bias	Authors' judgement	Support for judgement
Random sequence generation (selection bias)	Unclear risk	Unclear Quote: "randomly assigned to one of the two groups (treatment and control) with equal probability and balanced into similar blocks"
Allocation concealment (selection bias)	Unclear risk	Not reported
Blinding (performance bias and detection bias) All outcomes	High risk	No attention control
Blinding of outcome assessment (detection bias) All outcomes	Unclear risk	Not reported
Incomplete outcome data (attrition bias)	Low risk	ITT not reported

Teixeira 1999 (Continued)

End of intervention		No losses
Selective reporting (reporting bias)	Unclear risk	Protocol not available
Other bias	High risk	Recruitment via advertisements
Imbalanced exposure	High risk	Imbalanced exposure

Toledano-Zarhi 2011

Methods	Design: mixed training plus non-exercise intervention vs non-exercise intervention after UC Randomisation mechanism: mechanism not reported Allocation concealment: unknown Blinding: unknown ITT: yes (LOCF) Measurements: end of intervention (6 weeks) Withdrawals: 1 from intervention group (discontinued intervention)
Participants	Randomised: 28 participants Intervention: 14 participants; 11 men and 3 women; age 65 years (SD 10); 1-3 weeks post-stroke Control: 14 participants; 10 men and 4 women; age 65 years (SD 12); 1-3 weeks post-stroke All participants had very minor ischaemic stroke Exclusion criteria: SBP > 200 mmHg; DBP > 110 mmHg; unstable angina; arrhythmia; congestive heart failure; ST depression \geq 2 mm on resting ECG; arterioventricular block with no pacemaker; severe peripheral vascular disease; severe lung disease; orthopaedic or neurological disability; dementia or major depression
Interventions	Intervention: mixed training; 2 days/week for total of 3 h/week for 6 weeks. Twice/week 35-55 min of treadmill, hand bike, and cycle ergometer at 50%-70% HR maximum. Once/week 45-55 min of group strength, flexibility, and co-ordination Control: home-based booklet with guidance on strength and flexibility and encouragement to continue with usual community routine Setting: hospital
Outcomes	Included outcomes: 6-MWT; Four Square Step Test; stair ascending and descending; treadmill performance (Bruce protocol); BP
Notes	Described as 'aerobic' training but this is mixed training

Risk of bias

Bias	Authors' judgement	Support for judgement
Random sequence generation (selection bias)	Unclear risk	Method not reported
Allocation concealment (selection bias)	Unclear risk	Not reported
Blinding (performance bias and detection bias) All outcomes	High risk	No suitable attention control

Toledano-Zarhi 2011 *(Continued)*

Blinding of outcome assessment (detection bias) All outcomes	Unclear risk	Not reported
Incomplete outcome data (attrition bias) End of intervention	Low risk	ITT 1/28 (4%) lost overall; from intervention group (discontinued intervention)
Selective reporting (reporting bias)	Unclear risk	No protocol available
Other bias	Low risk	None known
Imbalanced exposure	High risk	Imbalanced exposure

Topcuoglu 2015

Methods	<p>Design: RCT of cardiorespiratory upper limb exercise plus UC vs UC - during UC</p> <p>Randomisation: computer-generated numbers and the treatment group was assigned by the system</p> <p>Allocation concealment: not described</p> <p>Blinding: blinded outcome assessment</p> <p>ITT: not described</p> <p>Measurements: baseline (0 weeks) and end of programme (4 weeks)</p> <p>Withdrawals: none</p>
Participants	<p>Randomised: 52 participants randomised with only 40 participants included; intervention 20 and control 20</p> <p>Intervention: 20, mean age 65.95 years (SD 8.7), men 11 and time since stroke 75.3 (SD 29.3) days</p> <p>Control: 20, mean age 67.5 years (SD 11.2), men 11 and time since stroke 81.40 (36.3) days</p> <p>Inclusion criteria: hemiplegic stroke within ≥ 1 and ≤ 6 months post-stroke, diagnosed with complex regional pain syndrome</p> <p>Exclusion criteria: aphasia, serious mental disorder, a disease that could hinder the aerobic exercise programme to be carried out with upper-arm ergometry, a history of fracture accounting for CRPS, those with whom no cooperation could be established, and those without sitting balance for 20 min</p>
Interventions	<p>Intervention: received standard rehabilitation programme for CRPS and stroke and aerobic exercise programme accompanied by arm crank ergometry for 5 days/week for 30 min/day for 4 weeks. Standardised CPT for CRPS type 1 and comprehensive stroke physio programme, which included therapeutic exercises, neurological exercises, postural exercises, balance and co-ordination exercises</p> <p>Control: standardised CPT for complex regional pain syndrome type 1 and comprehensive stroke physio programme, which included therapeutic exercises, neurological exercises, postural exercises, balance and co-ordination exercises</p> <p>Setting: hospital</p>
Outcomes	Included outcomes: independence (FIM), QoL (NHP), mood (BDI)

Topcuoglu 2015 (Continued)

Other outcomes: motor level using Brunnstrom's staging for the upper extremity and the hand Spasticity (Modified Ashworth scale), pain

Notes Included outcomes have no available data

Risk of bias

Bias	Authors' judgement	Support for judgement
Random sequence generation (selection bias)	Low risk	Computer-generated numbers, treatment group assigned by the system
Allocation concealment (selection bias)	Unclear risk	Not described
Blinding (performance bias and detection bias) All outcomes	High risk	No attention control and no description of blinding of other study personnel
Blinding of outcome assessment (detection bias) All outcomes	Low risk	Assessment provided by same physician pre- and post- who were not aware of participants' group assignment
Incomplete outcome data (attrition bias) End of intervention	Low risk	ITT not described but no dropouts
Selective reporting (reporting bias)	Unclear risk	No trial registry available
Other bias	Low risk	None known
Imbalanced exposure	High risk	No attention control

Van de Port 2012

Methods	<p>Design: multicentre randomised trial of mixed training vs usual outpatient care - after UC</p> <p>Randomised: online minimisation procedure</p> <p>Allocation concealment: unknown</p> <p>Blinding: assessors blinded to group allocation</p> <p>ITT: yes</p> <p>Measurements: end of intervention (12 weeks) and follow-up (24 weeks)</p> <p>Withdrawals: intervention group (4 participants did not start intervention, 1 participant withdrew without reason); control (1 participant at the end of intervention missing assessment, 2 participants died from cancer, 2 participants had recurrent stroke, 2 participants withdrew without reason)</p>
Participants	<p>Randomised: 250 participants</p> <p>Intervention: 124 participants; 82 men and 42 women; mean age 56 years (SD 10); time post-stroke 80.9 days (SD 13.0)</p>

Van de Port 2012 (Continued)

Control: 126 participants; 80 men and 46 women; mean age 58 years (SD 10); time post-stroke 77.8 days (SD 15.0)

Inclusion criteria: verified stroke (according to WHO definition); able to walk a minimum of 10 m unassisted; discharged home from rehabilitation centre; requirement to continue PT during outpatient care

Exclusion criteria: cognitive deficits (MMSE < 24 score); unable to communicate; lived > 30 km from rehabilitation centre

Interventions	<p>Invention group: circuit training programme for 90 min twice/week for 12 weeks. Training included 8 stations intended to improve walking competency. Each station exercise was performed for 3 min with 3 min recovery</p> <p>Control group: outpatient CPT care, no restriction or detail given regarding time or duration of these sessions</p> <p>Setting: rehabilitation outpatient centre</p>
Outcomes	Included outcomes: mobility domain of SIS; RMI; falls efficacy scale; NEADL; HADS; fatigue severity scale; Motricity index; 6-MWT; 5-metre comfortable walking speed test; timed balance test; TUG; modified stair test
Notes	—

Risk of bias

Bias	Authors' judgement	Support for judgement
Random sequence generation (selection bias)	Low risk	Participants stratified by rehabilitation centre using an online minimisation procedure
Allocation concealment (selection bias)	Low risk	Risk removed due to online dynamic allocation mechanism: i.e. there is no allocation list to conceal
Blinding (performance bias and detection bias) All outcomes	Unclear risk	Some degree of attention control
Blinding of outcome assessment (detection bias) All outcomes	Low risk	Blinded outcome assessment. The efficacy of blinding was confirmed through statistical analysis of guesses of allocation
Incomplete outcome data (attrition bias) End of intervention	Low risk	<p>ITT analysis used</p> <p>8/250 (3%) losses. Slight imbalance in losses in the control group 7/124 and training group 1/126</p> <p>Intervention group (4 participants did not start intervention, 1 participant withdrew without reason); control group (1 participant at the end of intervention missing assessment, 2 participants died from cancer, 2 participants had recurrent stroke, 2 participants withdrew without reason)</p>
Incomplete outcome data (attrition bias) End of follow-up	Low risk	<p>ITT analysis used</p> <p>8/250 (3%) overall losses</p>
Selective reporting (reporting bias)	Unclear risk	Some planned secondary outcomes in the trial register (Dutch Trial Register NTR1534) were not reported or not followed up beyond baseline (chair rise, Motricity index). Other unplanned outcomes appear in report including func-

Van de Port 2012 (Continued)

		tional ambulation categories (included in review) and the Letter Cancellation Task (but this is not included in this review)
Other bias	Low risk	None known
Imbalanced exposure	High risk	Imbalanced exposure Quote: "The circuit training group received 4461 treatment sessions compared with 4378 for the UC group. The average treatment time/session was 72 (SD 39) mins for the intervention group compared with 34 (SD 10) mins for the control group (P < 0.05)."

Vanroy 2017

Methods	<p>Design: randomised trial. Cardiorespiratory training (cycling) plus UC vs non-exercise intervention plus UC – commenced during UC with some participants discharged home. A second phase in which the intervention group were allocated to 2 different exposures will be excluded from this review</p> <p>Randomisation: permuted block randomisation using computer. Stratified on stroke type, motor function and cardiorespiratory fitness</p> <p>Allocation concealment: allocation schedule held offsite</p> <p>Blinding: assessor blinded to group allocation</p> <p>ITT: unclear what was done</p> <p>Measurements: at the end of intervention (3 months). We excluded data at 6- and 12-month follow-up as other exposures started at the end of the 3-month exercise intervention</p> <p>Withdrawals: 2/33 (6%) lost at 3 months in the intervention group (1 high BP, 1 refusal). 1/26 (4%) lost at 3 months in the control group (discharged home)</p>
Participants	<p>Randomised: total 59 participants. 33 participants were randomised to intervention group, 26 to control group</p> <p>Intervention: 33 participants; 20 men (61%) and 13 women (39%); mean age: 66.7 (SD 8.8); 50.5 (SD 19.8) days after stroke</p> <p>Control: 26 participants; 18 men (69%) and 8 women (31%); mean age: 63.8 (SD 11.8); 48.5 (SD 19.2) days after stroke</p> <p>Inclusion criteria: first-ever stroke; age ≤ 80 years; 3-10 weeks post stroke; able to carry out simple instructions; able to pedal a MOTomed cycling leg trainer at 50 revolutions/min</p> <p>Exclusion criteria: pre-existing neurologic disorders with impaired functionality; existing pre-stroke; pre-stroke BI < 50; absolute contraindications for exercise testing</p>
Interventions	<p>Intervention: cardiorespiratory cycling exercise using a MOTomed seated cycling ergometer. Sessions were in intervals weeks 1-8, and continuous weeks 9-12 all performed at 50 pedal revolutions/min or at a self-chosen frequency but maintaining the target HR training zone. Intensity progressed from 60%-75% HR reserve. Frequency of intervention: 30 min/day for 3 days/week for 3 months. Total session time starting at 51 min reduced to 40 min as intensity increased.</p> <p>The intervention group also received 4 educational sessions (weeks 3, 6, 8, 12) about stroke and risk factors, importance of an active lifestyle, how to increase physical activity and cardiorespiratory capacity during and after the study</p> <p>Control: passive, supine mobilisation therapy of paretic hip and knee: 30 min/day for 3 days/week for 3 months</p>

Vanroy 2017 (Continued)

Setting: inpatient rehabilitation centre or at home if discharged

Outcomes	<p>Included outcomes: cardiorespiratory fitness (peak workload and oxygen uptake), mobility (FAC, preferred walking speed (10 m), maximum walking speed (10 m))</p> <p>Other outcomes: knee extension strength (omitted as a handheld dynamometer was used). In second paper measures of physical activity (steps, energy expenditure SenseWear) and also self-reported physical activity (diary, Physical Activity Scale for Individuals with Physical Disabilities). Also Baecke Questionnaire of Habitual Physical Activity only used at 12 months which is not end of intervention</p>
Notes	Originally included as 2017 ePub; no trial registry entry

Risk of bias

Bias	Authors' judgement	Support for judgement
Random sequence generation (selection bias)	Low risk	Computer-based permuted block method
Allocation concealment (selection bias)	Low risk	Allocation schedule was offsite
Blinding (performance bias and detection bias) All outcomes	High risk	Attention control balances the groups however participants were aware of the different intervention programmes
Blinding of outcome assessment (detection bias) All outcomes	Low risk	The outcome assessors were blinded. Participants were aware of different programmes but instructed not to inform the assessor
Incomplete outcome data (attrition bias) End of intervention	Low risk	ITT not described but very low attrition
Selective reporting (reporting bias)	Unclear risk	All outcomes specified in the methods were reported, however no pre-published protocol documents or trial registry entries
Other bias	Low risk	The intervention group also received 4 educational sessions (weeks 3, 6, 8, 12) relating to continuing the intervention after it had finished, since this is focused on the period after our outcome of interest at the end of the intervention it is unlikely that it led to bias
Imbalanced exposure	Low risk	Balanced exposure

Verheyden 2009

Methods	<p>Design: randomised trial of functional strength training plus UC vs UC</p> <p>Randomisation: simple randomisation</p> <p>Allocation concealment: information not included</p> <p>Blinding: assessor blinded</p> <p>ITT: not completed</p> <p>Measurements: before and end of intervention (5 weeks)</p> <p>Withdrawals: none, however 2 participants received fewer hours of intervention therapy due to early discharge. In the control group, 3 participants were discharged early and therefore received fewer hours of UC. All participants were evaluated before discharge and included in analysis</p>
Participants	Randomised: total 33 participants. 17 participants were randomised to intervention, 16 to control

Physical fitness training for stroke patients (Review)

Verheyden 2009 (Continued)

Intervention: 17 participants; 11 men, 6 women; mean age: (combined men and women) 55 years (SD 11); mean height: unknown; mean weight: unknown; type of stroke: ischaemic 15, haemorrhagic 2; paretic side: right 9, left 8; time since stroke onset: 53 (SD 24) days

Control: 16 participants; 9 men, 7 women; mean age: (combined men and women) 62 years (SD 14); mean height: unknown; mean weight: unknown; type of stroke: ischaemic 13, haemorrhagic 3; paretic side: right 7, left 9; time since stroke onset: 49 (SD 28) days

Inclusion criteria: stroke-related hemiparesis. Full recovery from an earlier stroke

Exclusion criteria: an age of ≥ 80 years; unable to understand instructions; other disorders that could affect motor performance or an ability to obtain maximum trunk performance

Interventions	<p>Intervention: participants in the training group (n = 17) received resistance training for the trunk for 30 min, 4 times/week for 5 weeks. Seated exercises included selective movements of the upper and lower part of the trunk in supine and in sitting. In addition conventional multidisciplinary stroke rehabilitation, such as neuro-developmental treatment and motor learning strategies, was provided. No other details were reported.</p> <p>Control: participants in the control group (n = 16) received conventional multidisciplinary stroke rehabilitation, such as neuro-developmental treatment and motor learning strategies. No other details were reported</p> <p>Setting: rehabilitation centre</p>
Outcomes	<p>Included outcomes: Trunk Impairment Scale</p> <p>Other outcomes: Tinetti Scale (only reported at baseline)</p>
Notes	—

Risk of bias

Bias	Authors' judgement	Support for judgement
Random sequence generation (selection bias)	Unclear risk	Method described only as simple randomisation by personnel not involved in the study
Allocation concealment (selection bias)	Unclear risk	Not reported in paper
Blinding (performance bias and detection bias) All outcomes	High risk	"...patients nor the physiotherapists who delivered the interventions were blinded"
Blinding of outcome assessment (detection bias) All outcomes	Low risk	Assessor blinded
Incomplete outcome data (attrition bias) End of intervention	Low risk	<p>A total of 2 participants from the intervention group completed 3 and 4 h fewer of additional therapy due to early discharge. The participants were evaluated before discharge and included in the analysis. A total of 3 participants from the control group were discharged early after 21, 23, and 25 days respectively and therefore received fewer h of CPT (number of fewer h not reported)</p> <p>Although ITT was not referred to specifically there were "no dropouts during the course" of the study, and "... all participants were evaluated before discharge."</p>
Selective reporting (reporting bias)	Unclear risk	Trial register or protocol not available
Other bias	Low risk	None known

Verheyden 2009 (Continued)

Imbalanced exposure High risk Imbalanced exposure

Wang 2014

Methods	<p>Design: randomised trial of cardiovascular training plus UC vs UC - during UC Randomisation: sealed card selection by participants</p> <p>Allocation concealment: information not included Blinding: investigators were not blinded, outcome assessors and therapists were blinded ITT: not completed Measurements: before and end of intervention (6 weeks) Withdrawals: in the intervention group, unclear if up to 9 participants withdrew due to lower leg discomfort during intervention, transfer to another hospital or withdrawal from study</p>
Participants	<p>54 participants randomised: 27 were randomised to intervention, 27 to control Intervention: 23 participants; 19 men, 8 women; mean age: (combined men and women) 54 years (SD 7.2); mean height: unknown; mean weight: 71.1 kg (SD 10.2); type of stroke: ischaemic 15, haemorrhagic 12; paretic side: right 15, left 12; time since stroke onset: 1-6 months Control: 27 participants; 17 men, 10 women: mean age: (combined men and women) 52 years (SD 12.1); mean height: unknown; mean weight: 75.2 kg (SD 8.1); type of stroke: ischaemic 16, haemorrhagic 11; paretic side: right 18, left 9; time since stroke onset: 1-6 months</p> <p>Inclusion criteria: time since stroke onset of 1-6 months; age > 45 years; severely impaired with the affected leg marked ≤ 3 on the 7-point Chedoke–McMaster Stroke Assessment scale; unable to walk even with walk aids; the unaffected leg can move against normal resistance; fasting glucose < 7 mmol/L; no physician diagnosed diabetes; never using medications that may significantly alter HR and blood glucose level; and able to understand the purpose and content of the study</p> <p>Exclusion criteria: signs and symptoms of subarachnoid haemorrhage, transient ischaemic attack, severe cerebral oedema, O₂ dependence, angina, unstable cardiac conditions, peripheral arterial occlusive disease, abnormal high fever, severe pneumonia, high BP > 200/110 mmHg, dementia, aphasia operationally defined as incapacity to follow 2-point commands, untreated major depression, and other medical conditions that precluded participation in exercise training</p>
Interventions	<p>Intervention: participants in the training group (n = 23) received conventional stroke rehabilitation 5 days/week for 6 weeks, (3 x 40-min physical therapy sessions; 2 x 15-min OT sessions; 1 x 30-min acupuncture or traditional Chinese manipulation session; and 1 x 30-min physical agents therapy session). 1 x 40-min physical training session was replaced by low-intensity aerobic cardiovascular training 3 days a week for 6 weeks using a cycle ergometer. Cycling training consisted of 30 min sessions including: 5 min warm-up; 30 min active pedaling at an intensity based on an incremental graded exercise test (2.5 W ramp every 3 min maintaining 50 rpm until exhaustion); followed by 5-min cool down. Target HR was calculated as ((peak HR in graded exercise test – resting HR) x 50% to 70%) + resting HR</p> <p>Control: participants in the training group (n = 27) received conventional stroke rehabilitation 5 days/week for 6 weeks, (3 x 40-min physical therapy sessions; 2 x 15-min OT sessions; 1 x 30-min acupuncture or traditional Chinese manipulation session; and 1 x 30-min physical agents therapy session)</p> <p>Setting: rehabilitation centre</p>
Outcomes	<p>Included outcomes: BI; exercise test time; glucose tolerance variables (fasting glucose; fasting insulin; 2-h plasma glucose; homeostasis model assessment–insulin resistance index), and serum lipid profiles (total triglycerides, HDL cholesterol, LDL cholesterol)</p> <p>Other outcomes: Fugl–Meyer motor scores; peak and resting HR</p>
Notes	—

Risk of bias

Wang 2014 (Continued)

Bias	Authors' judgement	Support for judgement
Random sequence generation (selection bias)	Unclear risk	1 of 2 cards selected from a sealed envelope by participants
Allocation concealment (selection bias)	Unclear risk	Not reported in paper
Blinding (performance bias and detection bias) All outcomes	High risk	Therapists blinded but there was imbalanced intervention exposure
Blinding of outcome assessment (detection bias) All outcomes	Low risk	Outcome measures administered by a blinded rater
Incomplete outcome data (attrition bias) End of intervention	High risk	9/54 (17%) overall losses A total of up to 9 participants withdrew due to discomfort, hospital transfer, and general withdrawal from study. Unclear how these withdrawals were distributed between intervention and control groups. No details given of whether pre-intervention assessment data were included in analysis All 3 criteria for ITT analysis have not been met - methods suggest a per-protocol analysis
Selective reporting (reporting bias)	Unclear risk	Trial register or protocol not available
Other bias	Low risk	Not known
Imbalanced exposure	High risk	Intervention group was exposed to an additional exposure volume on top of UC PT

Winstein 2004

Methods	Design: randomised trial of resistance training plus UC vs UC - during and after UC Randomisation mechanism: unknown; method: stratified on Orpington Prognostic Scale (1.6-1.4 and 4.2-6.8) Allocation concealment: sealed envelopes Blinding: principal investigator but not outcome assessor ITT: no Measurements: end of intervention (4-6 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 men and 8 women; time since stroke 17.3 days (SD 10.6) Control: 20 participants; 2 men and 8 women; time since stroke 15.4 days (SD 5.5) Age: 29-76 years, most 35-75 years Inclusion criteria: first stroke; 2-35 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

Winstein 2004 (Continued)

Interventions	<p>Intervention: upper limb movements resisted by gravity, free weights, TheraBand and grip devices for fingers, 60 min/day 5 days/week for 4-6 weeks, high-intensity for 3 days/week and low-intensity higher velocity for 2 days/week, training target 20 h total</p> <p>Control: standard care delivered by OT, included muscle facilitation exercises using neuro-developmental approach, electrical stimulation, stretching, ADL and caregiver training; activities included use of upper limbs</p> <p>Setting: inpatient rehabilitation hospital and outpatient clinic</p>
Outcomes	<p>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</p> <p>Other outcomes: Fugl-Meyer scores</p>
Notes	Change from baseline scores reported and analysed

Risk of bias

Bias	Authors' judgement	Support for judgement
Random sequence generation (selection bias)	Unclear risk	Mechanism unknown; stratification based on Orpington Prognostic Scale (1.6-1.4 and 4.2-6.8)
Allocation concealment (selection bias)	Unclear risk	Envelopes; opaque, sealed, numbered is unknown
Blinding (performance bias and detection bias) All outcomes	High risk	<p>No suitable attention control</p> <p>Quote: "This treatment regimen was separate (i.e. it was added to the standard dose of occupational and physical therapy)."</p>
Blinding of outcome assessment (detection bias) All outcomes	High risk	<p>Outcome assessor not blinded</p> <p>Outcome measures related to muscle strength are biased due to use of a hand-held dynamometer</p>
Incomplete outcome data (attrition bias) End of intervention	Low risk	<p>ITT not reported</p> <p>2/42 (5%) losses at the end of intervention: 1 treatment group (medical complications), 1 control group (lost interest)</p>
Incomplete outcome data (attrition bias) End of follow-up	High risk	<p>ITT not reported</p> <p>11/42 (26%) losses at the end of follow-up: 4 intervention group; 5 control group (moved away or lost contact)</p>
Selective reporting (reporting bias)	Unclear risk	Protocol not available
Other bias	Low risk	None known
Imbalanced exposure	High risk	Imbalanced exposure

Yang 2006

Methods	<p>Design: randomised trial of mixed training vs no intervention - after UC</p> <p>Randomisation mechanism: picking envelopes</p> <p>Allocation concealment: sealed envelopes</p> <p>Blinding: investigator</p>
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Yang 2006 (Continued)

ITT: unknown

Measurements: end of intervention (4 weeks)

Withdrawals: none

Participants	Randomised: 48 participants Intervention: 24 participants; 16 men and 8 women; age 56.8 years (SD 10.2); time since stroke > 1 year Control: 24 participants; 18 men and 8 women; 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 min/day 3 days/week for 4 weeks; circuit comprised 6 x 5-min 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-min block, and increasing step and chair height, and the complexity of task; extended periods (5-min) warrant acknowledgement of a cardiorespiratory component despite the author's title (progressive resistance strength training) Control: no intervention
Outcomes	Included outcomes: gait endurance (6-MWT - outcome assessor not blinded); gait speed preferred (10 m); 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	Study 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
Random sequence generation (selection bias)	Unclear risk	Quote: "...independent person who picked one of the sealed envelopes 30 min before the start of the intervention."
Allocation concealment (selection bias)	Unclear risk	Sealed envelopes; opaque and numbered not reported
Blinding (performance bias and detection bias) All outcomes	High risk	No attention control
Blinding of outcome assessment (detection bias) All outcomes	Low risk	Investigator blinded
Incomplete outcome data (attrition bias) End of intervention	Low risk	ITT not reported No losses
Selective reporting (reporting bias)	Unclear risk	Protocol not available
Other bias	Low risk	None known
Imbalanced exposure	High risk	Imbalanced exposure

Yang 2014

Methods	Design: randomised cross-over trial of cardiorespiratory training plus UC (outpatient) vs UC (outpatient) Randomisation: computer-generated randomisation Allocation concealment: sealed envelopes Blinding: outcome assessor ITT: not completed Measurements: before and end (4 weeks) of intervention Withdrawals: in the intervention group, 1 participant withdrew due to a fall at home	
Participants	30 participants randomised: 15 participants were randomised to intervention, 15 to control Intervention: 15 participants; 9 men, 6 women; mean age: (combined men and women) 53.9 years (SD 10.5); mean height: unknown; mean weight: unknown; type of stroke: ischaemic 9, haemorrhagic 11; paretic side: right 11, left 4; time since stroke onset: 11.1 months (SD 8.1) Control: 15 participants; 13 men, 2 women: mean age: (combined men and women) 54.5 years (SD 8.0); mean height: unknown mean weight: unknown; type of stroke: ischaemic 8, haemorrhagic 7; paretic side: right 8, left 7; time since stroke onset: 11.1 months (SD 9.7) Inclusion criteria: first ever stroke; stroke onset > 3 months; unilateral hemiplegia; between 18-70 years of age; ability to walk 10 m with or without assistance; zero score of 3 levels of the National Institute of Health Stroke Scale Exclusion criteria: patients with aphasia who were unable to follow instructions; blindness or visual impairment; musculoskeletal disorders; cardiac disorders and peripheral neuropathy	
Interventions	Intervention: 15 participants in the training group received conventional stroke rehabilitation (1 h PT; 1 h OT). In addition extra cardiovascular training was given for 30 min, 5 times/week for 4 weeks. Cycling training consisted of 15 min sessions each of forward and backward cycling including: 150-s passive warm-up; 10-min active pedaling at 50-70 rpm at an intensity of stage 13 of the Borg scale; 150 seconds of passive cool-down Control: 15 participants in the control group received conventional stroke rehabilitation (1 h PT; 1 h OT) Setting: rehabilitation centre - usual outpatient care	
Outcomes	Included outcomes: 6-MWT; comfortable walking speed using 10-metre walk test Other outcomes: lower limb subscale of Fugl-Meyer assessment (LE-FMA); modified Ashworth scale	
Notes	The first iteration of this cross-over study is equivalent to a RCT The data in this paper, which can be analysed as a 2-group RCT, correspond to 'Group A' (intervention n = 15 per protocol) and 'Group B' (control n = 15) at the end of the first iteration ('T2') Authors indicate the 10-MWT was at a comfortable speed not a maximal speed	
Risk of bias		
Bias	Authors' judgement	Support for judgement
Random sequence generation (selection bias)	Low risk	Quote: "... computer-generated random numbers"
Allocation concealment (selection bias)	Unclear risk	Some evidence of concealment but the description is inadequate; only reported as Quote: "... held in sealed envelopes by an independent individual"

Yang 2014 (Continued)

Blinding (performance bias and detection bias) All outcomes	High risk	Imbalanced exposure
Blinding of outcome assessment (detection bias) All outcomes	Low risk	Blinded rater used
Incomplete outcome data (attrition bias) End of intervention	Low risk	1/30 (3%) total dropouts A total of 1 participant withdrew due to a fall at home; no details given of whether pre-intervention assessment data were included in analysis All 3 criteria for ITT analysis have not been met - methods suggest a per-protocol analysis, however only 1 participant affected
Selective reporting (reporting bias)	Unclear risk	Trial register or protocol not available
Other bias	Low risk	None known
Imbalanced exposure	High risk	Imbalanced exposure

Zedlitz 2012

Methods	<p>Design: multicentre randomised trial of mixed training plus non-exercise intervention vs non-exercise intervention - after UC</p> <p>Randomised: block randomisation; implemented individually but also as a cluster when numbers were low</p> <p>Allocation concealment: sealed envelopes</p> <p>Blinding: assessor blind to group allocation</p> <p>ITT: yes</p> <p>Measurements: end of intervention (12 weeks) and end of 6-month follow-up</p> <p>Withdrawals: 1 participant withdrew consent before allocation into group; intervention group (5 participants, 3 withdrew consent before end of intervention, 1 participant withdrew due to poor health before end of intervention; 1 participant withdrew due to recurrent stroke before follow-up); control group (6 participants, 3 withdrew consent, 1 got new job; 1 family emergency, 1 participant recurrent stroke all before end of intervention; 4 participants lost to follow-up)</p>
Participants	<p>Randomised: 84 participants</p> <p>Intervention: 38 participants (1 withdrew consent); 22 men and 23 women; mean age 54.8 years (SD 9.1); 4.4 years post-stroke (SD 4.2)</p> <p>Control: 45 participants; 21 men and 17 women; mean age 55.6 years (SD 8.8); 3.3 years post-stroke (SD 3.9)</p> <p>Inclusion criteria: sustained stroke > 4 months; reported severe fatigue; between ages 18-70 years; able to walk independently</p> <p>Exclusion criteria: severe cognitive deficits; severe comorbidity (cardiac disease, pulmonary disease); depression</p>

Zedlitz 2012 (Continued)

Interventions	<p>Invention group: treadmill walking and strength training ranging from 40%-70% maximum HR for 2 h twice/week for 12 weeks</p> <p>Control group: non-exercise control intervention (cognitive therapy)</p> <p>Setting: 8 rehabilitation centres</p>
Outcomes	Included outcomes: Checklist Individual Strength-subscale Fatigue; HADS; SIS; 6-MWT
Notes	—

Risk of bias

Bias	Authors' judgement	Support for judgement
Random sequence generation (selection bias)	Unclear risk	Randomisation implemented (individually) in groups of 8 in each centre by picking 1 of 8 sealed envelopes. If only 4 participants were available in 1 centre then they were allocated as a group (cluster)
Allocation concealment (selection bias)	Unclear risk	Full nature and use of envelopes is unclear
Blinding (performance bias and detection bias) All outcomes	High risk	No attention control
Blinding of outcome assessment (detection bias) All outcomes	Low risk	Blinded assessors used
Incomplete outcome data (attrition bias) End of intervention	Unclear risk	ITT analyses used 11/84 (13%) losses: intervention group (5 participants, 3 withdrew consent before end of intervention, 1 participant withdrew due to poor health before end of intervention); control group (6 participants, 3 withdrew consent, 1 got new job; 1 family emergency, 1 participant recurrent stroke all before end of intervention)
Incomplete outcome data (attrition bias) End of follow-up	High risk	ITT analyses used 16/84 (19%) total losses: intervention group (1 participant withdrew due to recurrent stroke before follow-up); control group (4 participants lost to follow-up)
Selective reporting (reporting bias)	Low risk	Included outcomes correspond to trial registry NTR2704. Some proposed cognitive outcomes not present in publication
Other bias	High risk	<p>Self-report questionnaires used</p> <p>Monitoring period before randomisation to identify those with potentially poor compliance</p> <p>Risk of self-selection bias as newspaper adverts used for recruitment</p>
Imbalanced exposure	High risk	Imbalanced exposure

Zou 2015

Methods	<p>Design: RCT. Resistance training vs attention control - after UC</p> <p>Randomisation: randomised by selection of sealed envelopes. Block sampling to ensure similar group sizes</p> <p>Allocation concealment: sealed envelopes used (not clear if sequentially numbered or opaque)</p> <p>Blinding: study investigators not blinded, outcome assessors blinded, participants may have understood nature of group assignments</p> <p>ITT: no pre-planned ITT analysis; outcome presented per-protocol</p> <p>Measurements: at the end of intervention (8 weeks)</p> <p>Withdrawals: 2/28 (7%) participants from the intervention group (2 withdrew due to muscle fatigue). 3/28 (11%) participants from the control group (3 due to moving to another location)</p>
Participants	<p>Randomised: 56 participants were randomised</p> <p>Intervention: 28 participants; 13 men (46%) and 15 women (54%); mean age: 52.3 (SD 6.9); 15 (SD 6.2) months after stroke</p> <p>Control: 28 participants; 9 men (32%) and 19 women (68%); mean age: 51.4 (SD 7.2); 8 (SD 5.1) months after stroke</p> <p>Inclusion criteria: age < 60 years, nondiabetic, > 6 months after stroke onset disabled stroke patients who had completed CPT. Baseline characteristics indicate at least 3 weeks of rehabilitation training and BI score > 60</p> <p>Exclusion criteria: diabetes, heart failure, unstable angina, dementia, and aphasia</p>
Interventions	<p>Intervention: resistance training; 3 sets of 15 repetitions of leg press, leg extension and leg curl using resistance training machines. Legs were trained unilaterally and alternately. Resistance was progressed every 2 weeks. Frequency of intervention: 40 min/day for 3 days/week for 8 weeks</p> <p>Control: active and passive upper and lower body stretching exercises. Frequency of intervention: 40 min/day for 3 days/week for 8 weeks</p> <p>Setting: outpatient clinics of 2 hospitals</p>
Outcomes	<p>Included outcomes: risk factors (blood glucose control indices, serum lipids, BMI); muscle strength; Fugl-Meyer scores</p> <p>Other outcomes: none</p>
Notes	No pre-published trial registry entry

Risk of bias

Bias	Authors' judgement	Support for judgement
Random sequence generation (selection bias)	Unclear risk	Physical method suggested but no mechanism actually described
Allocation concealment (selection bias)	High risk	Sealed envelopes not stated as opaque (or numbered) plus unblinded investigators could make this vulnerable
Blinding (performance bias and detection bias) All outcomes	Unclear risk	Those delivering intervention were blinded to baseline data and group assignment. Attention control was used but study authors indicated participants may have known which group they belonged to

Zou 2015 (Continued)

Blinding of outcome assessment (detection bias) All outcomes	Low risk	Outcome assessors and therapists were blinded to baseline data and group assignment
Incomplete outcome data (attrition bias) End of intervention	Low risk	ITT analysis not used. Few withdrawals, but those in the intervention group were due to muscle fatigue, 2/28 (7%), whereas those in the control group all withdrew due to moving to another location, 3/28 (11%)
Selective reporting (reporting bias)	Unclear risk	Trial registry or protocol not available
Other bias	Unclear risk	Not all participants completed all training content some of the stretches were active as well as passive
Imbalanced exposure	Low risk	Balanced attention control

6-MWT: 6-Minute Walk Test; **9-HPT:** 9-Hole Peg Test; **12-MWT:** 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; **BDI:** Beck Depression Inventory; **BI:** Barthel Index; **BMI:** body mass index; **BP:** blood pressure; **bpm:** beats per minute; **BWSTT:** body weight supported treadmill training; **CES-D:** Centre for Epidemiological Studies Depression scale; **CRPS:** complex regional pain syndrome; **CT:** computerised tomography; **CPT:** conventional physiotherapy; **DBP:** diastolic blood pressure; **ECG:** electrocardiogram; **EMS:** Elderly Mobility Scale; **FAC:** Functional Ambulation Classification; **FAI:** Frenchay Activity Index; **FAME:** family-mediated exercise; **FAPS:** Functional Ambulation Profile Score; **FIM:** Functional Independence Measure; **FST:** functional strength training; **FTHUE:** Functional Test of the Hemiparetic Upper Extremity; **HADS:** Hospital Anxiety and Depression Scale; **HDL:** high-density lipoprotein; **HR:** heart rate; **HRQoL:** health-related quality of life; **IQR:** interquartile range; **ITT:** intention-to-treat; **LDL:** low-density lipoprotein; **LOCF:** last observation carried forward; **LOT-R:** Life Orientation Test - Revised; **MAS:** Motor Assessment Scale; **MI:** myocardial infarction; **MMSE:** Mini Mental State Examination; **MRI:** magnetic resonance imaging; **mRS:** modified Rankin Scale; **NEADL:** Nottingham Extended Activities of Daily Living; **NHP:** Nottingham Health Profile; **NHS:** National Health Service; **OT:** occupational therapy; **PADS:** Peripheral Arterial Diseases Walking Impairment questionnaire; **PT:** physiotherapy; **QoL:** quality of life; **RCT:** randomised controlled trial; **RLOC:** Recovery Locus of Control Scale; **RM:** repetition maximum; **RMA:** Rivermead Motor Assessment; **RMI:** Rivermead Mobility Index; **RPE:** rate of perceived exertion; **RPM:** revolutions per minute; **SBP:** systolic blood pressure; **SD:** standard deviation; **SF-12:** Short Form-12 Health Survey Questionnaire; **SF-36:** Short Form 36 Health Survey; **SIS:** Stroke Impact Scale; **SSS:** Scandinavian Stroke Scale; **SWLS:** Satisfaction with Life Scale; **TUG:** timed up and go test; **UC:** usual care; **WHO:** World Health Organization

Characteristics of excluded studies [ordered by study ID]

Study	Reason for exclusion
Alabdulwahab 2015	Wrong control group
Askim 2018	Co-intervention
Awad 2015	Wrong control group
Baer 2018	Wrong type of intervention
Bang 2014	Wrong type of intervention
Bernhardt 2018	Wrong type of intervention
Boss 2017	Co-intervention
Brauer 2018	Co-intervention
Brouwer 2018	Wrong type of intervention

Study	Reason for exclusion
Buyukavci 2016	Wrong type of intervention
Cabanas-Valdés 2017	Wrong type of intervention
Choi 2015	Wrong type of intervention
Choi 2017	Wrong type of intervention
Chua 2016	Wrong type of intervention
Dong Hyun 2016	Wrong type of intervention
Dubey 2018	Wrong type of intervention
English 2015	Wrong type of intervention
Faulkner 2014	Co-intervention
Faulkner 2015	Co-intervention
Faulkner 2017a	Co-intervention
Graef 2016	Wrong control group
Gunnes 2017	Cointervention
Hahn 2015	Wrong type of intervention
Haruyama 2017	Wrong type of intervention
Hendrey 2018	Wrong control group
Heron 2017	Wrong type of intervention
Hillier 2014	Wrong type of intervention
Hornby 2016	Wrong control group
Hubbard 2015	Wrong type of intervention
Hunter 2018	Wrong control group
Immink 2014	Wrong type of intervention
Kim 2016b	Wrong type of intervention
Kim 2017b	Wrong control group
Kwon 2015	Wrong type of intervention
Lee 2015	Wrong control group
Lee 2016	Wrong type of intervention
Lee 2017a	Wrong type of intervention

Study	Reason for exclusion
Lee 2017b	Wrong type of intervention
Lee 2018a	Wrong type of intervention
Lee 2018b	Wrong type of intervention
Lim 2016	Wrong type of intervention
Lim 2017	Wrong type of intervention
Lin 2015	Wrong control group
Linder 2017	Wrong control group
Lund 2018	Wrong control group
Malagoni 2016	Wrong control group
Malik 2018	Wrong type of intervention
Marryam 2017	Wrong type of intervention
Martins 2017	Wrong type of intervention
McDonnell 2017	Wrong type of intervention
Meng 2018	Wrong type of intervention
Ordahan 2015	Wrong type of intervention
Pandian 2015	Cointervention
Park 2015a	Wrong type of intervention
Park 2015b	Wrong control group
Park 2015c	Wrong control group
Park 2016a	Wrong type of intervention
Park 2016b	Wrong type of intervention
Park 2016c	Wrong type of intervention
Park 2016d	Wrong control group
Park 2017a	Wrong type of intervention
Park 2017b	Wrong control group
Paul 2016	Wrong type of intervention
Rand 2015	Wrong control group
Redzuan 2012	Wrong type of intervention

Study	Reason for exclusion
Ribeiro 2017	Wrong control group
Roh 2016	Wrong type of intervention
Rose 2017	Wrong control group
Rose 2018	Wrong type of intervention
Ru 2017	Co-intervention
Schachten 2015	Wrong type of intervention
Seo 2015	Wrong control group
Sharma 2017	Wrong control group
Shin 2016	Wrong type of intervention
Sun 2016	Wrong control group
Tang 2014	Wrong control group
Vahlberg 2017	Co-intervention
Valkenborghs 2016	Wrong control group
Valkenborghs 2017	Wrong control group
Van Crielinge 2017	Wrong control group
Vasileva 2017	Wrong type of intervention
Wang 2015	Co-intervention
Wright 2018	Wrong control group
Zhang 2016	Wrong control group
Zhiyan 2017	Wrong type of intervention
Zhu 2016	Wrong control group

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

Brands Guendling 2017

Methods	RCT
Participants	Stroke n = 20
Interventions	Arm and leg training
Outcomes	PT

Physical fitness training for stroke patients (Review)

Brands Guendling 2017 *(Continued)*

Notes

Abstract only

Chan 2017

Methods	RCT
Participants	Stroke n = 32
Interventions	Aquatic exercise + land exercise vs land exercise only
Outcomes	BBS, Community Balance and Mobility Score, TUG, 2-MWT
Notes	Not clear if land training is outpatient UC

Chan 2018

Methods	RCT
Participants	Stroke n = unclear
Interventions	Conventional training arm of study (Tai Chi arm excluded) vs no intervention
Outcomes	Stroop test, mobility dual task performance
Notes	Conventional training unclear on content and progression; 2 connected studies with different reported sample sizes

Chen 2014

Methods	RCT
Participants	Stroke n = 77
Interventions	Lower limb exercise vs conventional rehabilitation
Outcomes	Muscle power, balance, NIHSS, mRS, BI, number of falls
Notes	Abstract only

Deshpande 2018

Methods	RCT
Participants	Stroke n = unknown
Interventions	Task-oriented circuit training
Outcomes	Upper limb function

Physical fitness training for stroke patients (Review)

Deshpande 2018 *(Continued)*

Notes	Abstract only
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Ellis 2018

Methods	RCT
Participants	Stroke n = 32
Interventions	Robotic resistance training
Outcomes	Upper limb function, strength, clinical battery
Notes	Robot device involved; unclear if this represents physical fitness training

Faulkner 2017b

Methods	RCT
Participants	Mixed stroke n = 16; TIA n = 31
Interventions	Cardiorespiratory training
Outcomes	Secondary prevention UC + education
Notes	Subgroup of stroke-only data sought from study authors

Floel 2018

Methods	RCT
Participants	Stroke n = 200
Interventions	Cardiorespiratory treadmill exercise vs relaxation
Outcomes	Gait speed, BI
Notes	Abstract only

Frimpong 2014

Methods	RCT
Participants	Stroke n = 20
Interventions	Circuit training + UC vs UC alone
Outcomes	10-MWT, 6-MWT, FAC

Frimpong 2014 *(Continued)*

Notes	Contacted study author about progression model of exercise intervention
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Gezer 2018

Methods	RCT
Participants	Stroke n = 42
Interventions	Aerobic exercise
Outcomes	Exercise tolerance, respiratory function, 6-MWT, FIM, NHP, BDI, and Pittsburgh Sleep Quality Index
Notes	May not be randomised; study author contacted

Hwang 2015

Methods	Randomised cross-over study
Participants	Stroke n = 11
Interventions	Aquatic exercise
Outcomes	Resting HR, mean arterial pressure, respiratory variables, normal gait speed, TUG, psychological variables relating to affect
Notes	Need cross-over data from first iteration; study author contacted

Jeon 2016

Methods	RCT
Participants	Stroke n = 12
Interventions	Strength training
Outcomes	Range of motion, pain, modified motor assessment score
Notes	Nature of control group unclear

Kim 2015

Methods	RCT
Participants	Stroke n = 27
Interventions	Cycle ergometer
Outcomes	BBS, TUG test, 10-MWT

Physical fitness training for stroke patients (Review)

Kim 2015 *(Continued)*

Notes	Not known whether any progression of intervention
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Kim 2017c

Methods	RCT
Participants	Stroke n = 30
Interventions	Circuit training + UC vs UC + co-intervention?
Outcomes	BBS, timed up and go test, FAC, 6-MWT
Notes	The control group may incorporate an exercise co-intervention that is not UC

Koç 2015

Methods	RCT
Participants	Stroke n = 134
Interventions	Home-based mixed training
Outcomes	BI
Notes	Progression and intervention content unclear; sought from study authors

Kumaran 2016

Methods	RCT
Participants	Stroke n = 62
Interventions	Context-based exercise programme
Outcomes	SIS, 5-MWT, 6-MWT
Notes	Abstract only

Lawal 2016

Methods	RCT
Participants	Stroke n = 91
Interventions	Circuit class
Outcomes	MMT, Modified Tardieu Scale

Lawal 2016 (Continued)

Notes	Abstract only
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Maheshwari 2018

Methods	RCT
Participants	Stroke n = 47
Interventions	Task-specific exercise with or without strength training
Outcomes	Fugl Meyer, MAL, ARAT
Notes	Abstract only

Matsumoto 2016

Methods	RCT
Participants	Stroke n = 120
Interventions	Aquatic exercise
Outcomes	10-MWT, Modified Ashworth Scale, SF-36, lower-extremity function, QoL
Notes	Unclear if intervention is progressive fitness training

Oh 2016

Methods	RCT
Participants	Stroke n = 40
Interventions	Lumbar stabilisation exercise group vs general physical therapy
Outcomes	Pulmonary function
Notes	Unclear if intervention is progressive

Opara 2016

Methods	RCT
Participants	Stroke n = 60
Interventions	BWSTT
Outcomes	Functional Index Repty, FAC, TUG Test, 10-MWT

Opara 2016 (Continued)

Notes	Abstract only
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Ploughman 2017

Methods	RCT
Participants	Stroke n = 60
Interventions	Cardiorespiratory exercise vs activity intervention vs 2 non-exercise control groups
Outcomes	Cognition outcomes
Notes	Abstract only

Pudipeddi 2016

Methods	Controlled study; randomisation unclear
Participants	Stroke n = 30
Interventions	Strength training + UC vs UC
Outcomes	Strength, spasticity
Notes	Abstract only

Ruescas-Nicolau 2015

Methods	RCT
Participants	Stroke n = 13
Interventions	Cardiovascular/task oriented interval training vs control
Outcomes	6-MWT, TUG, Tinetti-walking subscale
Notes	Abstract only

Sanchez Sanchez 2015

Methods	RCT
Participants	Stroke n = 12
Interventions	Strength training vs conventional rehabilitation
Outcomes	Fugl-Meyer Assessment, WMFT

Physical fitness training for stroke patients (Review)

Sanchez Sanchez 2015 *(Continued)*

Notes	Abstract only
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Song 2015a

Methods	RCT
Participants	Stroke n = 40
Interventions	Sliding machine exercise
Outcomes	Balance
Notes	Need more information about the nature of the exercise

Song 2015b

Methods	RCT
Participants	Stroke n = 30
Interventions	Individual circuit training vs class circuit training vs conventional PT
Outcomes	Walking velocity, cadence, and 2-MWT
Notes	Unclear whether the intervention is progressive fitness training

Szczygiel 2015

Methods	RCT
Participants	Stroke n = 60
Interventions	Partial body weight support walking
Outcomes	10-MWT, 3-D assessment of gait
Notes	Abstract only

Van den Berg 2016

Methods	RCT
Participants	Stroke n = 63
Interventions	Unclear; mixed training possibly
Outcomes	Mobility section of the SIS; other sections of the SIS; mobility, RMI, BI, NEADL, TUG test, mRS, Fugl Meyer lower extremity, Motricity Index, BBS, HADS

Physical fitness training for stroke patients (Review)

Van den Berg 2016 *(Continued)*

Other outcomes: General Self-Efficacy Scale; and Fatigue Severity Scale. Caregivers also completed the HADS, Carer QoL and the Expanded Caregiver Strain Index, length of stay, number of readmissions, caregiver satisfaction with the intervention

Notes	Not enough information to characterise the intervention: ACTRN12613000779774
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Vij 2015

Methods	RCT
Participants	Stroke n = 40
Interventions	Strength training, gait training
Outcomes	Step length, stride length, cadence, gait velocity, spasticity, foot pressure, Wisconsin Gait Scale
Notes	Abstract only

Wu 2017

Methods	RCT
Participants	Stroke, n = 60
Interventions	Bodybuilding exercise (resistance training?)
Outcomes	Anxiety, depression, patient satisfaction with care, re-bleeding
Notes	Abstract only; full text only in Chinese

Xu 2015

Methods	RCT
Participants	Stroke n = 120
Interventions	Exercise vs 3 non-exercise comparisons
Outcomes	Fugl-Meyer Motor Function Scale, NIHSS, and modified BI
Notes	Full text in Chinese

Yang 2018

Methods	RCT
Participants	Stroke n = 60

Yang 2018 (Continued)

Interventions	Strength training vs Bobath vs robot rehabilitation
Outcomes	Peak torque of knee joint, Fugl-Meyer Score, FIM, BBS
Notes	Abstract only

Yelnik 2017

Methods	RCT
Participants	Stroke n = 104
Interventions	Physical therapy including training
Outcomes	Fugl-Meyer Score, number of days to walking 10 m unassisted, balance, autonomy, QoL, unexpected medical events
Notes	Unclear intervention content

Zhang 2015

Methods	RCT
Participants	Stroke n = 40
Interventions	Sling exercise therapy
Outcomes	Lower-limb motor function
Notes	Full text in Chinese

2-MWT: 2 minute walk test; **5-MWT:** 5-Metre Walk Test; **6-MWT:** 6-Minute Walk Test; **10-MWT:** 10-Metre Walking Test; **ARAT:** Action Research Arm Test; **BBS:** Berg Balance Scale; **BI:** Barthel Index; **BDI:** Beck Depression Inventory; **BWSTT:** body weight supported treadmill training; **FAC:** Functional Ambulation Classification; **FIM:** Functional Independence Measure; **HADS:** Hospital Anxiety and Depression Scale; **HR:** heart rate; **MAL:** Motor Activity Log; **MMT:** Manual Muscle Test; **mRS:** modified Rankin Scale; **NEADL:** Nottingham Extended Activities of Daily Living; **NHP:** Nottingham Health Profile; **NIHSS:** National Institutes of Health Stroke Scale; **PT:** physiotherapy; **QoL:** quality of life; **RCT:** randomised controlled trial; **RMi:** Rivermead Mobility Index; **SIS:** Stroke Impact Scale; **TIA:** transient ischaemic attack; **TUG:** Timed Up-and Go Test; **UC:** usual care; **WMFT:** Wolf Motor Function Test

Characteristics of ongoing studies [ordered by study ID]

ACTRN12615000728538

Trial name or title	Home-based, tailored intervention for reducing falls after stroke: the Falls After Stroke Trial (FAST)
Methods	RCT
Participants	N = 270
Interventions	Mixed training

ACTRN12615000728538 (Continued)

Outcomes	Self-report falls incidence, BBS, 6MWT, self-report and accelerometer-measured physical activity, community participation (Later-Life Function and Disability Instrument), HRQoL, Step test, Health care utilisation and costs, gait speed
Starting date	Unknown
Contact information	Prof Catherine Dean, Ground Floor 75 Talavera Road, Macquarie University, NSW 2109, Australia; +61 2 9850 6620; catherine.dean@mq.edu.au
Notes	

ACTRN12616000391471

Trial name or title	A study on benefit of circuit class therapy on mobility, balance, reintegration into normal life and quality of life of people with stroke
Methods	RCT
Participants	N = 40
Interventions	Mixed training
Outcomes	TUG, BBS, Reintegration to Normal Living Index, HRQoL
Starting date	9 March 2015
Contact information	Dr Nor Azlin Mohd. Nordin, Physiotherapy Programme, School of Rehabilitation Sciences, Faculty of Health Sciences, Jalan Raja Muda Aziz, Universiti Kebangsaan Malaysia, 50300 Kuala Lumpur, Malaysia; +6019 359 4418, +603 26878038; norazlin8@ukm.edu.my
Notes	Recruitment completed

ACTRN12616001288415

Trial name or title	A comparison of two forms of physiotherapy on functional performance after acquired brain injury: a pilot randomised controlled trial
Methods	RCT
Participants	N = 30
Interventions	Mixed training
Outcomes	Global Impression of Change scale, STS item of the Mobility Scale for Acute Stroke Patients (MSAS), muscle strength, goal attainment, subjective ranking of functional task performance
Starting date	22 September 2016
Contact information	Mr Davide de Sousa, Physiotherapy Department, Graythwaite Rehabilitation Centre, Ryde Hospital, Denistone Road, Eastwood NSW 2122, Australia; +61298587144; davide.desousa@health.nsw.gov.au

ACTRN12616001288415 (Continued)

Notes	Details of functional tasks and strategies used in the intervention are not presented
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ACTRN12617000452392

Trial name or title	Core muscles strengthening for balance and gait performance in individuals with chronic stroke
Methods	RCT
Participants	Stroke
Interventions	Core strength training
Outcomes	Conventional training
Starting date	
Contact information	
Notes	Not clear if progressive in nature

ACTRN12617000746336

Trial name or title	Walking away fatigue and disease after stroke
Methods	RCT
Participants	N = 30
Interventions	Cardiorespiratory training
Outcomes	Fatigue Severity Scale, feasibility, daily step count, fasting glucose, resting BP, BMI, gait speed, blood lipids, daily time spent in moderate intensity activity, gait endurance, MAS
Starting date	Unknown
Contact information	Dr Niru Mahendran, 12D47, Faculty of Health, University of Canberra, 1 University Drive, Bruce ACT 2617, Australia; +612 6206 8302; niru.mahendran@canberra.edu.au
Notes	

ChiCTR ICR 15006362

Trial name or title	Effect of early low-intensity aerobic training with ergometer on the activities of daily living among severely impaired post-stroke hemiplegic patients: a pilot study
Methods	RCT
Participants	N = 42

ChiCTR ICR 15006362 (Continued)

Interventions	Cardiorespiratory training
Outcomes	BI, FAC scale, Frequency Activities Index, Fugl-Meyer motor score, exercise test duration, peak heart rate
Starting date	Unknown
Contact information	Huaping Pan, 168 Gushan Rd, Jiangning District, Nanjing, Jiangsu, +86 18901588339, heap-ing_pan70@163.com
Notes	

ChiCTR-IOR-17010821

Trial name or title	Effect of sling exercise training on the balance function of stroke patients with hemiplegia
Methods	Intervention vs control
Participants	N = 50
Interventions	Strength training
Outcomes	BBS, Fugl-Meyer, TUG, Modified Ashworth Scale, BI
Starting date	Unknown
Contact information	Liu Jing 410505633@qq.com
Notes	Unclear if training is progressive in nature

CTRI/2016/09/007258

Trial name or title	Exercise using all four limbs in half-side paralysis
Methods	RCT
Participants	N = 50
Interventions	Cardiorespiratory training
Outcomes	FAC, RVGA, Fugl-Meyer, mRS
Starting date	1 January 2016
Contact information	Dr Kamal Narayan Arya, Pt. Deendayal Upadhyaya Intitute for the Physically Handicapped, 4 VD Marg, New Delhi, Central, DELHI 110002 India; 9899897408; kamalnarya@yahoo.com
Notes	

CTRI/2016/10/007337

Trial name or title	Effectiveness of physiotherapy training to improve control of sitting on floor
Methods	RCT
Participants	N = 50
Interventions	Task-orientated exercise
Outcomes	Attainment of squatting and sitting on the floor using goal attainment scale, lower limb strength using Motricity Index (lower limb strength), Fugl Meyer Scale (lower limb motor recovery), short fall efficacy scale (fear of falling, Neuro QoL-Short form (ability to participate in social roles and activities))
Starting date	11 September 2015
Contact information	prakashvaidhiyalingam@gmail.com
Notes	

CTRI/2017/03/008061

Trial name or title	Comparison of home exercises verses exercises given in hospital set up in improving functional recovery of upper limbs in post stroke patients
Methods	RCT
Participants	N = 60
Interventions	Home-based exercises by care givers with routine therapy given at hospital setup
Outcomes	Fugl-Meyer MAS (upper extremity level of impairment), WMFT (upper extremity function), SIS (participation level)
Starting date	29 January 2016
Contact information	abraham.joshua@manipal.edu
Notes	

CTRI/2018/01/011543

Trial name or title	Efficacy of task-oriented training approach on trunk and hip musculature to improve balance in stroke subjects: a randomised controlled trial
Methods	RCT
Participants	N = 40
Interventions	Task-oriented training approach for trunk and hip abductor

CTRI/2018/01/011543 (Continued)

Outcomes	Trunk Impairment Scale, Brunel Balance Assessment, Tinetti performance oriented mobility assessment scale, stroke rehabilitation assessment of movement measures
Starting date	1 March 2018
Contact information	abraham.joshua@manipal.edu
Notes	

IRCT20150721023277N2

Trial name or title	The efficacy of occupation-based and exercise-based interventions on performance components and areas of occupation in subjects with chronic stroke
Methods	RCT
Participants	N = 45
Interventions	Structured exercise protocol including the range of motion and strengthening exercises, balance and endurance training and functional use of the upper extremity
Outcomes	Participation in occupational areas 2. Performance components including upper limb function, balance and functional mobility and cognition
Starting date	22 December 2017
Contact information	lajevardi.l@iums.ac.ir
Notes	

IRCT2016102430477N1

Trial name or title	Effect of rehabilitation in stroke recovery
Methods	RCT
Participants	N = 20
Interventions	Resistance training
Outcomes	Neurophysiological parameters (rest motor threshold, active motor threshold, recruitment curve, cortical silent period and ipsilateral silent period) recorded by transcranial magnetic stimulation, Modified BI, Modified Ashworth Scale, Fugl-Meyer
Starting date	Unknown
Contact information	Fahimeh Kamali fahimehkamali@hotmail.com
Notes	Possibility it may not be progressive strength training

IRCT20171105037256N4

Trial name or title	The effect of dual-task exercises on balance, falling and activities of daily living in stroke patients
Methods	Intervention vs control
Participants	Unknown
Interventions	Mixed training
Outcomes	TUG
Starting date	Unknown
Contact information	Unknown
Notes	Possibility it may not be progressive in nature

JPRN-UMIN000019380

Trial name or title	The effect of walking exercise by Nordic pole on the aerobic performance for stroke patients
Methods	RCT
Participants	N = 40
Interventions	Cardiorespiratory
Outcomes	Gait speed, gait distance, HR and O ₂ consumption during 6-MWT
Starting date	Unknown
Contact information	Hidetoshi Takahashi taka1959@saitama-med.ac.jp
Notes	

Miller 2014

Trial name or title	Protocol for a randomised controlled clinical trial investigating the effectiveness of Fast muscle Activation and Stepping Training (FAST) for improving balance and mobility in sub-acute stroke
Methods	RCT
Participants	N = 60
Interventions	Mixed training
Outcomes	Chedoke-McMaster Stroke Assessment, BBS, 10-MWT, maximum voluntary contraction, gait speed, Physiological Balance Test

Miller 2014 (Continued)

Starting date	November 2012
Contact information	S Jayne Garland jayne.garland@ubc.ca
Notes	

NCT01161329

Trial name or title	Description of physical and psychosocial problems one year after stroke and the effect of intensified physical activity for patients with stroke - a combined physical and behavioural approach
Methods	RCT
Participants	N = 67
Interventions	High intense functional exercise programme
Outcomes	BBS Short Physical Performance Battery
Starting date	September 2009 (completed 2016)
Contact information	karin.hellstrom@neuro.uu.se
Notes	

NCT01915368

Trial name or title	Determining Optimal post-Stroke Exercise (DOSE)
Methods	RCT
Participants	N = 75
Interventions	Physical exercise
Outcomes	Ambulatory function measured by the 6-MWT, ambulatory function from the 5-Meter Walk Test, balance function from the BBS, ambulatory function from the FAC, QoL measured with EuroQol, cognition measured by the Montreal Cognitive Assessment, cognition measured by the Digit Symbols Substitution Test, cognition measured by the Trail Making Test, depression measured by Patient Health Questionnaire-9, HR measured during the intervention sessions, step count measured during the intervention sessions
Starting date	September 2013
Contact information	chihya.hung@ubc.ca
Notes	

NCT01916486

Trial name or title	Vitality: promoting cognitive function in older adults with chronic stroke (Vitality)
Methods	RCT
Participants	N = 119
Interventions	Mixed training
Outcomes	Alzheimer's Disease Assessment Scale Cognitive Subscale Plus, IADL Scale, Fatigue Severity Scale, Short Physical Performance Battery, 6-MWT, TUG, quadriceps strength, grip strength, European QoL
Starting date	November 2013
Contact information	Janice J Eng
Notes	

NCT02272426

Trial name or title	The safety and tolerability of an aerobic and resistance exercise program with cognitive training post-stroke
Methods	RCT
Participants	N = 132
Interventions	Mixed training
Outcomes	Adverse events related to interventions, training programme adherence, Cognitive Assessment Battery, Depression Scale, QoL
Starting date	November 2014
Contact information	Unknown
Notes	Possibility of co-intervention with cognitive training

NCT02437006

Trial name or title	Early intervention with a low-intensity leg cycling exercise program for individuals after stroke
Methods	RCT
Participants	N = 120
Interventions	Cardiorespiratory training
Outcomes	Exercise capacity, sympathetic nerve tests

NCT02437006 (Continued)

Starting date	March 2014
Contact information	Miao-Ju Hsu mjhsu@kmu.edu.tw
Notes	

NCT02494518

Trial name or title	Forced aerobic exercise for stroke rehabilitation
Methods	RCT
Participants	N = 34
Interventions	Mixed training
Outcomes	Fugl Meyer Assessment, WMFT, SIS, Metabolic Stress Test, ARAT, 6-MWT
Starting date	July 2015
Contact information	Susan Linder
Notes	

NCT02550015

Trial name or title	High intensity interval training after stroke
Methods	RCT
Participants	N = 70
Interventions	Cardiorespiratory training
Outcomes	Maximal Oxygen Uptake, change in BP, 10-MWT, TUG, BBS, FIM, International Physical Activity Questionnaire, Montreal Cognitive Assessment, 6-MWT
Starting date	September 2015
Contact information	Torunn Askim
Notes	

NCT02550990

Trial name or title	Synergistic effects of aerobic exercise and cognitive training on cognition in stroke patients with cognitive decline
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NCT02550990 (Continued)

Methods	RCT
Participants	N = 75
Interventions	Cardiorespiratory training
Outcomes	Montreal Cognitive Assessment, Wechsler Memory Scale, Wechsler Adult Intelligence Scale, FIM, Lawton IADL Scale, SIS, TUG, 6-MWT, mobility, Fugl-Meyer Assessment, RMI, Geriatric Depression Scale, MVC knee extension strength
Starting date	September 2015
Contact information	Ching-Yi Wu cywu@mail.cgu.edu.tw
Notes	

NCT02619110

Trial name or title	The effect of backward walking treadmill training on balance in patient with chronic stroke
Methods	RCT
Participants	N = 30
Interventions	Cardiorespiratory training
Outcomes	BBS, pulmonary function test, 10-MWT, 6-MWT, TUG
Starting date	February 2014
Contact information	Lan Y Guo
Notes	

NCT02703805

Trial name or title	FIT for FUNCTION
Methods	RCT
Participants	N = 216
Interventions	Mixed training - unclear
Outcomes	Reintegration to Normal Living Index, Rapid Assessment of Physical Activity, BBS, Short Physical Performance Battery, 6-MWT, grip and knee strength, European QoL 5-Dimension Questionnaire, cardiovascular risk factors, self-efficacy for physical activity (Stanford 6-item Scale), level of participant knowledge, skill, and confidence for self-management (Patient Activation Measure) and healthcare utilisation and cost evaluation

NCT02703805 (Continued)

Starting date	May 2014
Contact information	Julie Richardson, PhD McMaster University
Notes	NCT02703805

NCT02710773

Trial name or title	Backward treadmill training in patients with chronic stroke
Methods	RCT
Participants	N = 20
Interventions	Cardiorespiratory training
Outcomes	10-MWT, gait analysis, SIS, Modified Ashworth Scale
Starting date	April 2016
Contact information	Alessandro Picelli alessandro.picelli@univr.it
Notes	

NCT02717715

Trial name or title	SunRISe Study - Stroke Rehabilitation In Suriname
Methods	RCT
Participants	N = 20
Interventions	Cardiorespiratory training
Outcomes	Change in peak oxygen uptake
Starting date	March 2016
Contact information	Anton De Kom
Notes	Possibility that training could be mixed, details unknown

NCT02731235

Trial name or title	The effect of aerobic exercise in patients with minor stroke
Methods	RCT

NCT02731235 (Continued)

Participants	N = 84
Interventions	Cardiorespiratory training
Outcomes	Graded Cycling Test with Talk Test, Physical Activity Scale, Short time activity measurements, WHO-five Well-being Index, Montreal Cognitive Assessment, Major Depression Inventory, Multidimensional Fatigue Inventory
Starting date	January 2016
Contact information	Christina Kruuse christina.kruuse.01@regionh.dk
Notes	

NCT02753322

Trial name or title	Training dual-task balance and walking in people with stroke
Methods	RCT
Participants	N = 84
Interventions	Dual-task training, single-task training, limbs exercise
Outcomes	Degree of the dual-task interference, standing balance (with eyes open and closed), 10-MWT, obstacle crossing, Chinese version of Activities-specific Balance Confidence Scale, Chedoke Arm and Hand Activity Inventory, incidence of falls
Starting date	April 2016
Contact information	Margaret WY Poon Email: pwy751@ha.org.hk
Notes	

NCT02855424

Trial name or title	The effect of leg cycling exercise program at low or moderate intensity for individuals with subacute stroke
Methods	RCT
Participants	N = 90
Interventions	Low-intensity exercise vs moderate-intensity exercise vs traditional rehabilitation
Outcomes	Symptom-limit exercise tolerance tests, changed activity of autonomic nervous system, 10-MWT, BI, Stroke-Specific QoL Scale, Fugl-Meyer (lower extremity), Multi-dimensional Fatigue Inventory, performance of cycling

NCT02855424 (Continued)

Starting date	August 2016
Contact information	Miao-Ju Hsu Email: mjhsu@kmu.edu.tw
Notes	

NCT02902367

Trial name or title	SMS-guided training after acute stroke or transient ischemic attack - a randomised controlled trial (SMS/TIA)
Methods	RCT
Participants	N = 80
Interventions	Outdoor walking and strength exercise vs UC
Outcomes	6-MWT, Short Physical Performance Battery, 10-MWT, hand-dynamometer, body composition, cardiometabolic risk markers, mortality, health-related QoL
Starting date	November 2016
Contact information	Birgit Vahlberg Email: birgit.vahlberg@pubcare.uu.se
Notes	

NCT02923765

Trial name or title	Stepper aerobic training on fitness, disability, inflammation and thrombosis in stroke patients
Methods	RCT
Participants	N = 170
Interventions	Aerobic training by a stepper vs usual rehabilitation vs healthy participants
Outcomes	Cardiopulmonary Exercise Test, FIM, thrombosis and coagulation activities of blood samples by flow cytometry, dynamic TG assay, and enzyme-linked Immunosorbent assay
Starting date	October 2017
Contact information	Shu-Chun Huang Email: mr7171@cgmh.org.tw
Notes	

NCT02937480

Trial name or title	Efficacy of task-specific training in physical activity level post-stroke
Methods	RCT
Participants	N = 38
Interventions	Task-specific training vs sham training
Outcomes	Physical activity levels (physical activity monitor, Human Activity Profile), gait speed, TUG, Upper Extremity Performance Test (TEMPA), handgrip strength, 6-MWT, SS-QOL
Starting date	August 2016
Contact information	Christina Danielli Coelho de Morais Faria Email: chrismoraisf@yahoo.com
Notes	

NCT02938000

Trial name or title	E-rehabilitation: aerobic resistance training for stroke survivors
Methods	RCT
Participants	N = 3
Interventions	TheraBand with exercise video vs UC with advice to exercise
Outcomes	Peak VO2 using 6-MWT, BBS, adherence to exercise programme, Patient Health Questionnaire - 9 (PHQ 9)
Starting date	August 2016
Contact information	William P Neil Email: William.P.Neil@kp.org
Notes	Reconsider when full text is available

NCT02948725

Trial name or title	Clinical application of cross-education during stroke rehabilitation (X-Ed-Stroke01)
Methods	RCT
Participants	N = 24
Interventions	Cross-education and standard rehabilitation vs standard rehabilitation
Outcomes	Fugl-Meyer Assessment, grip and wrist strength, volume of motor cortex activation

NCT02948725 *(Continued)*

Starting date	November 2016
Contact information	Jon Farthing Email: jon.farthing@usask.ca
Notes	

NCT03122626

Trial name or title	Does participation in a group, task-oriented community-based exercise program improve the ability to do everyday activities among people with stroke?
Methods	RCT
Participants	N = 60
Interventions	Together In Movement and Exercise (TIME) Program vs wait-listed control group
Outcomes	Subjective Index of Physical and Social Outcome, NEADL (multiple secondary outcomes)
Starting date	February 2017
Contact information	Nancy Salbach Email: nancy.salbach@utoronto.ca
Notes	

NCT03259932

Trial name or title	Comparison of fatigue and recovery after stroke depending on the usual management with or without physical training (FRAM)
Methods	RCT
Participants	N = 160
Interventions	Physical activity – aerobic exercise, muscle building in circuit training, balance and flexibility exercises
Outcomes	Fatigue relief (fatigue severity scale)
Starting date	September 2017
Contact information	Vincent.gremeaux@chu-dijon.fr
Notes	

NCT03425890

Trial name or title	Effect of self-empowered upper limb repetitive engagement (SURE) program on upper limb recovery after stroke
Methods	RCT
Participants	N = 20
Interventions	SURE Program – individualised daily self exercise and functional use of the arm and hand on their own outside of therapy 60 min a day 6 days a week for 4 weeks. Strengthening and exercise exercises. Control group received no program, only an educational booklet on stroke
Outcomes	Upper limb Fugl Meyer Scale (primary outcome), ARAT, rating of everyday arm-use in the community and home, Stanford Fatigue Visual Numeric Scale, VAS scale for pain, Modified Ashworth Scale, duration of affected upper limb activity in h, bilateral motor cortex brain activation
Starting date	February 2018
Contact information	Lay_fong_chin@ttsh.com.sg
Notes	

NCT03458884

Trial name or title	Does cardiorespiratory interval training improve post-stroke fatigue?
Methods	RCT
Participants	N = 50
Interventions	Cardiorespiratory interval training (3 days a week, 8 weeks)
Outcomes	Post-stroke fatigue, peak O ₂ consumption, VO ₂ peak, feasibility (fidelity, adherence and adverse events)
Starting date	March 2018
Contact information	Anna.brandal@ume.se
Notes	

NCT03479632

Trial name or title	Aerobic exercise for non-ambulatory stroke survivors
Methods	RCT
Participants	N = 40
Interventions	Aerobic walking programme using a treadmill with body-weight support system. Control receive only standard care
Outcomes	Resting heart rate, resting BP, change in vital capacity and change in forced vital capacity

NCT03479632 (Continued)

Starting date	March 2018
Contact information	aalqahtani@kumc.edu
Notes	

NCT03528148

Trial name or title	The effect of elliptical cross training bike for stroke patients
Methods	RCT
Participants	N = 50
Interventions	Active cycling group, conventional physical therapy
Outcomes	Walking speed and step length
Starting date	August 2018
Contact information	chouliwe@mail.cmuh.org.tw
Notes	

NCT03548090

Trial name or title	The effect of plantarflexion training in people with chronic stroke
Methods	RCT
Participants	N = 50
Interventions	Skateboard exercise at an incline angle with different bodyweight (50%, 75%, 90%)
Outcomes	Step length asymmetry ratio, EMG of gastrocnemius, soleus, plantarflexion torque, walking speed, SIS
Starting date	October 2018
Contact information	Daniel.wingard@uth.tmc.edu
Notes	

PACTR201511001359344

Trial name or title	The Nigerian stroke aerobic study (NISAS)
Methods	RCT
Participants	N = 56

Physical fitness training for stroke patients (Review)

PACTR201511001359344 (Continued)

Interventions	Continuous aerobic training (cycling) and interval training (cycling)
Outcomes	VO2 max, gait speed, motor function, balance, lipid profile, fasting blood sugar, red and white blood count, packed cell volume, anthropometric (e.g. BMI), biochemical (e.g. urea), cardiovascular (BP etc)
Starting date	1 October 2018
Contact information	Nelson.ekechukwu@unn.edu.ng
Notes	

PACTR201712002689193

Trial name or title	Effect of 6 weeks task-orientated circuit training on balance and quality of life of stroke
Methods	RCT
Participants	N = 30
Interventions	Task-orientated circuit training (balance training, double leg standing, tandem walking, standing and walking, squat exercises)
Outcomes	BBS, SS-QoL Scale
Starting date	Not yet recruiting
Contact information	Sinda4life@gmail.com
Notes	

RBR-26q4z9

Trial name or title	Effect of exercises with action observation and aquatic physical therapy in arm recovery after stroke
Methods	Not listed
Participants	N = 60
Interventions	Action observation training
Outcomes	Fugl-Meyer Scale
Starting date	Not listed
Contact information	Not listed
Notes	

RBR-2mf595

Trial name or title	Serious game for evaluation and treatment in stroke
Methods	RCT
Participants	N = 24
Interventions	Resistance training
Outcomes	MVC, TUG, gait speed, Modified Ashworth Scale, Fugl Meyer, Modified BI, NHP, motor control
Starting date	Unknown
Contact information	Unknown
Notes	Unclear if randomised

RBR-4g6fhf

Trial name or title	The effects of exercise with cycle ergometer in patients after acute stroke
Methods	RCT
Participants	N = 24
Interventions	Cardiorespiratory training
Outcomes	Dynamometry for assessment of upper and lower limb muscle strength, Ordinal Scale of Muscle Tone Assessment in Adults for evaluation of muscle tone, 10-MWT for gait evaluation, BBS for balance evaluation, Manovacuometry, Spirometry, Mental State Minisease for Cognitive Assessment, mRS, and Scandinavian Stroke Scale
Starting date	Unknown
Contact information	douglaspinheirodarosa@yahoo.com.br
Notes	

RBR-4wk4b3

Trial name or title	Influence of an exercise program on cardiac remodeling and functional capacity of patients with stroke
Methods	RCT
Participants	N = 40
Interventions	Cardiorespiratory training
Outcomes	6-MWT, neurological assessment, nutritional assessment, ambulatory BP monitoring, transthoracic echocardiography, and assessment of QoL

RBR-4wk4b3 (Continued)

Starting date	2016
Contact information	sgzanati@fmb.unesp.br
Notes	

RBR-4wz3w3

Trial name or title	Task-oriented group therapy and home-based exercise increase in the amount of practice in the subacute phase after Stroke - randomised clinical trial
Methods	RCT
Participants	N = 110
Interventions	Unclear; mixed training
Outcomes	Fugl-Meyer, grip strength, box and block test, 6-MWT, TUG test
Starting date	March 2017
Contact information	michaelsenstella@hotmail.com
Notes	

RBR-5thjgv

Trial name or title	Effects of physical training on metabolic, hemodynamic, autonomic and inflammatory parameters of post-stroke individuals
Methods	RCT
Participants	N = 30
Interventions	Resistance training
Outcomes	Muscle strength, 10-MWT, TUG test, HR variability, haemodynamic and inflammatory markers
Starting date	August 2017
Contact information	prof.brodrigues@gmail.com
Notes	RBR-5thjgv

RBR-7699xz

Trial name or title	Multidisciplinary analysis of a motor rehabilitation protocol with partial weight support for post stroke patients: a randomised clinical trial
Methods	RCT

Physical fitness training for stroke patients (Review)

RBR-7699xz (Continued)

Participants	N = 50
Interventions	Cardiorespiratory training
Outcomes	BBS, stride velocity, gait kinematics, BI
Starting date	2014
Contact information	elisangela.manffra@pucpr.br
Notes	

RBR-7hqk8t

Trial name or title	Efficacy of task-specific training in changing neurotrophic factors and impact on clinical outcomes in individuals with stroke: a randomised controlled trial
Methods	RCT
Participants	N = 36
Interventions	Mixed training
Outcomes	Neurotrophic factor concentration, 10-MWT, 6-MWT, TUG test
Starting date	February 2018
Contact information	scalzopl@gmail.com
Notes	

TCTR20160601005

Trial name or title	Effectiveness of antigravity treadmill training in improving walking capacity and balance in hemiparetic ischemic stroke patients
Methods	RCT
Participants	N = 34
Interventions	Cardiorespiratory - unclear
Outcomes	6-MWT, FAC, balance, muscle EMG, satisfaction after antigravity treadmill training
Starting date	July 2016
Contact information	kwanyupa@gmail.com
Notes	

TCTR20170615002

Trial name or title	Effects of task-oriented training on upper extremity functional performance in patients with sub-acute stroke: a randomised controlled trial
Methods	RCT
Participants	N = 28
Interventions	Resistance training - unclear
Outcomes	Upper extremity functional performance and recovery, SIS
Starting date	August 2017
Contact information	ayeayethantumt@gmail.com
Notes	

Vahlberg 2018

Trial name or title	Protocol and pilot study of a short message service-guided training after acute stroke/transient is-chemic attack to increase walking capacity and physical activity
Methods	RCT
Participants	N = 80
Interventions	Mixed training
Outcomes	6-MWT, chair-rising, mobility, gait speed, handgrip strength, body composition (fat mass and muscle mass), biochemical risk-markers, health-related QoL, and cardiovascular events
Starting date	November 2016
Contact information	birgit.vahlberg@pubcare.uu.se
Notes	NCT02720276

10-MWT: 10-Metre Walk Test; **6-MWT:** 6-Minute Walk Test; **ARAT:** Action Research Arm Test; **BBS:** Berg Balance Scale; **BMI:** body mass index; **BI:** Barthel Index; **BP:** blood pressure; **EMG:** electromyography; **FAC:** Functional Ambulation Classification; **FIM:** Functional Independence Measure; **HRQoL:** health-related quality of life; **IADL:** Instrumental Activities of Daily Living; **MAS:** Motor Assessment Scale; **mRS:** modified Rankin Scale; **MVC:** maximal voluntary contraction; **NEADL:** Nottingham Extended Activities of Daily Living Scale; **NHP:** Nottingham Health Profile; **QoL:** quality of life; **RCT:** randomised controlled trial; **RMI:** Rivermead Mobility Index; **RVGA:** Rivermead Visual Gait Assessment; **SIS:** Stroke Impact Scale; **SS-QoL:** Stroke Specific Quality of Life Scale; **STS:** sit to stand; **TIA:** transient ischaemic attack; **TUG:** Timed Up and Go Test; **UC:** usual care; **VAS:** Visual Analogue Scale; **WHO:** World Health Organization; **WMFT:** Wolf Motor Function Test

DATA AND ANALYSES

Comparison 1. Cardiorespiratory training versus control - end of intervention

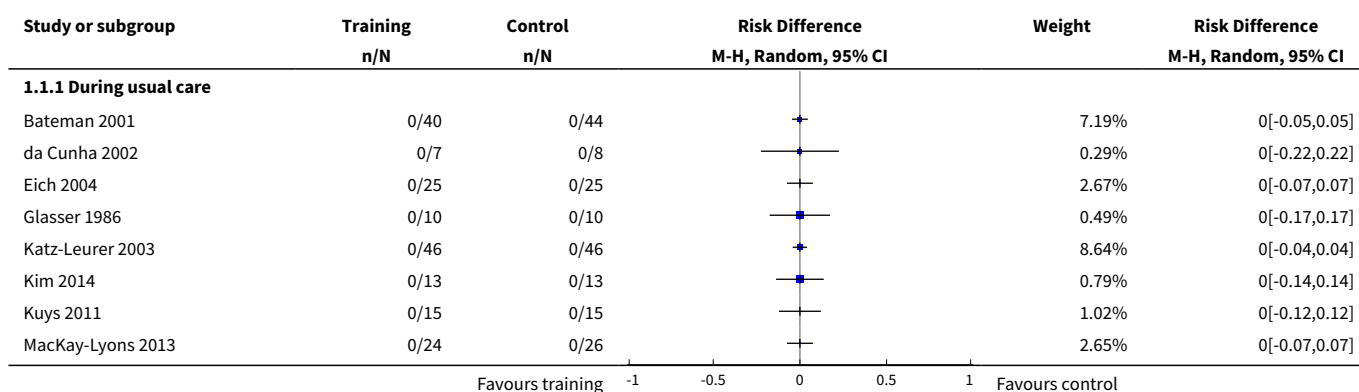
Outcome or subgroup title	No. of studies	No. of participants	Statistical method	Effect size
1 Death	32	1631	Risk Difference (M-H, Random, 95% CI)	0.0 [-0.01, 0.01]
1.1 During usual care	16	698	Risk Difference (M-H, Random, 95% CI)	0.0 [-0.02, 0.02]
1.2 After usual care	16	933	Risk Difference (M-H, Random, 95% CI)	0.0 [-0.02, 0.02]
2 Disability - Functional Independence Measure	3	162	Std. Mean Difference (IV, Random, 95% CI)	0.21 [-0.10, 0.52]
2.1 During usual care	1	52	Std. Mean Difference (IV, Random, 95% CI)	0.23 [-0.32, 0.78]
2.2 After usual care	2	110	Std. Mean Difference (IV, Random, 95% CI)	0.17 [-0.29, 0.63]
3 Disability - Barthel Index	3	243	Mean Difference (IV, Random, 95% CI)	6.65 [-0.67, 13.98]
3.1 During usual care	2	115	Mean Difference (IV, Random, 95% CI)	10.48 [-11.83, 32.80]
3.2 After usual care	1	128	Mean Difference (IV, Random, 95% CI)	2.60 [-0.15, 5.35]
4 Disability - Rivermead Mobility Index (scale 0 to 15)	3	146	Mean Difference (IV, Random, 95% CI)	1.56 [0.20, 2.92]
4.1 During usual care	2	110	Mean Difference (IV, Random, 95% CI)	1.43 [-0.62, 3.49]
4.2 After usual care	1	36	Mean Difference (IV, Random, 95% CI)	2.0 [0.53, 3.47]
5 Disability - combined disability scales	8	462	Std. Mean Difference (IV, Random, 95% CI)	0.52 [0.19, 0.84]
5.1 During usual care	3	130	Std. Mean Difference (IV, Random, 95% CI)	0.88 [0.08, 1.68]
5.2 After usual care	5	332	Std. Mean Difference (IV, Random, 95% CI)	0.33 [0.11, 0.55]
6 Risk factors - blood pressure, systolic	5	318	Mean Difference (IV, Random, 95% CI)	-0.20 [-4.00, 5.60]
6.1 During usual care	1	12	Mean Difference (IV, Random, 95% CI)	26.33 [1.95, 50.71]
6.2 After usual care	4	306	Mean Difference (IV, Random, 95% CI)	-1.41 [-5.25, 2.43]

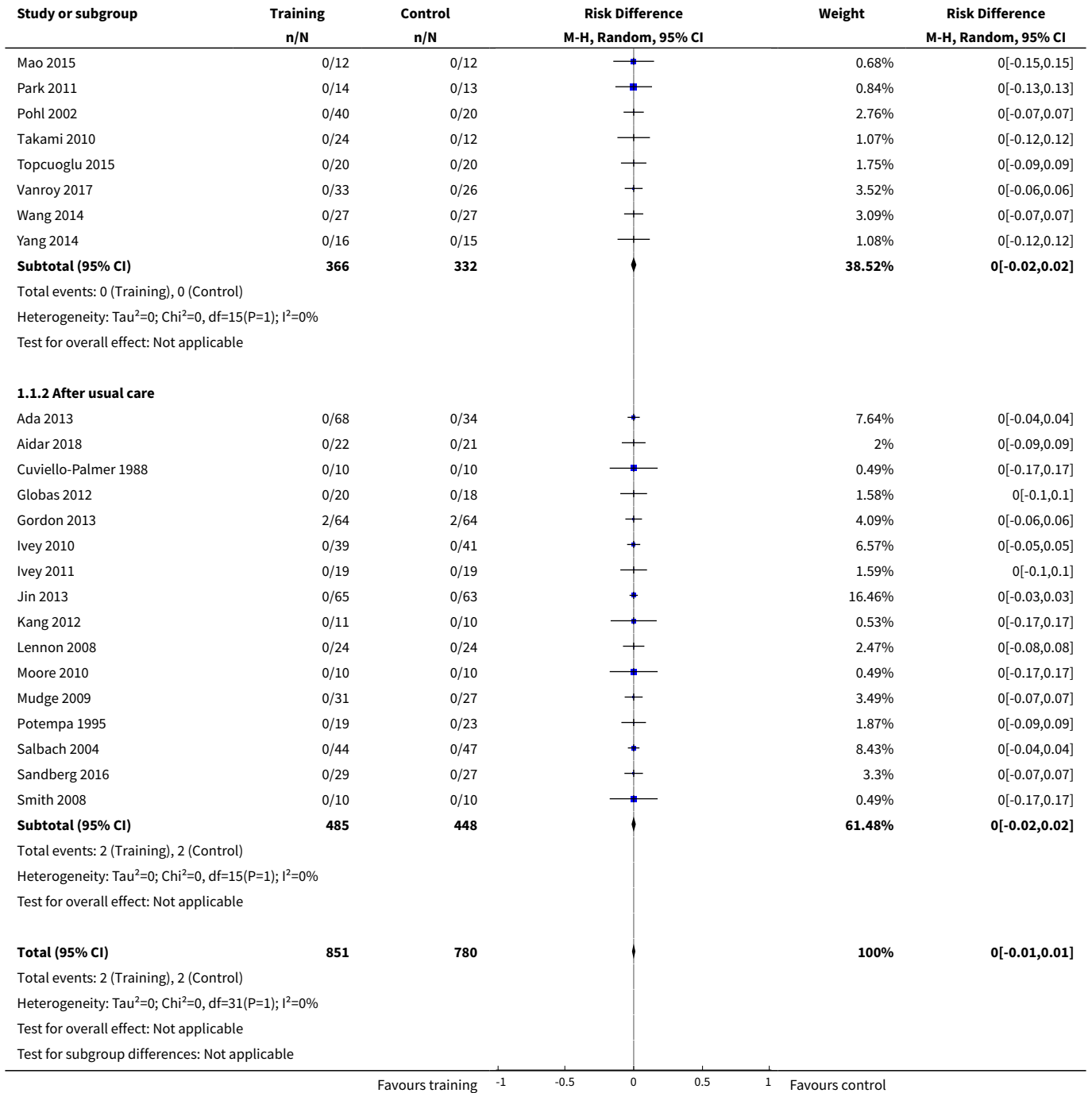
Outcome or subgroup title	No. of studies	No. of participants	Statistical method	Effect size
7 Risk factors - blood pressure, diastolic	5	318	Mean Difference (IV, Random, 95% CI)	-0.15 [-2.28, 1.98]
7.1 During usual care	1	12	Mean Difference (IV, Random, 95% CI)	1.0 [-10.46, 12.46]
7.2 After usual care	4	306	Mean Difference (IV, Random, 95% CI)	-0.19 [-2.35, 1.98]
8 Risk factors - body mass index (BMI)	2	174	Mean Difference (IV, Random, 95% CI)	1.19 [-0.38, 2.76]
8.1 During usual care	0	0	Mean Difference (IV, Random, 95% CI)	0.0 [0.0, 0.0]
8.2 After usual care	2	174	Mean Difference (IV, Random, 95% CI)	1.19 [-0.38, 2.76]
9 Physical fitness - peak VO ₂	9	438	Mean Difference (IV, Random, 95% CI)	3.40 [2.98, 3.83]
9.1 During usual care	3	121	Mean Difference (IV, Random, 95% CI)	2.28 [0.75, 3.81]
9.2 After usual care	6	317	Mean Difference (IV, Random, 95% CI)	3.51 [3.06, 3.96]
10 Physical fitness - maximum cycling work rate	6	336	Mean Difference (IV, Random, 95% CI)	10.60 [1.88, 19.33]
10.1 During usual care	3	148	Mean Difference (IV, Random, 95% CI)	3.48 [-5.23, 12.19]
10.2 After usual care	3	188	Mean Difference (IV, Random, 95% CI)	13.37 [8.55, 18.19]
11 Mobility - functional ambulation categories	2	73	Mean Difference (IV, Random, 95% CI)	0.53 [0.21, 0.85]
11.1 During usual care	2	73	Mean Difference (IV, Random, 95% CI)	0.53 [0.21, 0.85]
11.2 After usual care	0	0	Mean Difference (IV, Random, 95% CI)	0.0 [0.0, 0.0]
12 Mobility - walking maximal speed (over 5 to 10 metres)	17	782	Mean Difference (IV, Random, 95% CI)	7.66 [3.65, 11.68]
12.1 During usual care	10	383	Mean Difference (IV, Random, 95% CI)	5.20 [0.48, 9.92]
12.2 After usual care	7	399	Mean Difference (IV, Random, 95% CI)	10.94 [7.13, 14.76]

Outcome or subgroup title	No. of studies	No. of participants	Statistical method	Effect size
13 Mobility - walking preferred speed	12	588	Mean Difference (IV, Random, 95% CI)	4.47 [2.07, 6.87]
13.1 During usual care	6	211	Mean Difference (IV, Random, 95% CI)	3.90 [-1.25, 9.05]
13.2 After usual care	6	377	Mean Difference (IV, Random, 95% CI)	4.69 [1.57, 7.80]
14 Mobility - walking capacity (6-MWT metres)	16	882	Mean Difference (IV, Random, 95% CI)	33.41 [19.04, 47.78]
14.1 During usual care	7	225	Mean Difference (IV, Random, 95% CI)	32.10 [10.11, 54.10]
14.2 After usual care	9	657	Mean Difference (IV, Random, 95% CI)	37.03 [15.54, 58.51]
15 Mobility - walking capacity (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 - community walk (min)	2	47	Mean Difference (IV, Random, 95% CI)	-10.54 [-14.11, -6.98]
16.1 During usual care	2	47	Mean Difference (IV, Random, 95% CI)	-10.54 [-14.11, -6.98]
16.2 After usual care	0	0	Mean Difference (IV, Random, 95% CI)	0.0 [0.0, 0.0]
17 Physical function - Berg Balance Scale (score 0 to 56)	8	471	Mean Difference (IV, Random, 95% CI)	1.92 [0.16, 3.68]
17.1 During usual care	3	160	Mean Difference (IV, Random, 95% CI)	0.79 [-2.01, 3.59]
17.2 After usual care	5	311	Mean Difference (IV, Random, 95% CI)	2.67 [0.07, 5.26]
18 Physical function - Timed Up and Go (sec)	5	223	Mean Difference (IV, Random, 95% CI)	-3.42 [-4.78, -2.05]
18.1 During usual care	1	20	Mean Difference (IV, Random, 95% CI)	-2.10 [-6.27, 2.07]
18.2 After usual care	4	203	Mean Difference (IV, Random, 95% CI)	-3.58 [-5.02, -2.13]

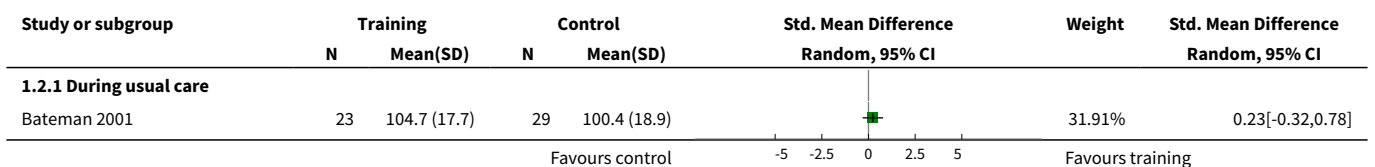
Outcome or subgroup title	No. of studies	No. of participants	Statistical method	Effect size
19 Health-related QoL - SF-36 & SF-12 Physical Health Component	2	164	Std. Mean Difference (IV, Random, 95% CI)	0.51 [0.20, 0.82]
19.1 During usual care	0	0	Std. Mean Difference (IV, Random, 95% CI)	0.0 [0.0, 0.0]
19.2 After usual care	2	164	Std. Mean Difference (IV, Random, 95% CI)	0.51 [0.20, 0.82]
20 Health-related QoL - SF-36 & SF-12 Mental Health Component	2	164	Std. Mean Difference (IV, Random, 95% CI)	0.58 [-0.52, 1.68]
20.1 During usual care	0	0	Std. Mean Difference (IV, Random, 95% CI)	0.0 [0.0, 0.0]
20.2 After usual care	2	164	Std. Mean Difference (IV, Random, 95% CI)	0.58 [-0.52, 1.68]
21 Health-related QoL - EuroQol EQ-5D	2	158	Mean Difference (IV, Random, 95% CI)	6.55 [-1.36, 14.47]
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	158	Mean Difference (IV, Random, 95% CI)	6.55 [-1.36, 14.47]
22 Mood - Beck Depression Index	2	56	Mean Difference (IV, Random, 95% CI)	-1.22 [-5.62, 3.19]
22.1 During usual care	0	0	Mean Difference (IV, Random, 95% CI)	0.0 [0.0, 0.0]
22.2 After usual care	2	56	Mean Difference (IV, Random, 95% CI)	-1.22 [-5.62, 3.19]

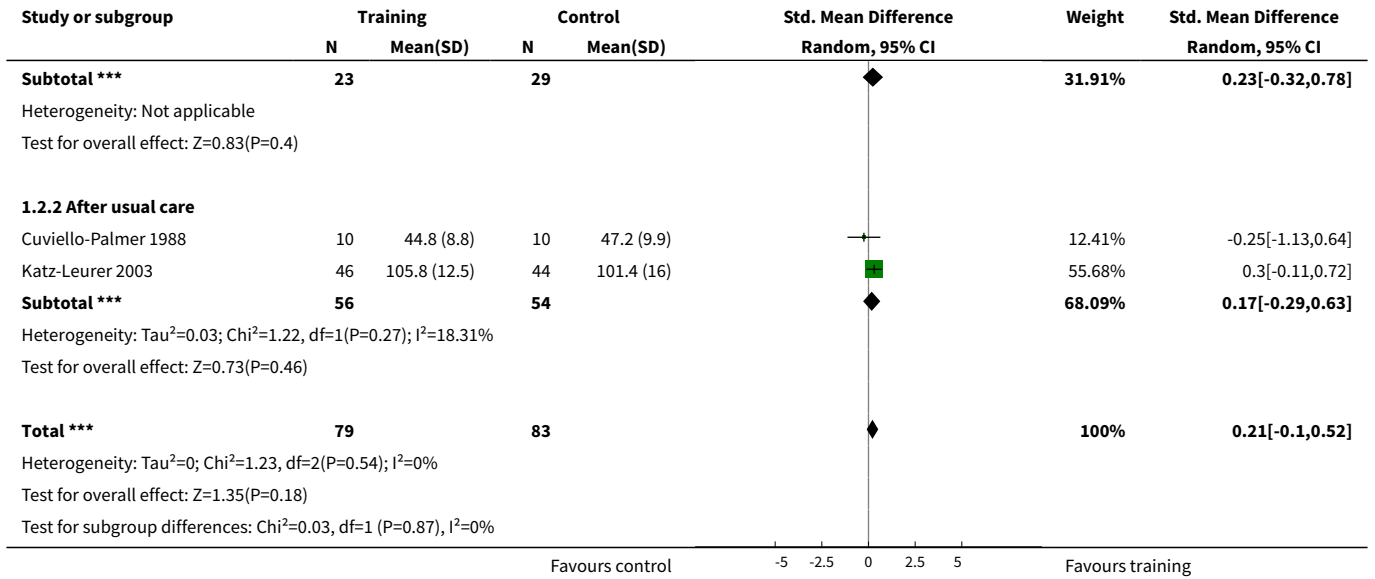
Analysis 1.1. Comparison 1 Cardiorespiratory training versus control - end of intervention, Outcome 1 Death.



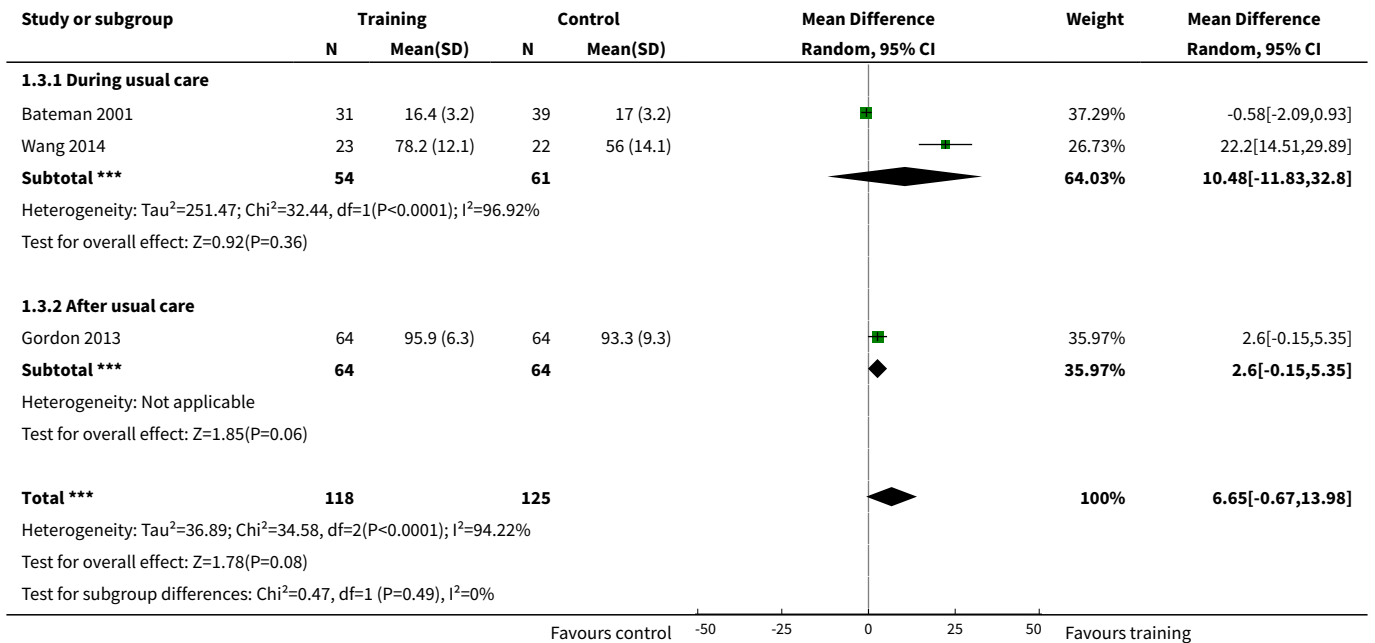


Analysis 1.2. Comparison 1 Cardiorespiratory training versus control - end of intervention, Outcome 2 Disability - Functional Independence Measure.

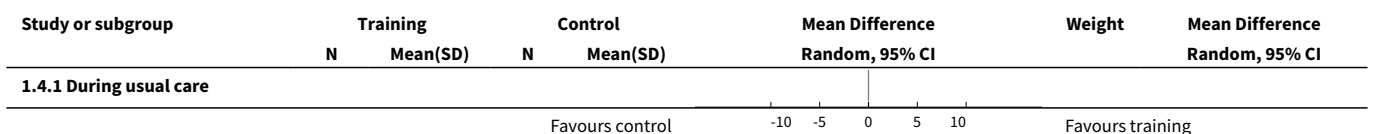


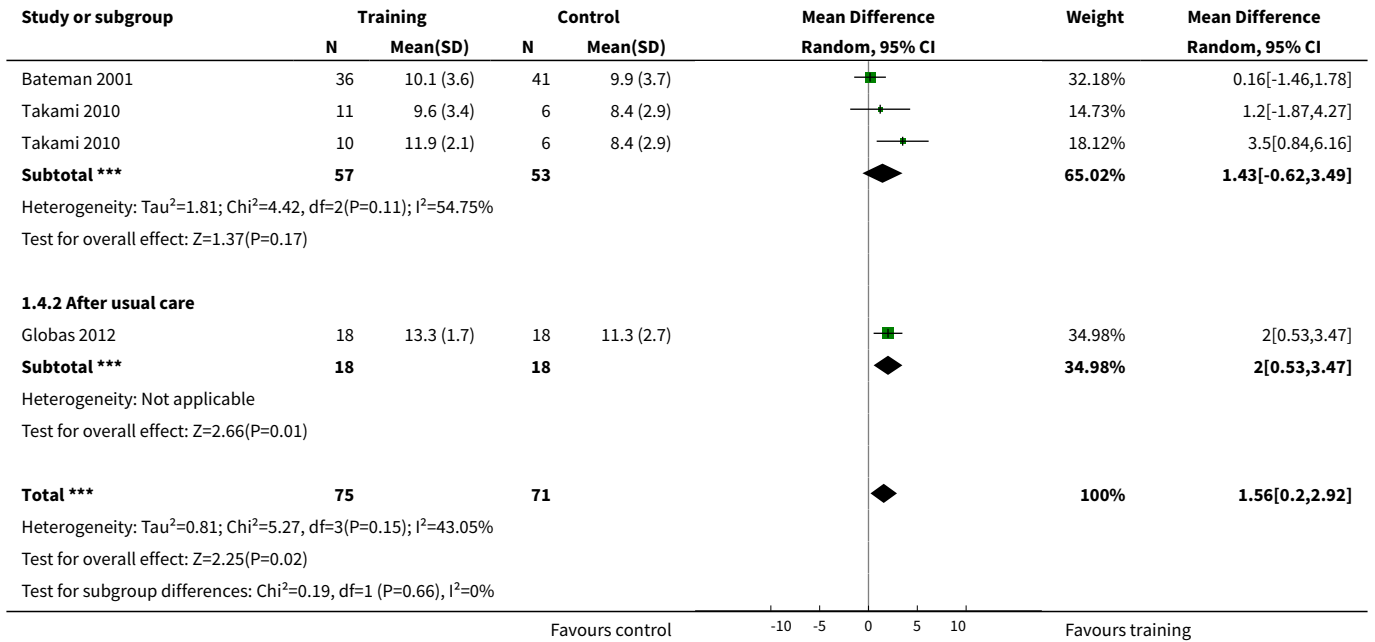


Analysis 1.3. Comparison 1 Cardiorespiratory training versus control - end of intervention, Outcome 3 Disability - Barthel Index.

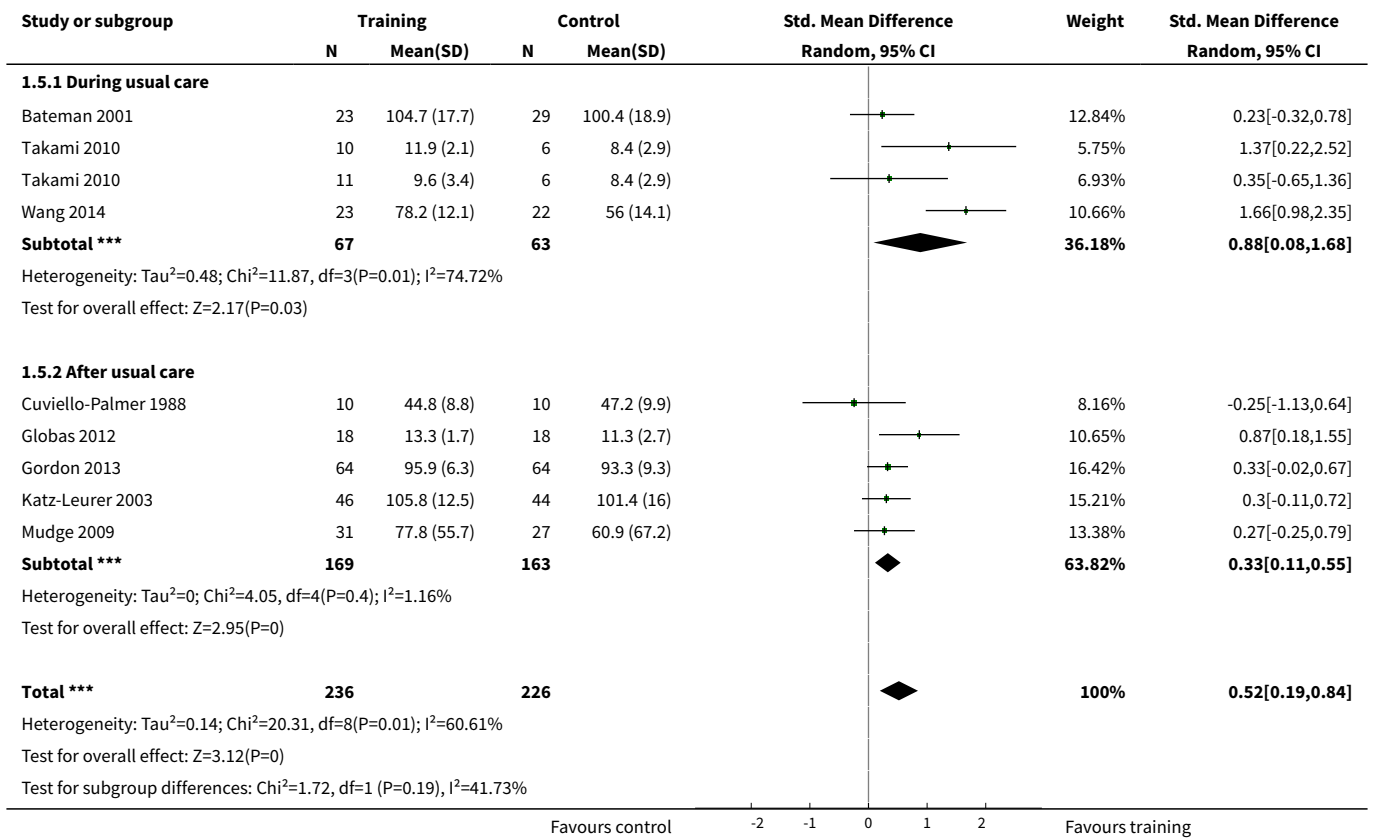


Analysis 1.4. Comparison 1 Cardiorespiratory training versus control - end of intervention, Outcome 4 Disability - Rivermead Mobility Index (scale 0 to 15).

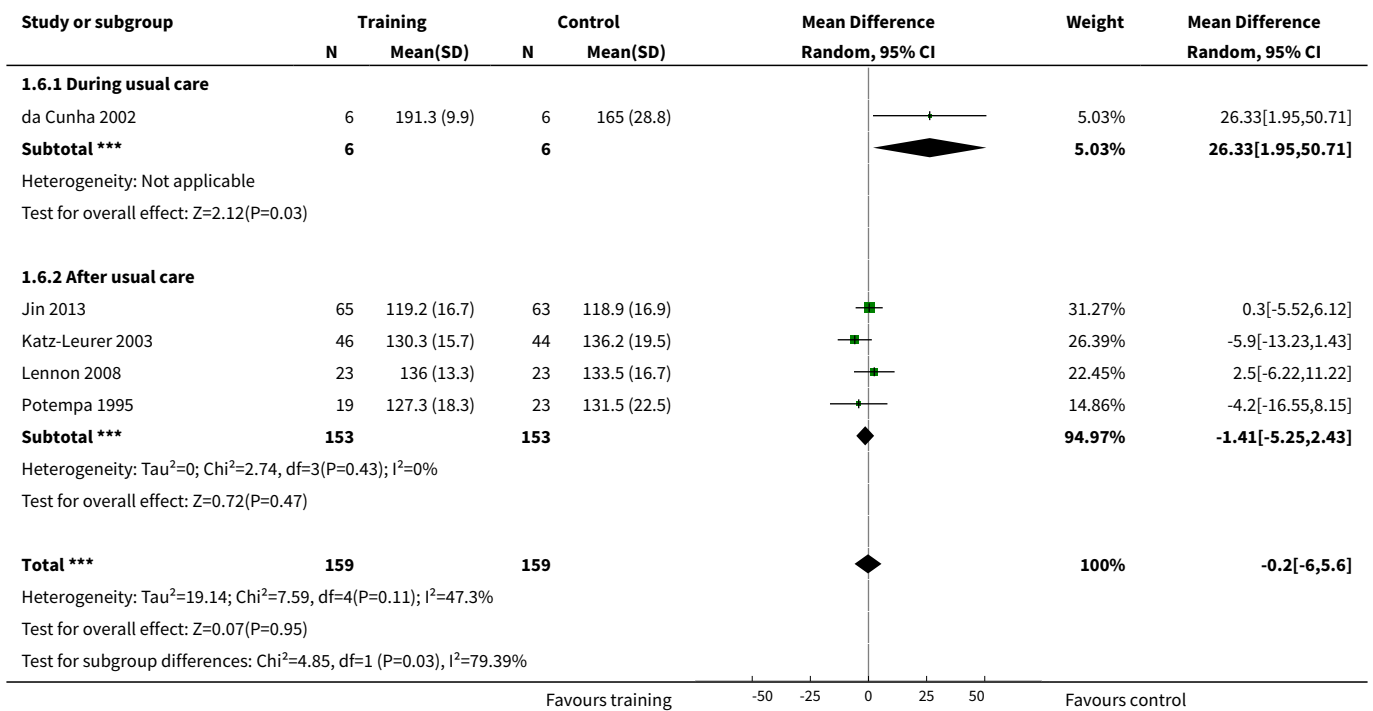




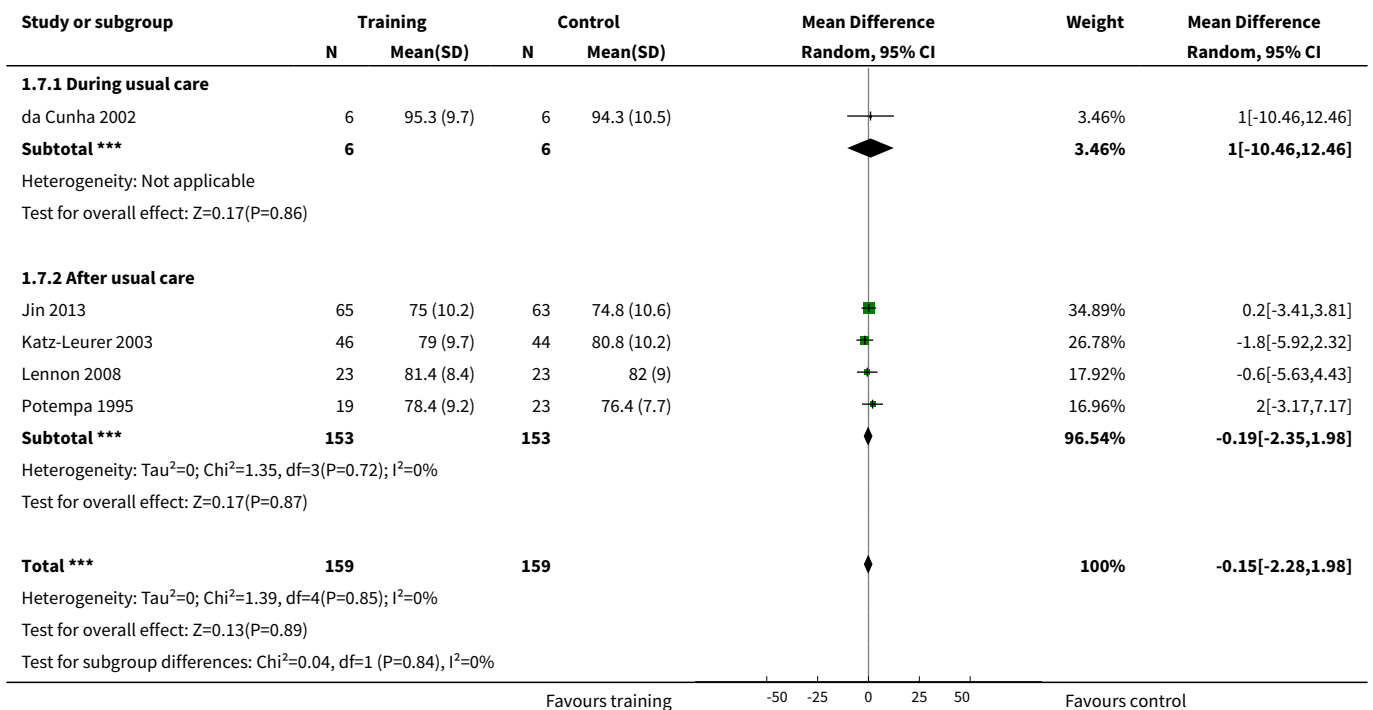
Analysis 1.5. Comparison 1 Cardiorespiratory training versus control - end of intervention, Outcome 5 Disability - combined disability scales.



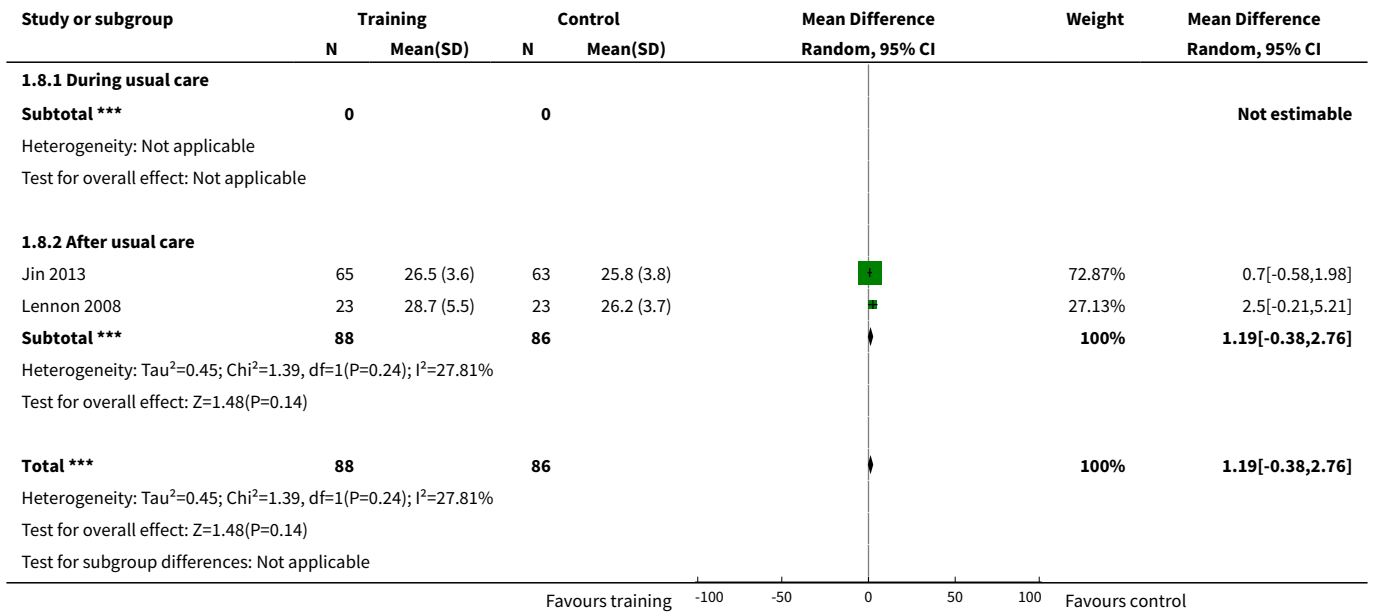
Analysis 1.6. Comparison 1 Cardiorespiratory training versus control - end of intervention, Outcome 6 Risk factors - blood pressure, systolic.



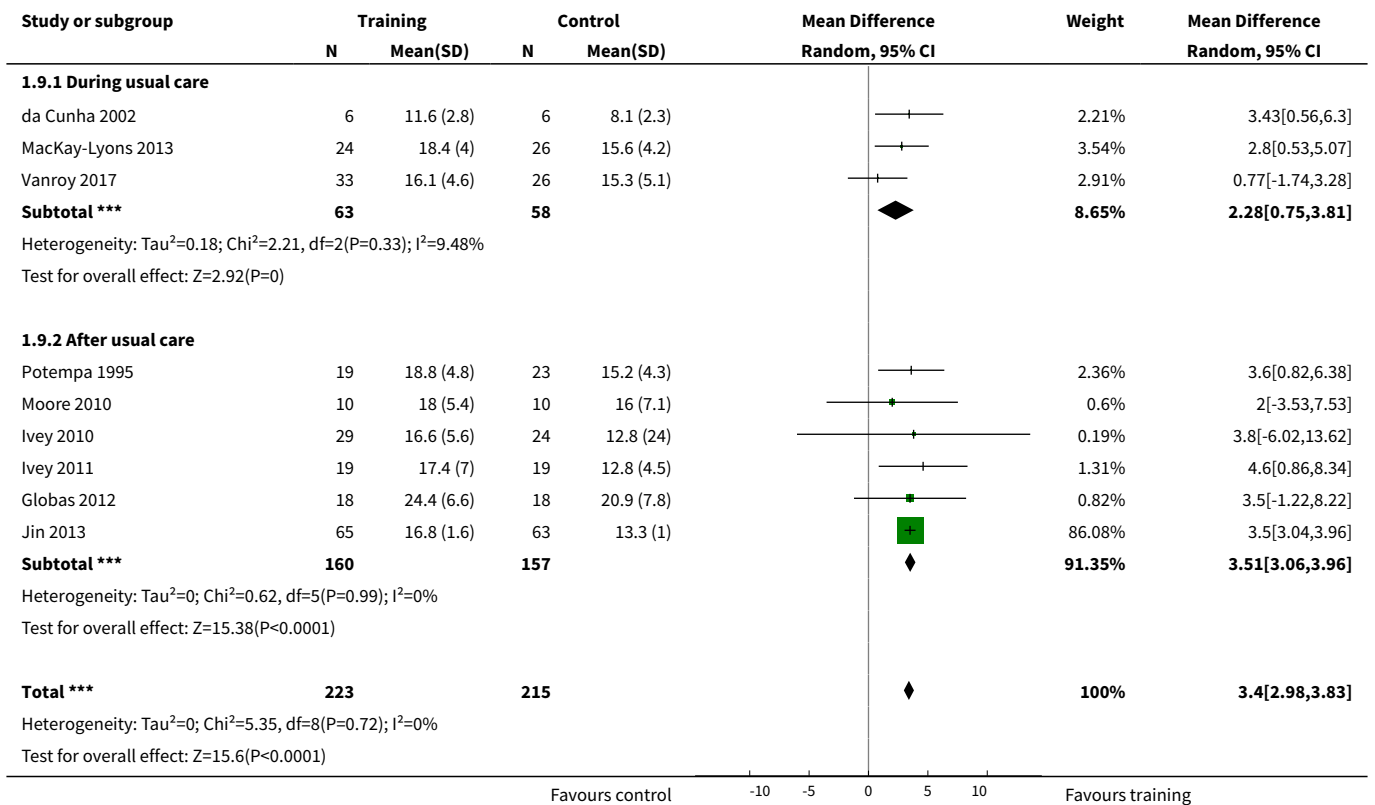
Analysis 1.7. Comparison 1 Cardiorespiratory training versus control - end of intervention, Outcome 7 Risk factors - blood pressure, diastolic.

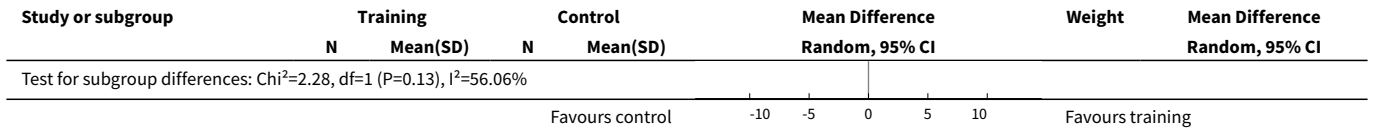


Analysis 1.8. Comparison 1 Cardiorespiratory training versus control - end of intervention, Outcome 8 Risk factors - body mass index (BMI).

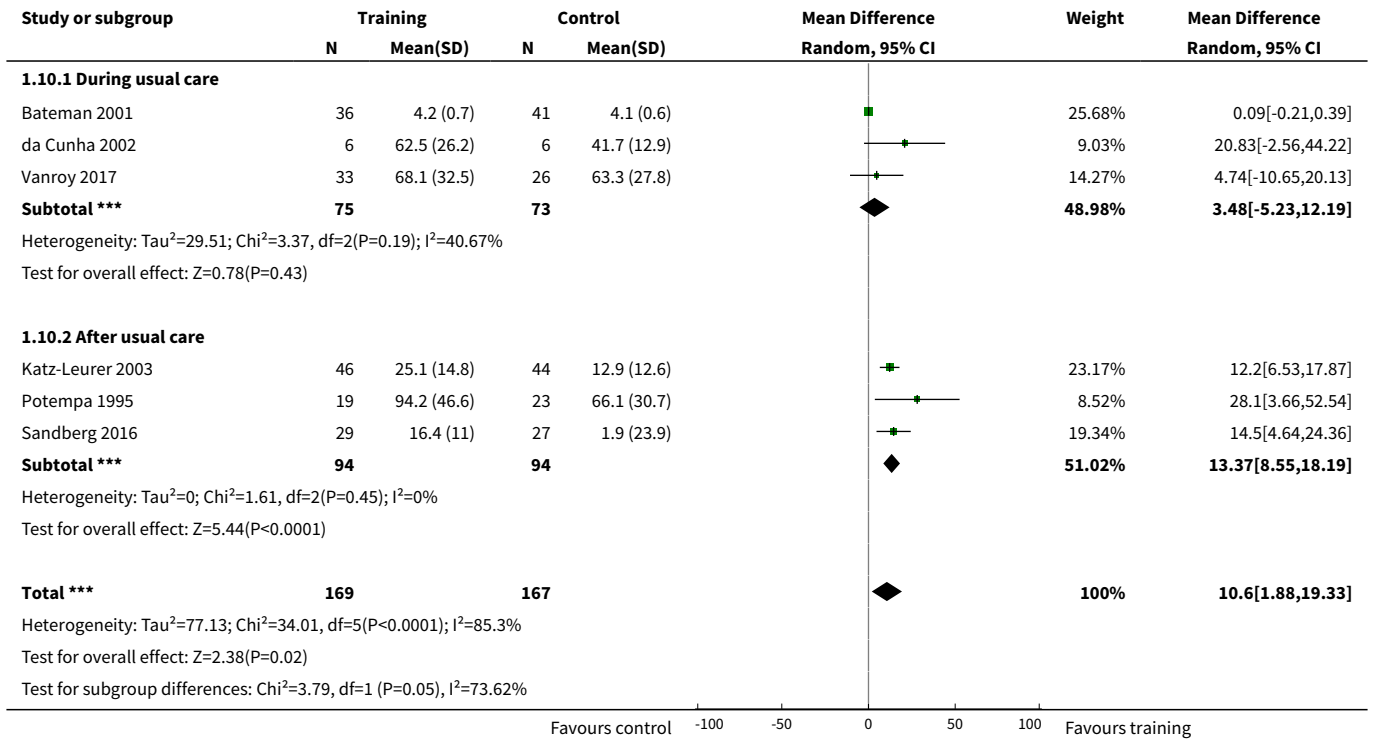


Analysis 1.9. Comparison 1 Cardiorespiratory training versus control - end of intervention, Outcome 9 Physical fitness - peak VO₂.

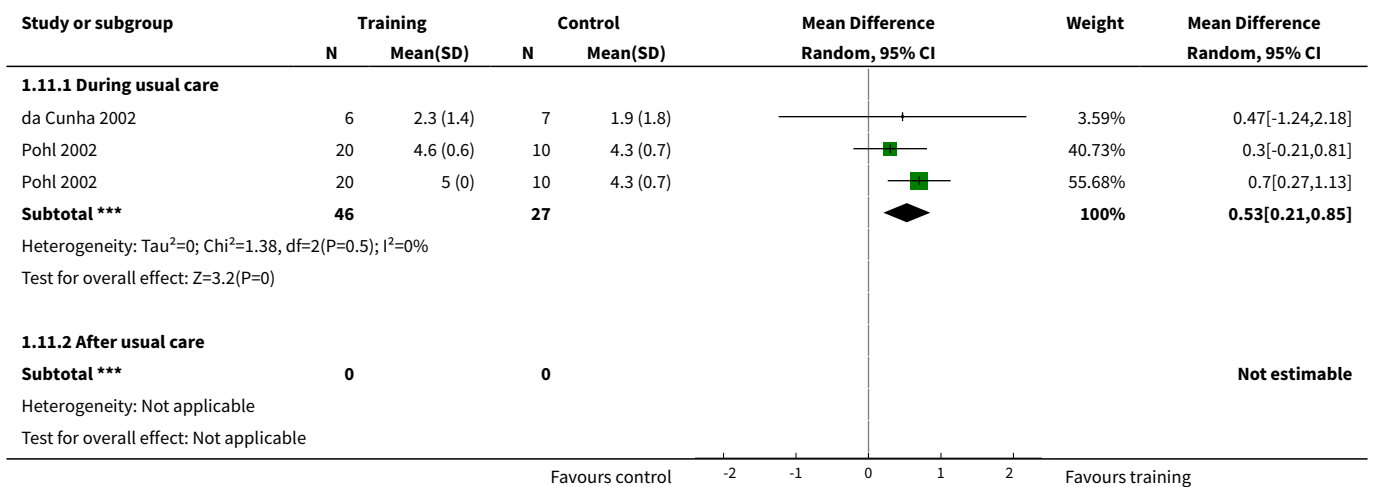


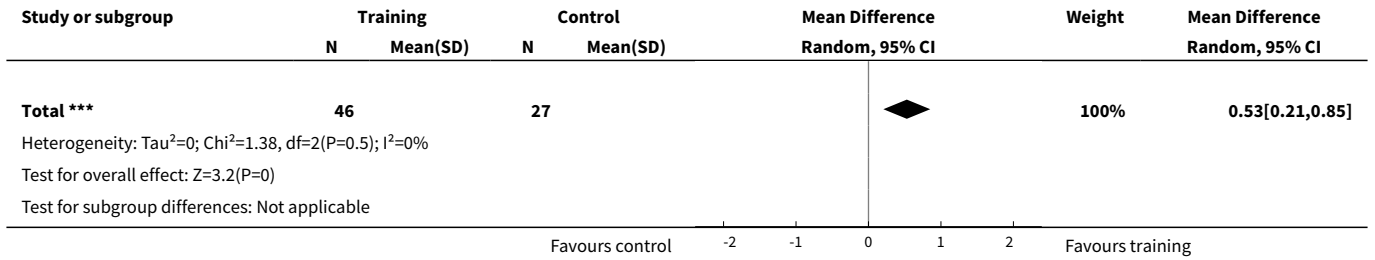


Analysis 1.10. Comparison 1 Cardiorespiratory training versus control - end of intervention, Outcome 10 Physical fitness - maximum cycling work rate.

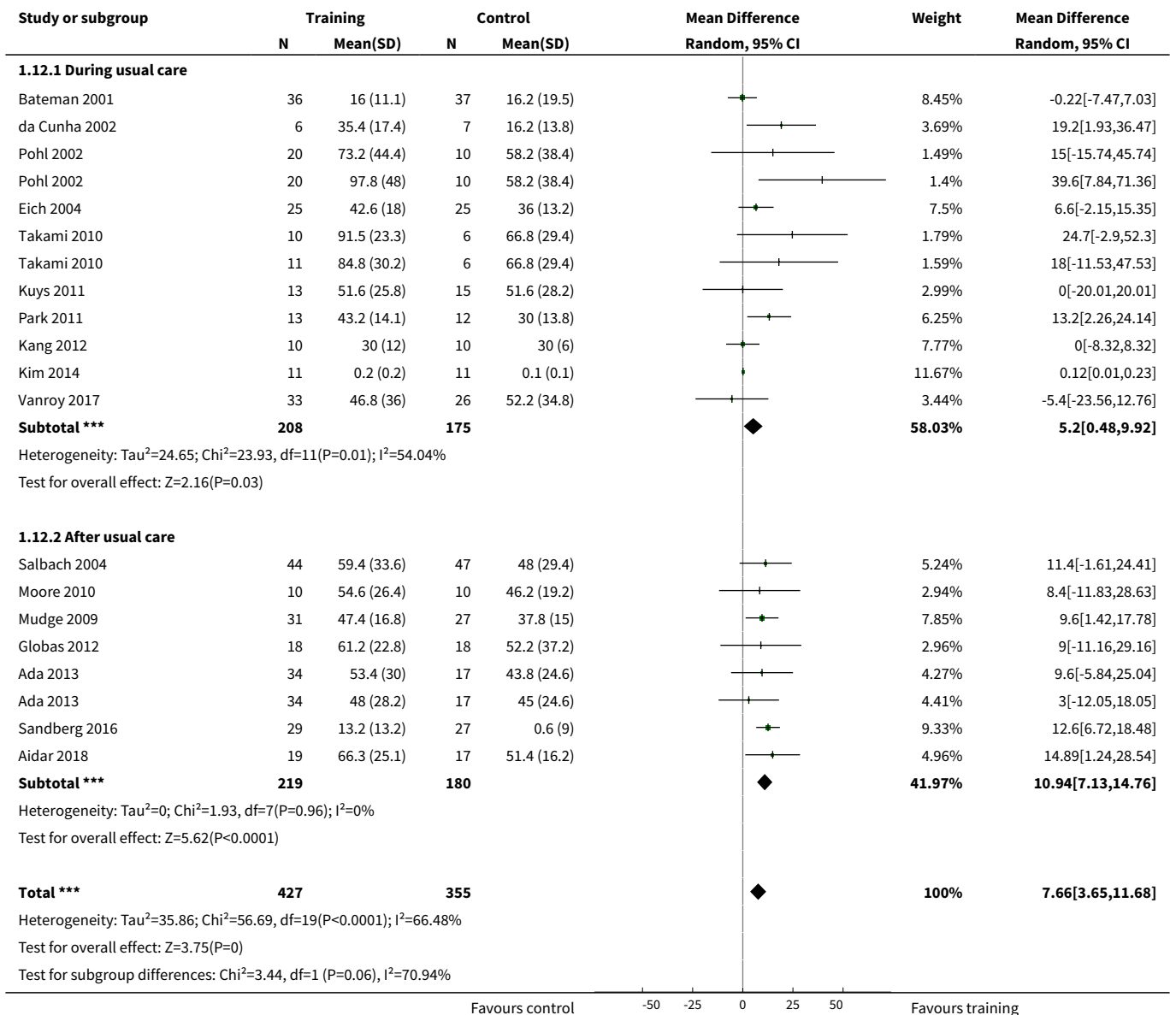


Analysis 1.11. Comparison 1 Cardiorespiratory training versus control - end of intervention, Outcome 11 Mobility - functional ambulation categories.

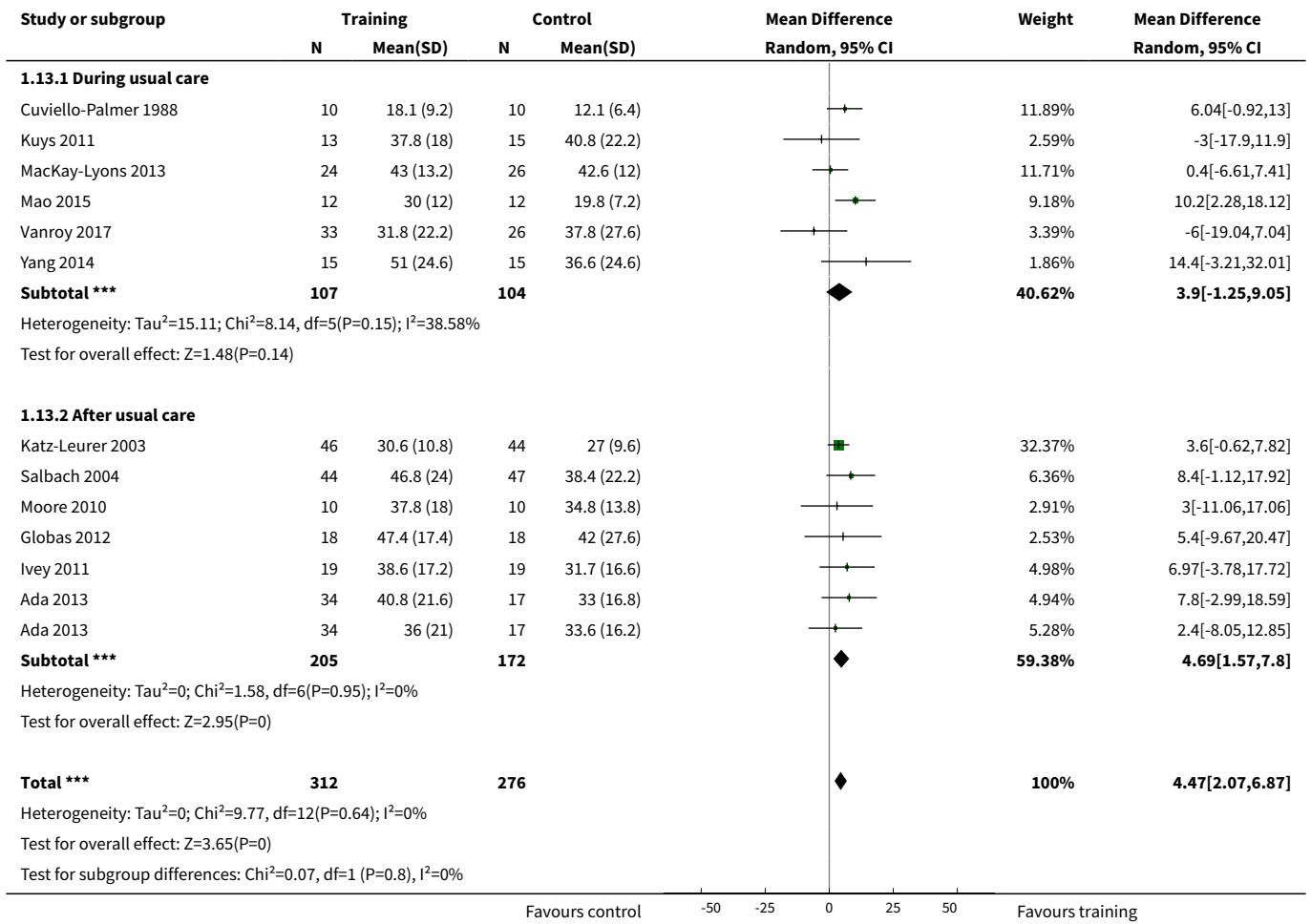




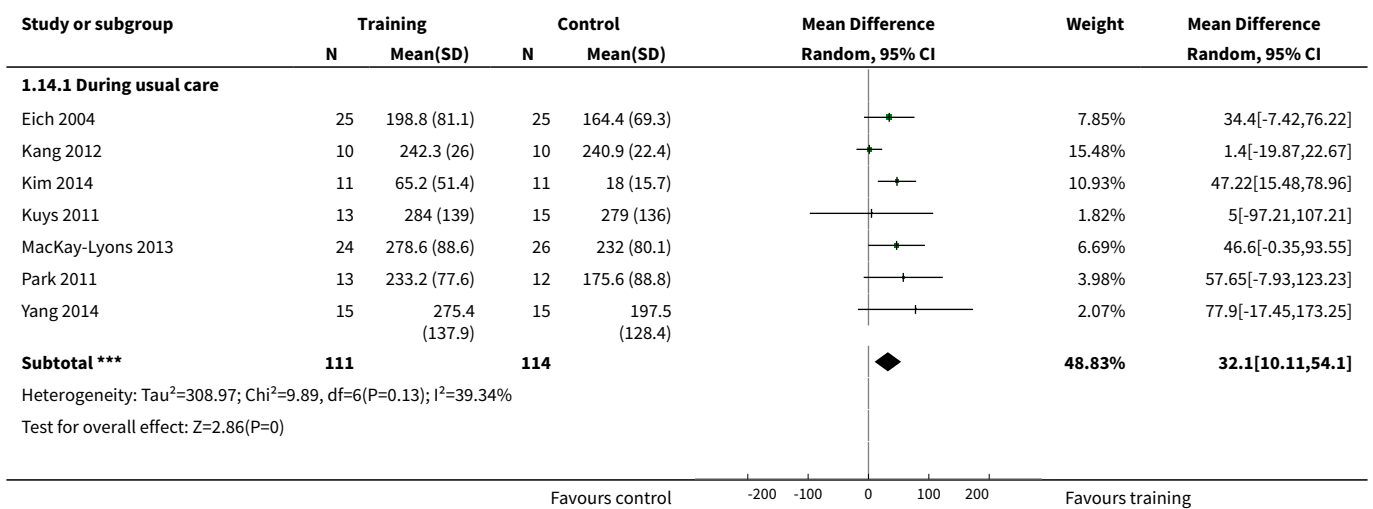
Analysis 1.12. Comparison 1 Cardiorespiratory training versus control - end of intervention, Outcome 12 Mobility - walking maximal speed (over 5 to 10 metres).

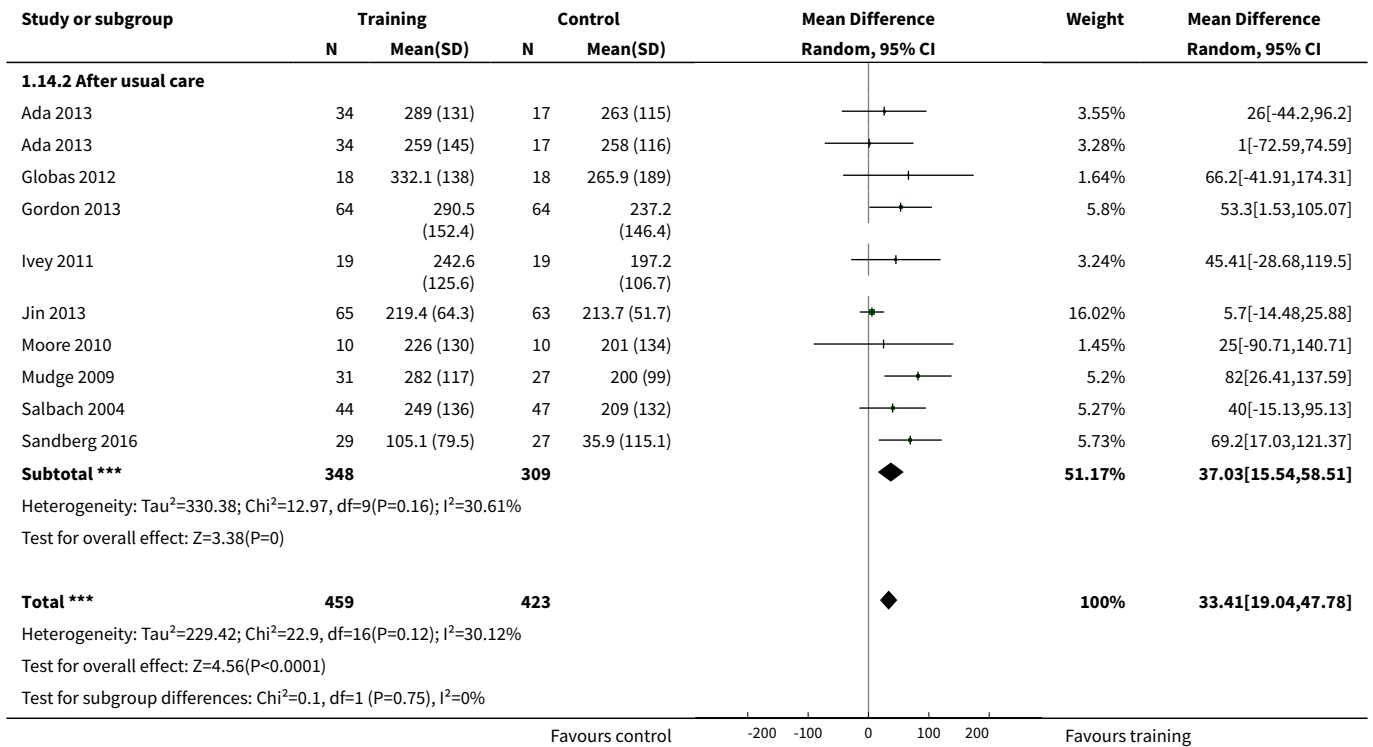


Analysis 1.13. Comparison 1 Cardiorespiratory training versus control - end of intervention, Outcome 13 Mobility - walking preferred speed.

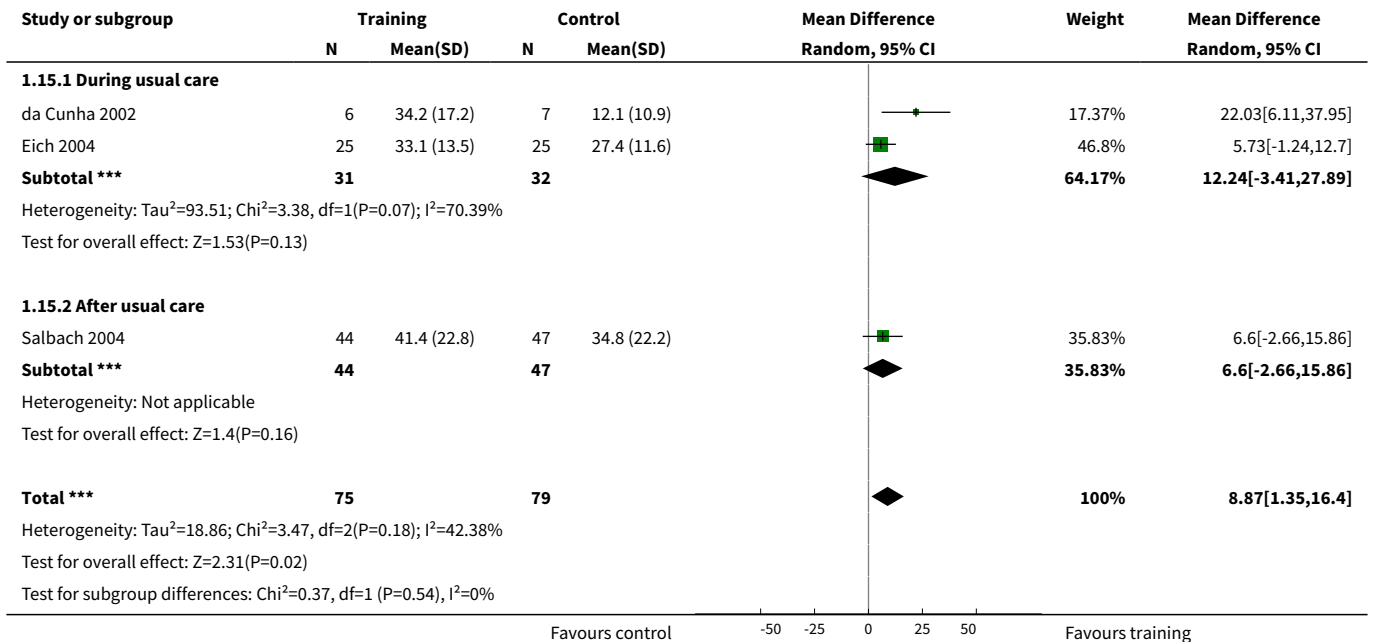


Analysis 1.14. Comparison 1 Cardiorespiratory training versus control - end of intervention, Outcome 14 Mobility - walking capacity (6-MWT metres).

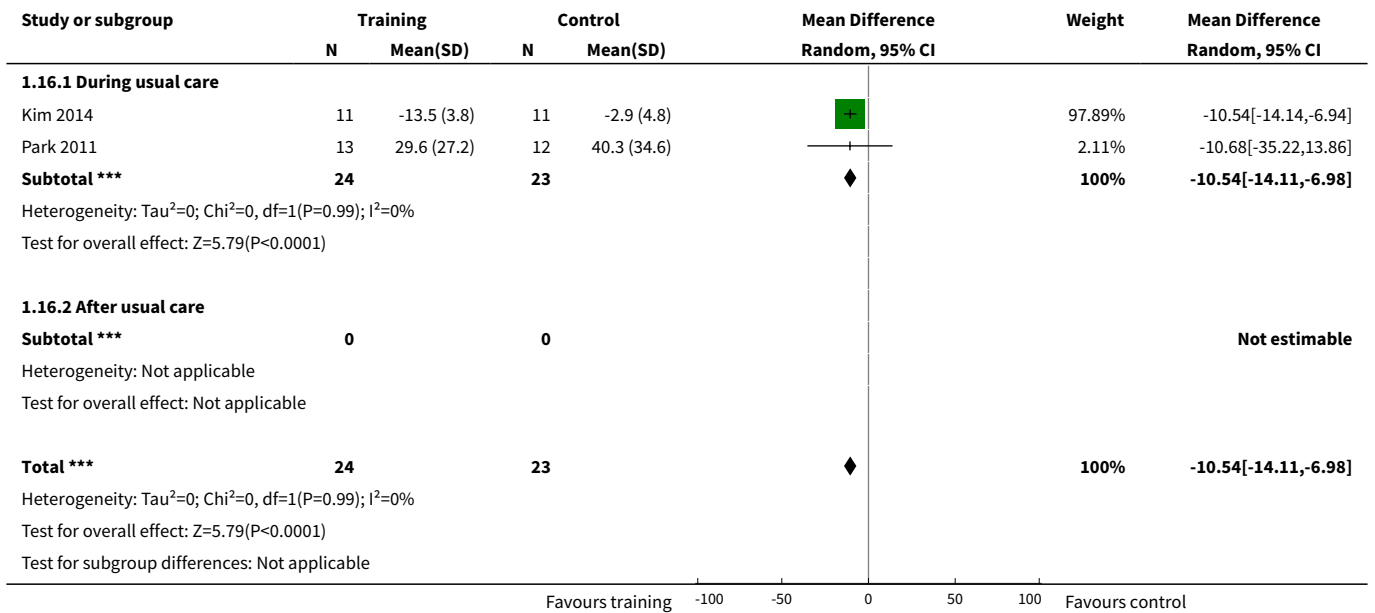




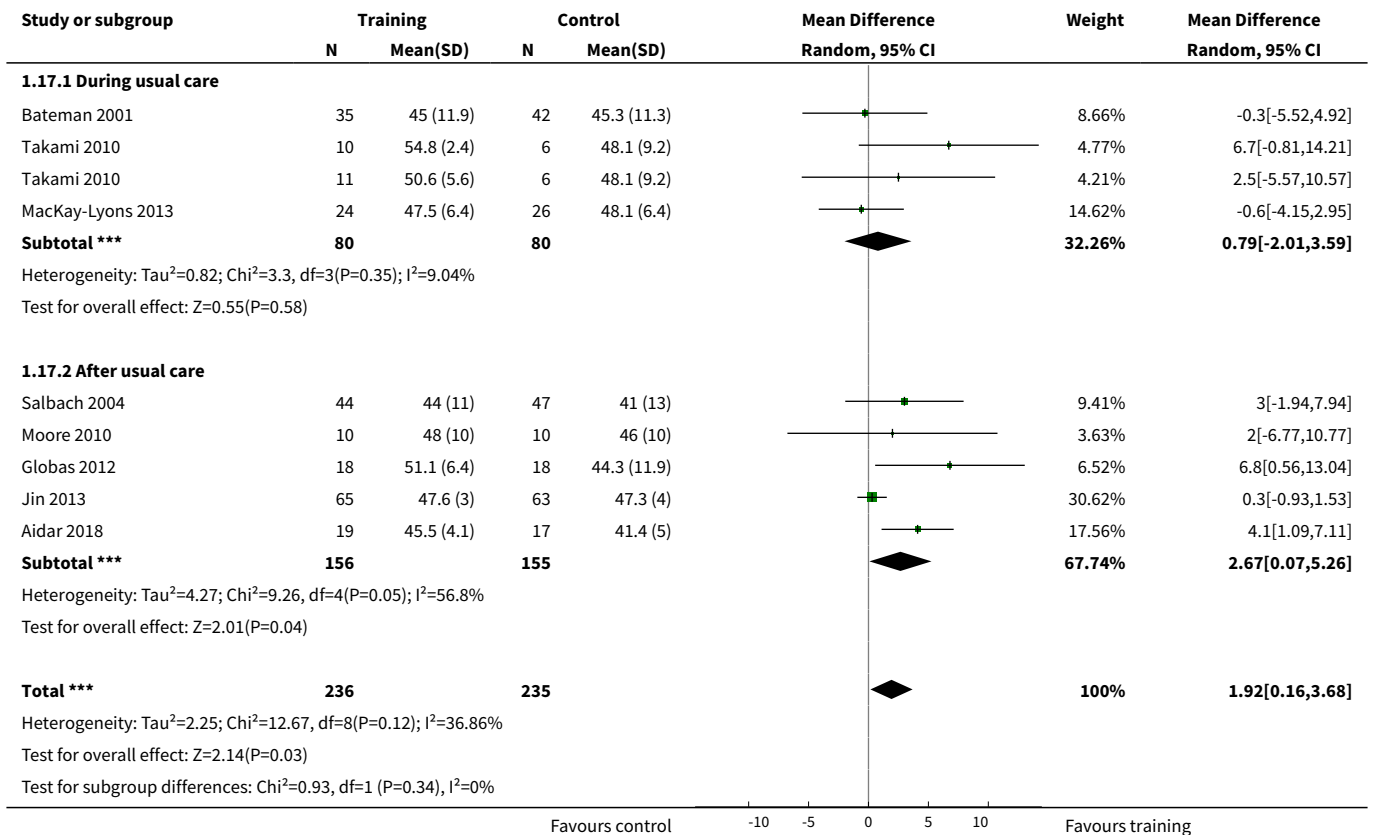
Analysis 1.15. Comparison 1 Cardiorespiratory training versus control - end of intervention, Outcome 15 Mobility - walking capacity (m/min).



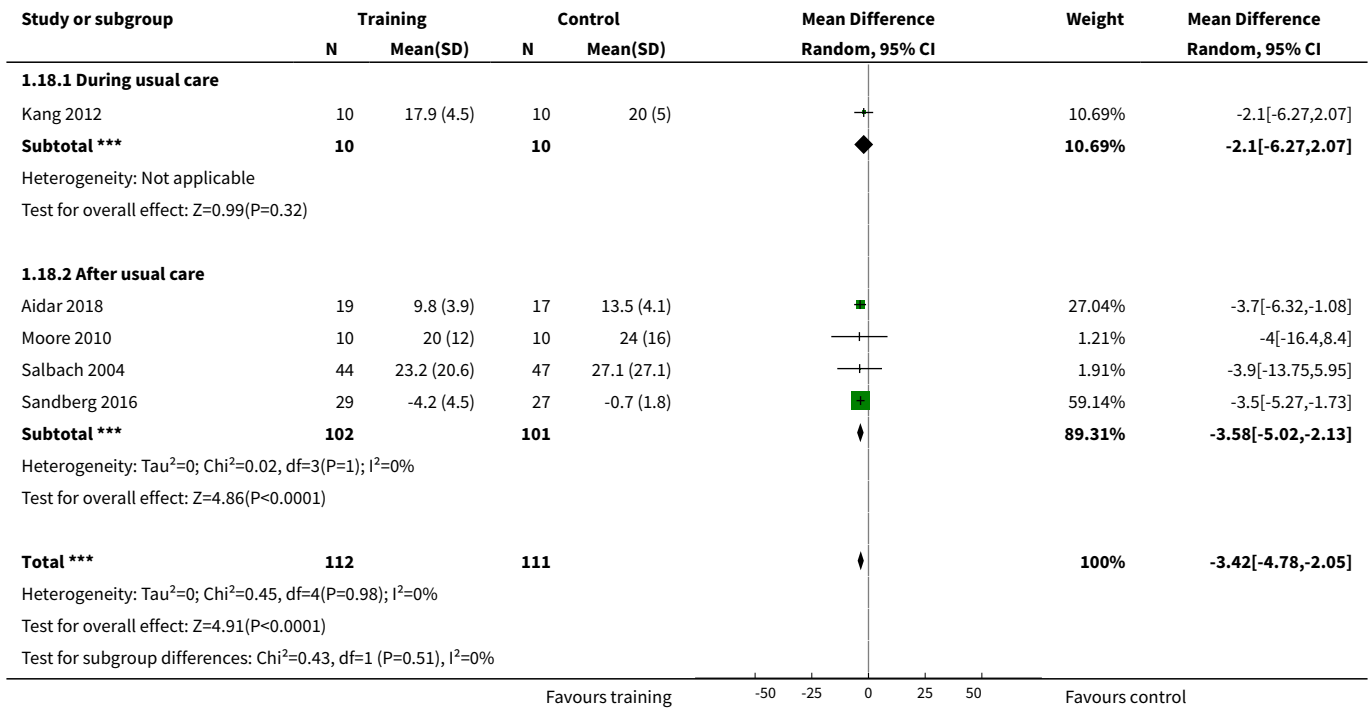
Analysis 1.16. Comparison 1 Cardiorespiratory training versus control - end of intervention, Outcome 16 Mobility - community walk (min).



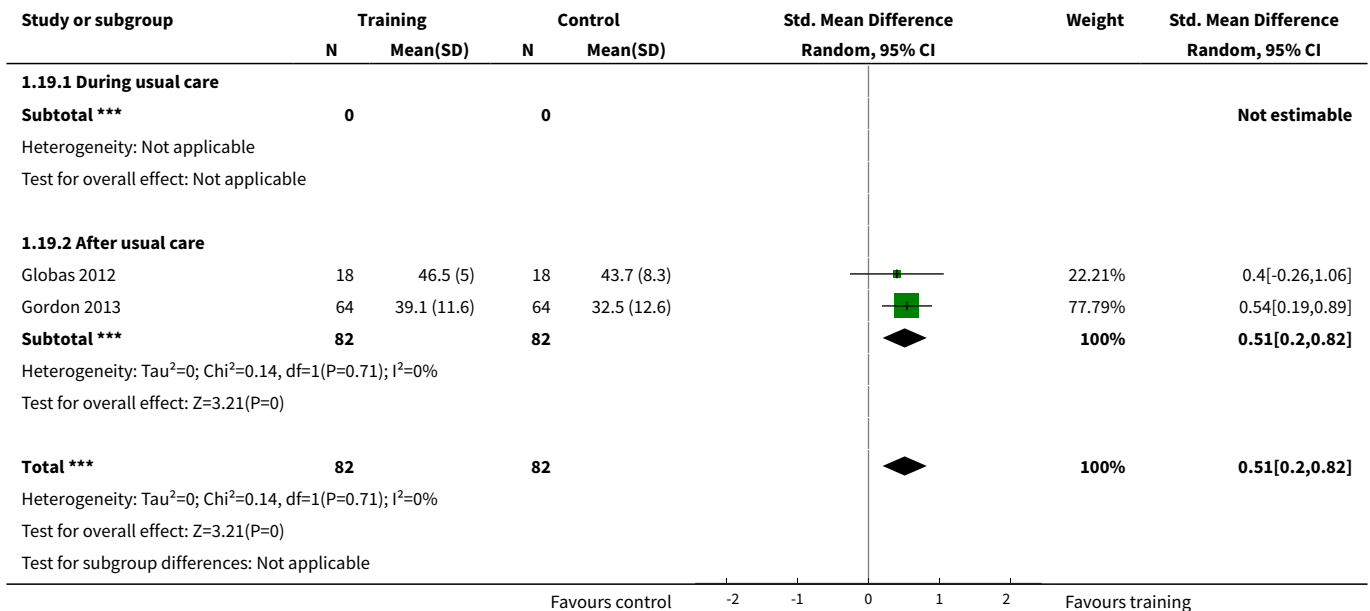
Analysis 1.17. Comparison 1 Cardiorespiratory training versus control - end of intervention, Outcome 17 Physical function - Berg Balance Scale (score 0 to 56).



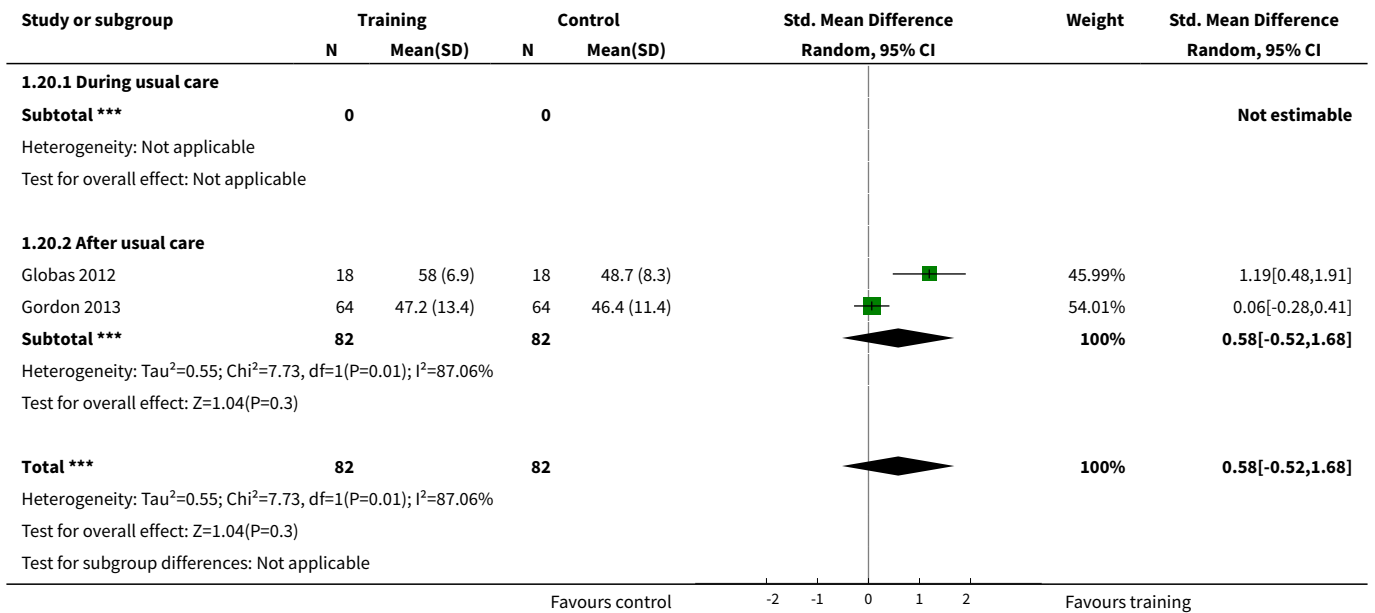
Analysis 1.18. Comparison 1 Cardiorespiratory training versus control - end of intervention, Outcome 18 Physical function - Timed Up and Go (sec).



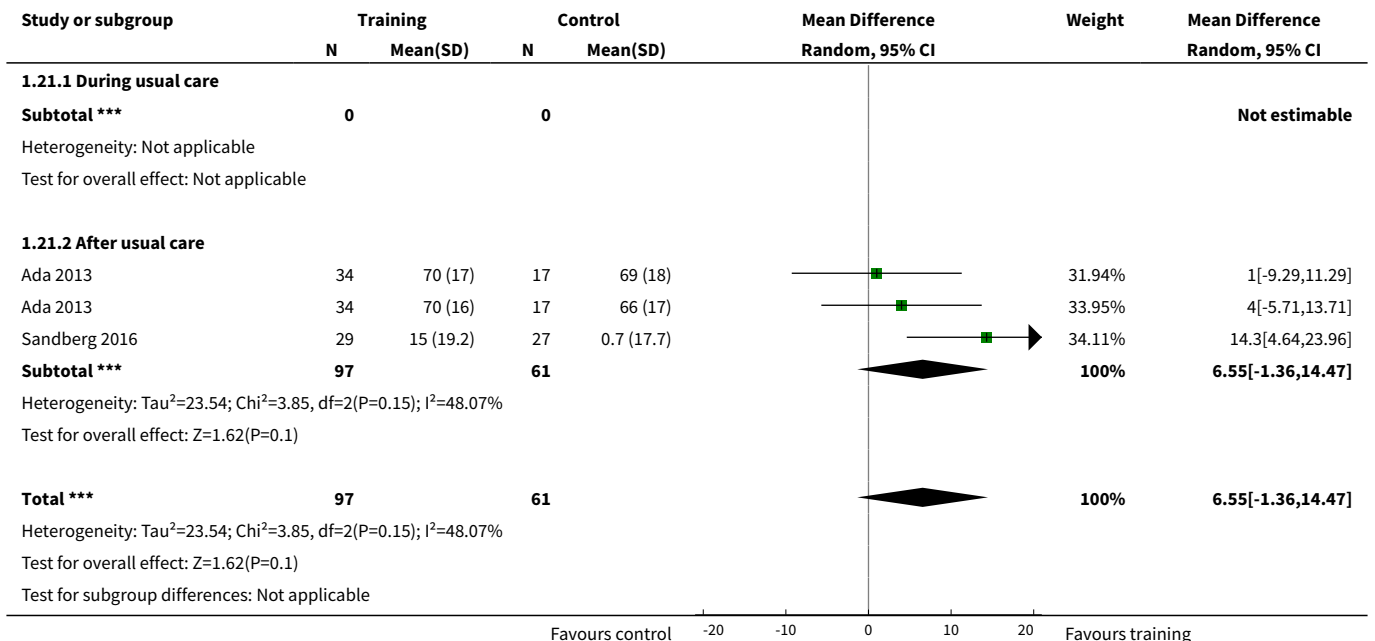
Analysis 1.19. Comparison 1 Cardiorespiratory training versus control - end of intervention, Outcome 19 Health-related QoL - SF-36 & SF-12 Physical Health Component.



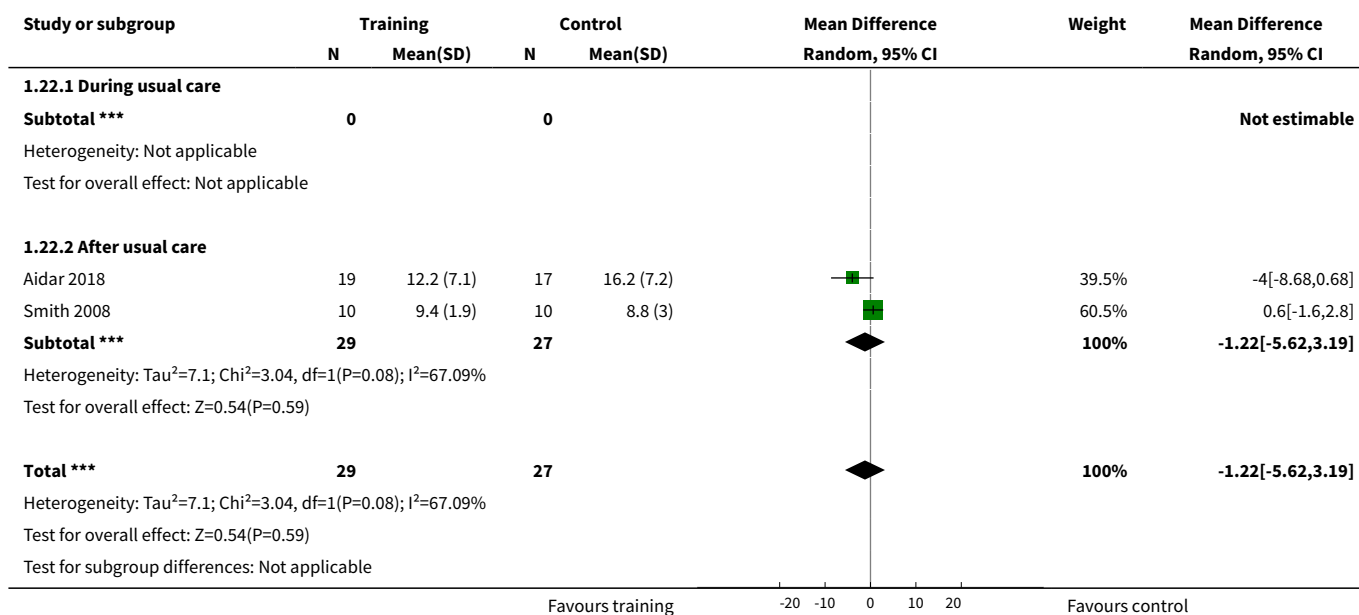
Analysis 1.20. Comparison 1 Cardiorespiratory training versus control - end of intervention, Outcome 20 Health-related QoL - SF-36 & SF-12 Mental Health Component.



Analysis 1.21. Comparison 1 Cardiorespiratory training versus control - end of intervention, Outcome 21 Health-related QoL - EuroQol EQ-5D.



Analysis 1.22. Comparison 1 Cardiorespiratory training versus control - end of intervention, Outcome 22 Mood - Beck Depression Index.

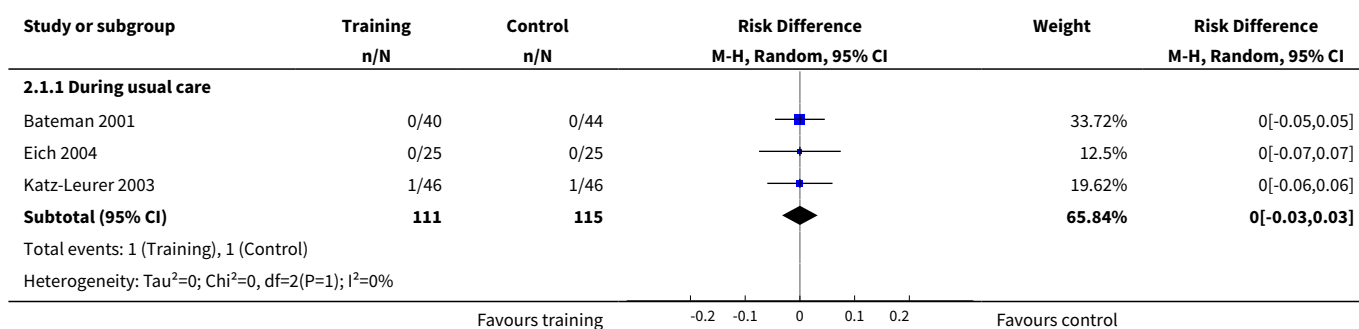


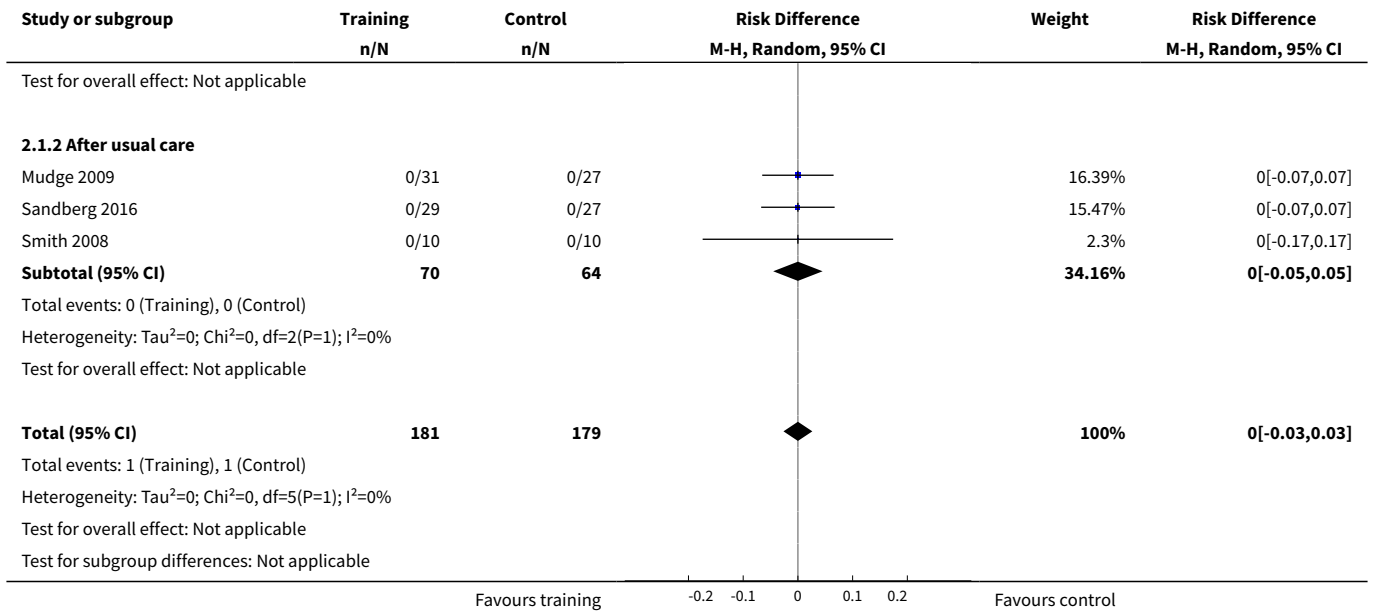
Comparison 2. Cardiorespiratory training versus control - end of retention follow-up

Outcome or subgroup title	No. of studies	No. of participants	Statistical method	Effect size
1 Death	6	360	Risk Difference (M-H, Random, 95% CI)	0.0 [-0.03, 0.03]
1.1 During usual care	3	226	Risk Difference (M-H, Random, 95% CI)	0.0 [-0.03, 0.03]
1.2 After usual care	3	134	Risk Difference (M-H, Random, 95% CI)	0.0 [-0.05, 0.05]
2 Disability - combined disability scales	3	220	Std. Mean Difference (IV, Random, 95% CI)	0.20 [-0.07, 0.46]
2.1 During usual care	1	83	Std. Mean Difference (IV, Random, 95% CI)	0.18 [-0.26, 0.61]
2.2 After usual care	2	137	Std. Mean Difference (IV, Random, 95% CI)	0.21 [-0.12, 0.55]
3 Mobility - walking maximal speed (m/min)	5	312	Mean Difference (IV, Random, 95% CI)	6.71 [2.40, 11.02]
3.1 During usual care	3	152	Mean Difference (IV, Random, 95% CI)	7.92 [2.01, 13.83]

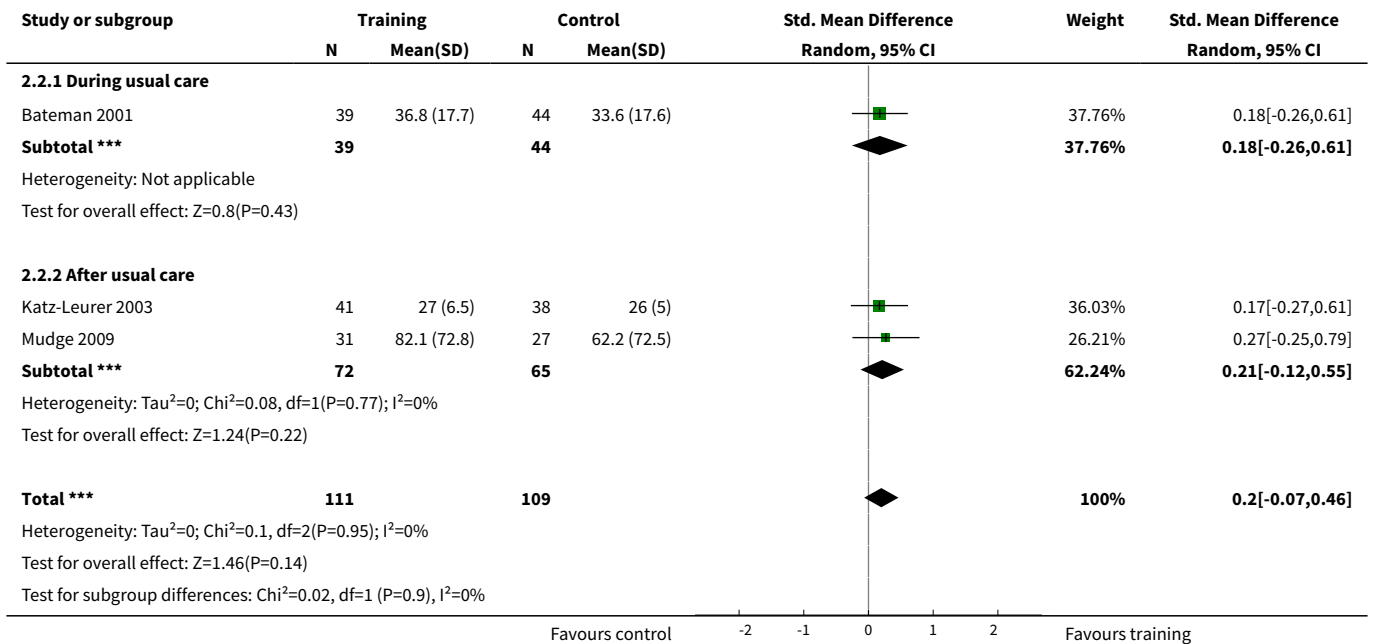
Outcome or subgroup title	No. of studies	No. of participants	Statistical method	Effect size
3.2 After usual care	2	160	Mean Difference (IV, Random, 95% CI)	5.33 [-0.96, 11.63]
4 Mobility - walking preferred speed (m/min)	3	176	Mean Difference (IV, Random, 95% CI)	1.67 [-3.27, 6.62]
4.1 During usual care	2	74	Mean Difference (IV, Random, 95% CI)	2.54 [-3.65, 8.73]
4.2 After usual care	1	102	Mean Difference (IV, Random, 95% CI)	0.14 [-8.08, 8.37]
5 Mobility - walking capacity (6-MWT metres)	5	283	Mean Difference (IV, Random, 95% CI)	38.29 [7.19, 69.39]
5.1 During usual care	3	123	Mean Difference (IV, Random, 95% CI)	50.76 [19.09, 82.43]
5.2 After usual care	2	160	Mean Difference (IV, Random, 95% CI)	22.34 [-44.02, 88.69]
6 Physical function - Berg Balance scale	2	134	Mean Difference (IV, Random, 95% CI)	0.04 [-2.48, 2.56]
6.1 During usual care	2	134	Mean Difference (IV, Random, 95% CI)	0.04 [-2.48, 2.56]
6.2 After usual care	0	0	Mean Difference (IV, Random, 95% CI)	0.0 [0.0, 0.0]
7 Health-related QoL - EuroQol EQ-5D	2	150	Mean Difference (IV, Random, 95% CI)	-4.25 [-8.00, 1.49]
7.1 During usual care	0	0	Mean Difference (IV, Random, 95% CI)	0.0 [0.0, 0.0]
7.2 After usual care	2	150	Mean Difference (IV, Random, 95% CI)	-4.25 [-8.00, 1.49]

Analysis 2.1. Comparison 2 Cardiorespiratory training versus control - end of retention follow-up, Outcome 1 Death.

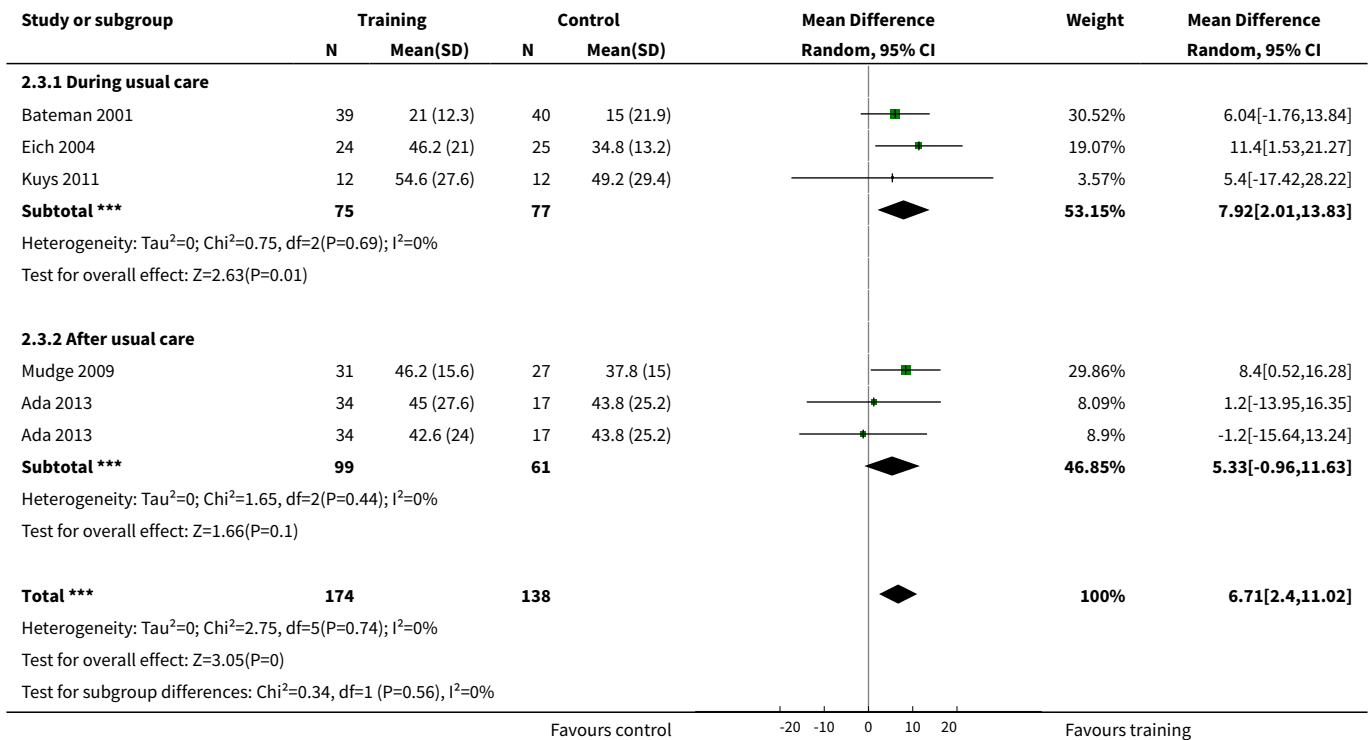




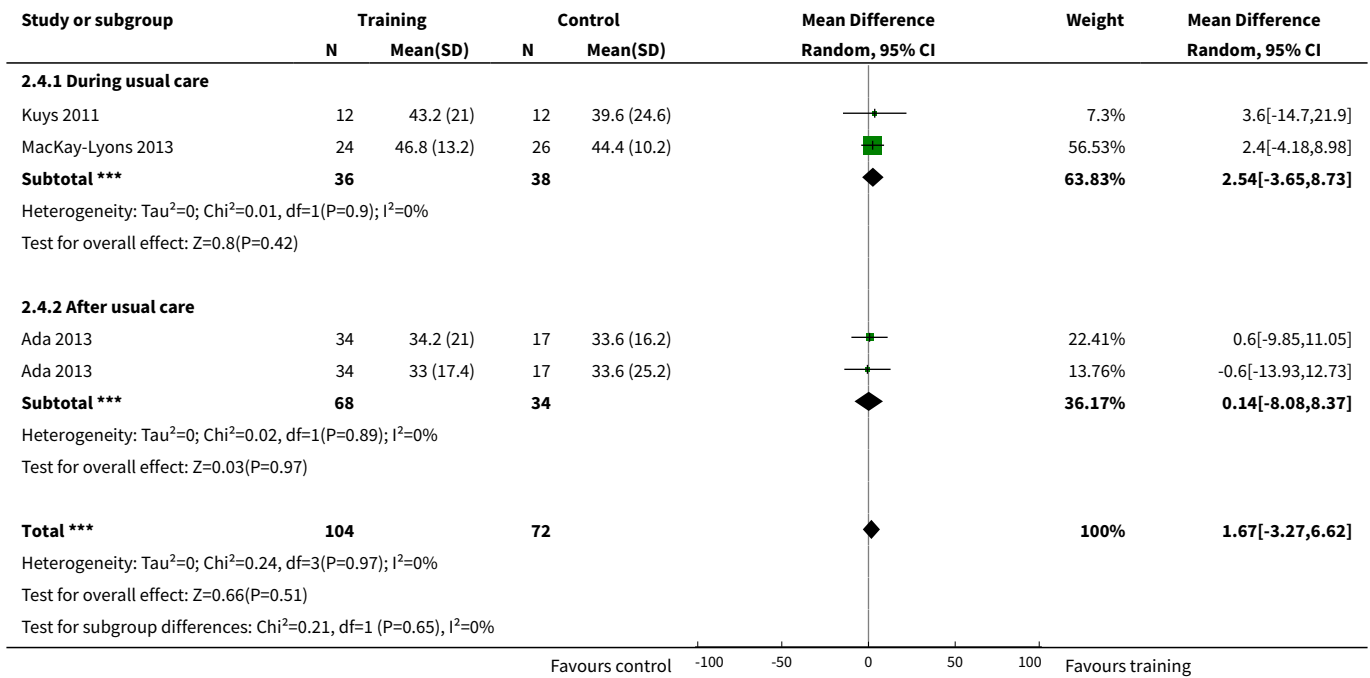
Analysis 2.2. Comparison 2 Cardiorespiratory training versus control - end of retention follow-up, Outcome 2 Disability - combined disability scales.



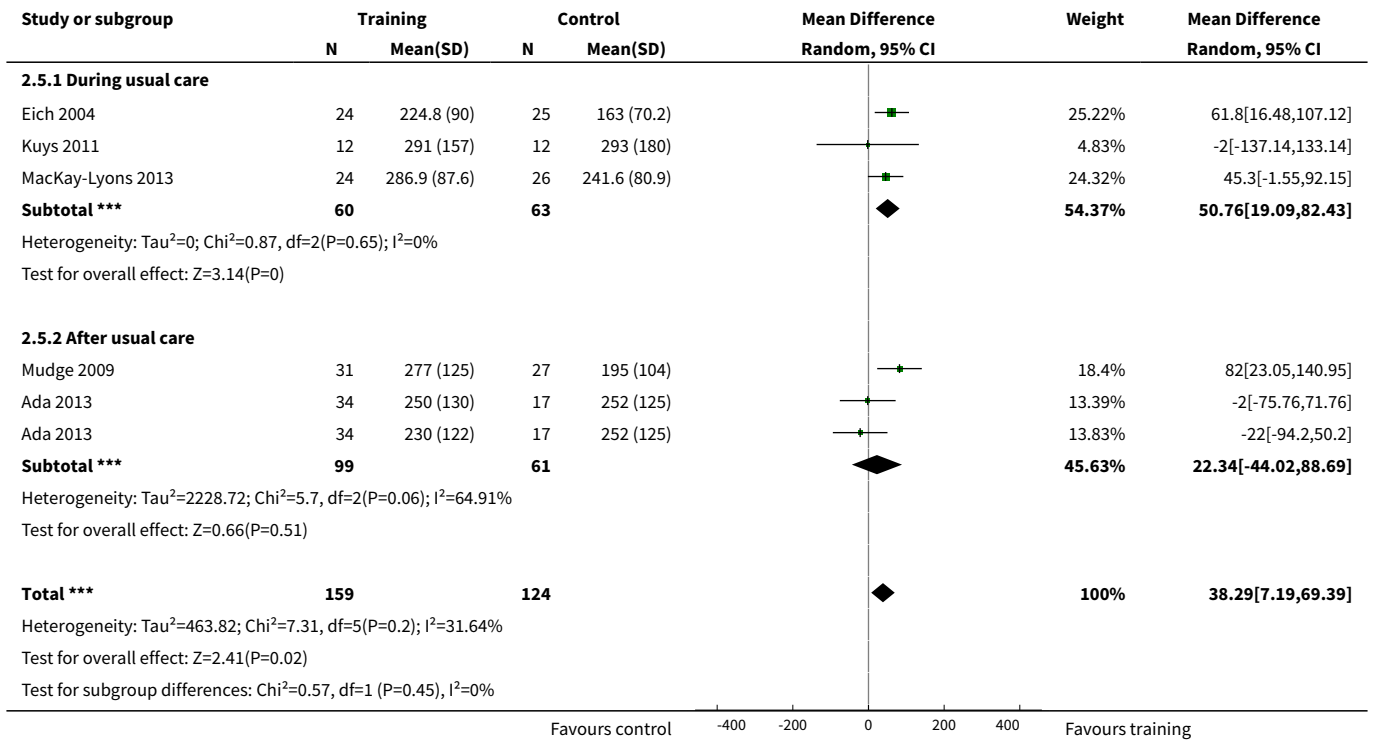
Analysis 2.3. Comparison 2 Cardiorespiratory training versus control - end of retention follow-up, Outcome 3 Mobility - walking maximal speed (m/min).



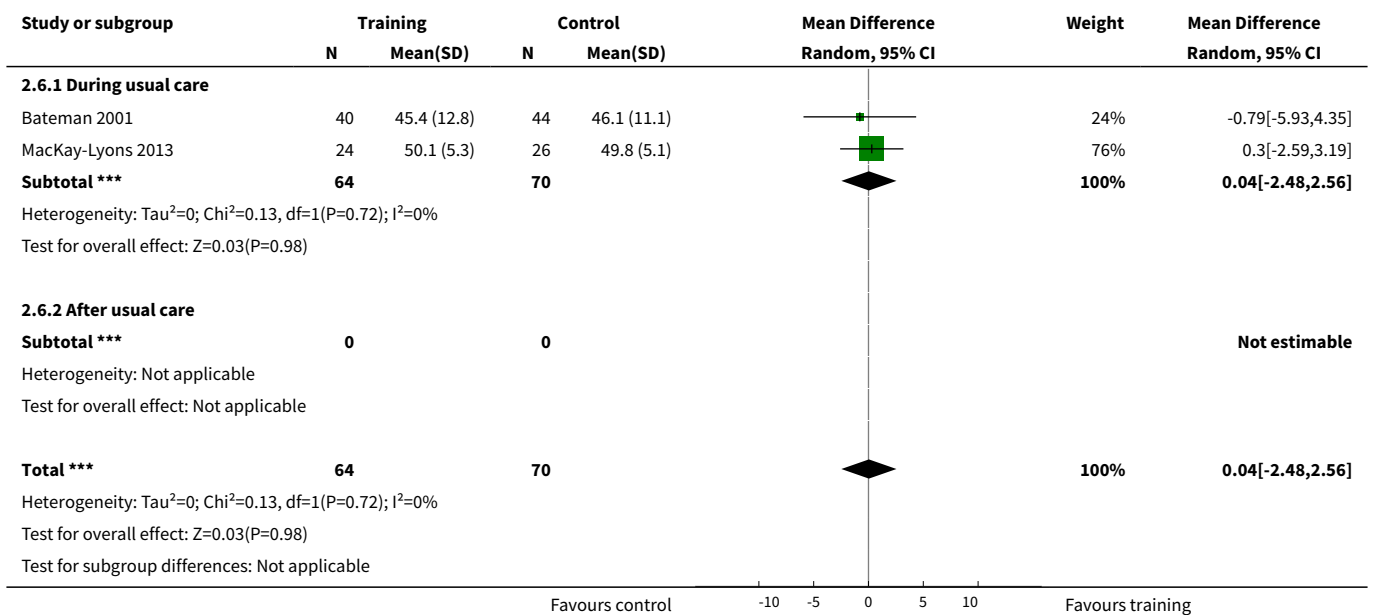
Analysis 2.4. Comparison 2 Cardiorespiratory training versus control - end of retention follow-up, Outcome 4 Mobility - walking preferred speed (m/min).



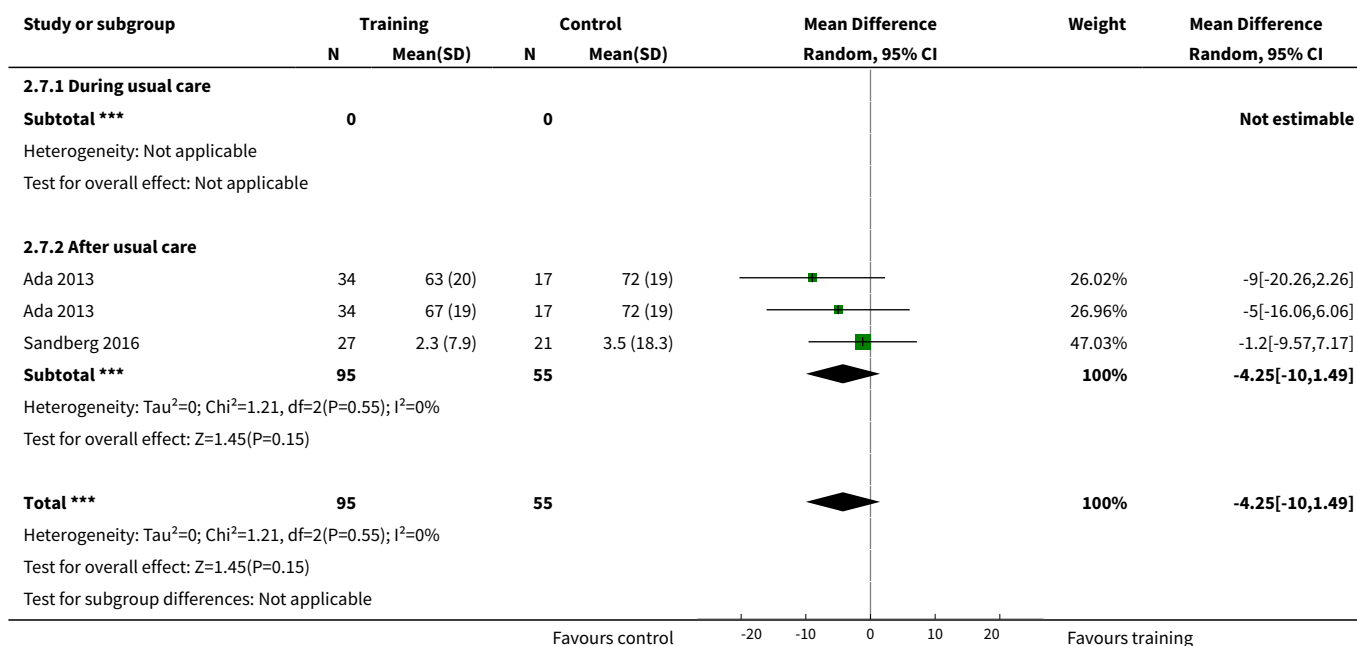
Analysis 2.5. Comparison 2 Cardiorespiratory training versus control - end of retention follow-up, Outcome 5 Mobility - walking capacity (6-MWT metres).



Analysis 2.6. Comparison 2 Cardiorespiratory training versus control - end of retention follow-up, Outcome 6 Physical function - Berg Balance scale.



Analysis 2.7. Comparison 2 Cardiorespiratory training versus control - end of retention follow-up, Outcome 7 Health-related QoL - EuroQol EQ-5D.



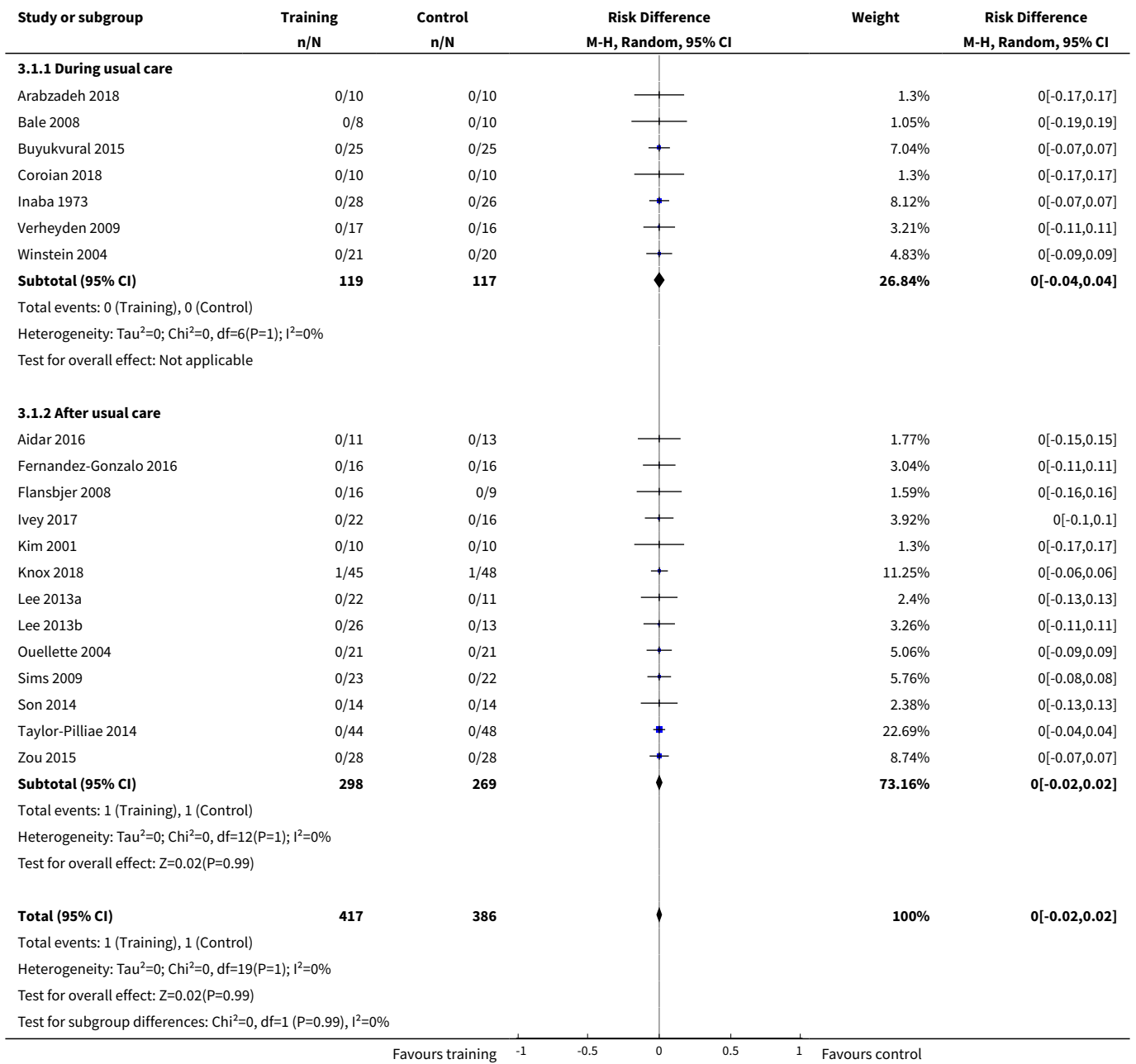
Comparison 3. Resistance training versus control - end of intervention

Outcome or subgroup title	No. of studies	No. of participants	Statistical method	Effect size
1 Death	20	803	Risk Difference (M-H, Random, 95% CI)	0.00 [-0.02, 0.02]
1.1 During usual care	7	236	Risk Difference (M-H, Random, 95% CI)	0.0 [-0.04, 0.04]
1.2 After usual care	13	567	Risk Difference (M-H, Random, 95% CI)	0.00 [-0.02, 0.02]
2 Physical fitness - composite measure of muscle strength	2	60	Std. Mean Difference (IV, Random, 95% CI)	0.58 [0.06, 1.10]
2.1 During usual care	0	0	Std. Mean Difference (IV, Random, 95% CI)	0.0 [0.0, 0.0]
2.2 During and after usual care	1	40	Std. Mean Difference (IV, Random, 95% CI)	0.47 [-0.16, 1.10]
2.3 After usual care	1	20	Std. Mean Difference (IV, Random, 95% CI)	0.84 [-0.09, 1.76]
3 Physical fitness - muscle strength, paretic knee flexion	3	93	Std. Mean Difference (IV, Random, 95% CI)	0.72 [0.10, 1.34]

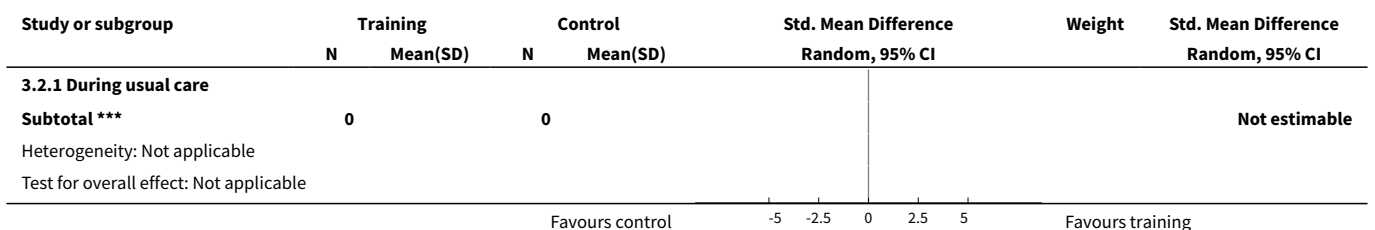
Outcome or subgroup title	No. of studies	No. of participants	Statistical method	Effect size
3.1 During usual care	1	18	Std. Mean Difference (IV, Random, 95% CI)	0.03 [-0.90, 0.96]
3.2 After usual care	2	75	Std. Mean Difference (IV, Random, 95% CI)	1.01 [0.52, 1.50]
4 Physical fitness - muscle strength, paretic knee extension	3	93	Std. Mean Difference (IV, Random, 95% CI)	1.09 [-0.23, 2.41]
4.1 During usual care	1	18	Std. Mean Difference (IV, Random, 95% CI)	-0.06 [-0.99, 0.87]
4.2 After usual care	2	75	Std. Mean Difference (IV, Random, 95% CI)	1.66 [0.53, 2.79]
5 Mobility - walking maximal speed (m/min)	7	274	Mean Difference (IV, Random, 95% CI)	2.83 [-0.49, 6.14]
5.1 During usual care	1	18	Mean Difference (IV, Random, 95% CI)	8.40 [2.82, 13.98]
5.2 After usual care	6	256	Mean Difference (IV, Random, 95% CI)	1.80 [-1.52, 5.12]
6 Mobility - walking preferred speed (m/min)	5	203	Mean Difference (IV, Random, 95% CI)	2.15 [-3.57, 7.87]
6.1 During usual care	1	18	Mean Difference (IV, Random, 95% CI)	9.0 [3.42, 14.58]
6.2 After usual care	4	185	Mean Difference (IV, Random, 95% CI)	-0.18 [-4.99, 4.63]
7 Mobility - walking capacity (6-MWT metres)	5	238	Mean Difference (IV, Random, 95% CI)	24.98 [11.98, 37.98]
7.1 During usual care	0	0	Mean Difference (IV, Random, 95% CI)	0.0 [0.0, 0.0]
7.2 After usual care	5	238	Mean Difference (IV, Random, 95% CI)	24.98 [11.98, 37.98]
8 Physical function - Berg Balance Scale (score 0 to 56)	5	220	Mean Difference (IV, Random, 95% CI)	3.27 [2.15, 4.38]
8.1 During usual care	1	20	Mean Difference (IV, Random, 95% CI)	3.70 [0.11, 7.29]
8.2 After usual care	4	200	Mean Difference (IV, Random, 95% CI)	3.22 [2.04, 4.39]
9 Physical function - stair climbing, maximal (sec/step)	2	91	Mean Difference (IV, Random, 95% CI)	-2.07 [-3.18, -0.96]

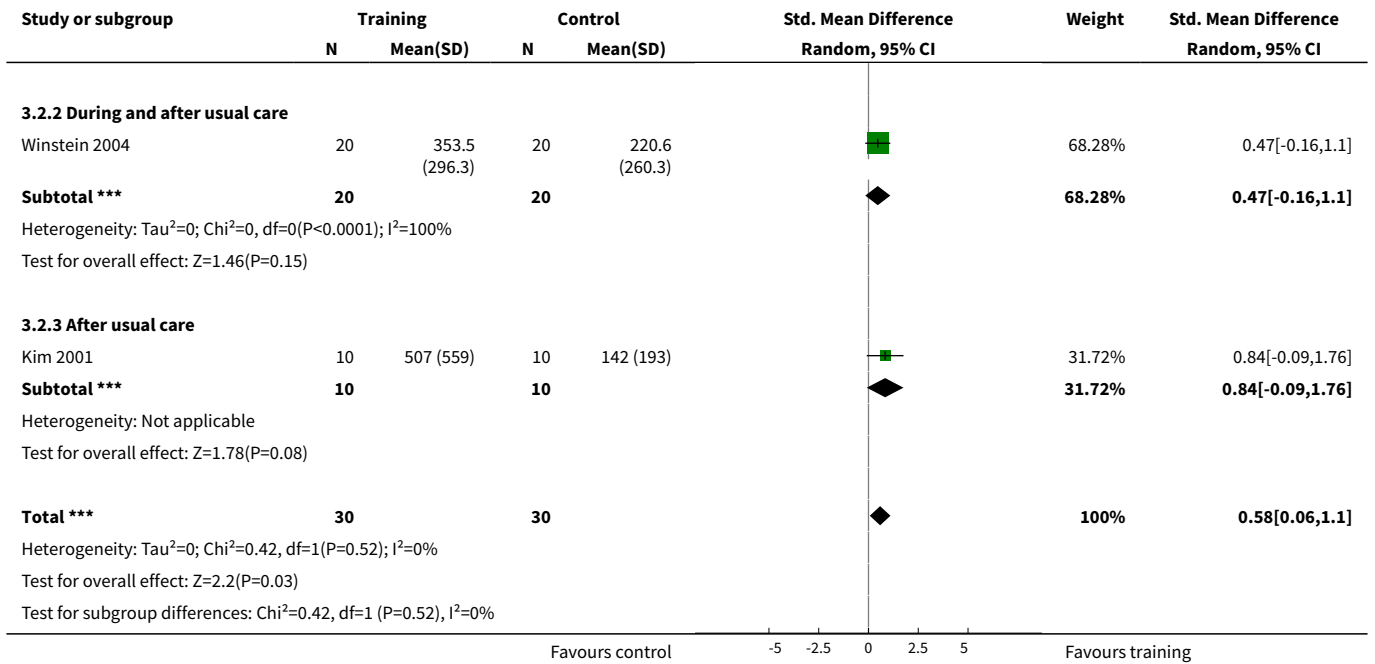
Outcome or subgroup title	No. of studies	No. of participants	Statistical method	Effect size
9.1 During usual care	1	50	Mean Difference (IV, Random, 95% CI)	-2.0 [-3.12, -0.88]
9.2 After usual care	1	41	Mean Difference (IV, Random, 95% CI)	-5.36 [-13.13, 2.41]
10 Physical function - Timed Up and Go (sec)	5	224	Mean Difference (IV, Random, 95% CI)	-3.46 [-6.94, 0.02]
10.1 During usual care	1	50	Mean Difference (IV, Random, 95% CI)	-2.0 [-3.12, -0.88]
10.2 After usual care	4	174	Mean Difference (IV, Random, 95% CI)	-5.72 [-7.92, -3.52]
11 Health-related QoL - SF-36 physical functioning (PF) scale	3	70	Mean Difference (IV, Random, 95% CI)	5.72 [-5.26, 16.70]
11.1 During usual care	0	0	Mean Difference (IV, Random, 95% CI)	0.0 [0.0, 0.0]
11.2 After usual care	3	70	Mean Difference (IV, Random, 95% CI)	5.72 [-5.26, 16.70]
12 Health-related QoL - SF-36 mental health (MH) scale	3	70	Mean Difference (IV, Random, 95% CI)	7.69 [1.56, 13.83]
12.1 During usual care	0	0	Mean Difference (IV, Random, 95% CI)	0.0 [0.0, 0.0]
12.2 After usual care	3	70	Mean Difference (IV, Random, 95% CI)	7.69 [1.56, 13.83]
13 Mood - Centre for Epidemiologic Studies for Depression scale (CES-D)	2	180	Mean Difference (IV, Random, 95% CI)	-3.76 [-6.98, -0.54]
13.1 During usual care	0	0	Mean Difference (IV, Random, 95% CI)	0.0 [0.0, 0.0]
13.2 After usual care	2	180	Mean Difference (IV, Random, 95% CI)	-3.76 [-6.98, -0.54]
14 Mood - combined depression scales	3	209	Std. Mean Difference (IV, Random, 95% CI)	-0.36 [-0.64, -0.09]
14.1 During usual care	0	0	Std. Mean Difference (IV, Random, 95% CI)	0.0 [0.0, 0.0]
14.2 After usual care	3	209	Std. Mean Difference (IV, Random, 95% CI)	-0.36 [-0.64, -0.09]

Analysis 3.1. Comparison 3 Resistance training versus control - end of intervention, Outcome 1 Death.

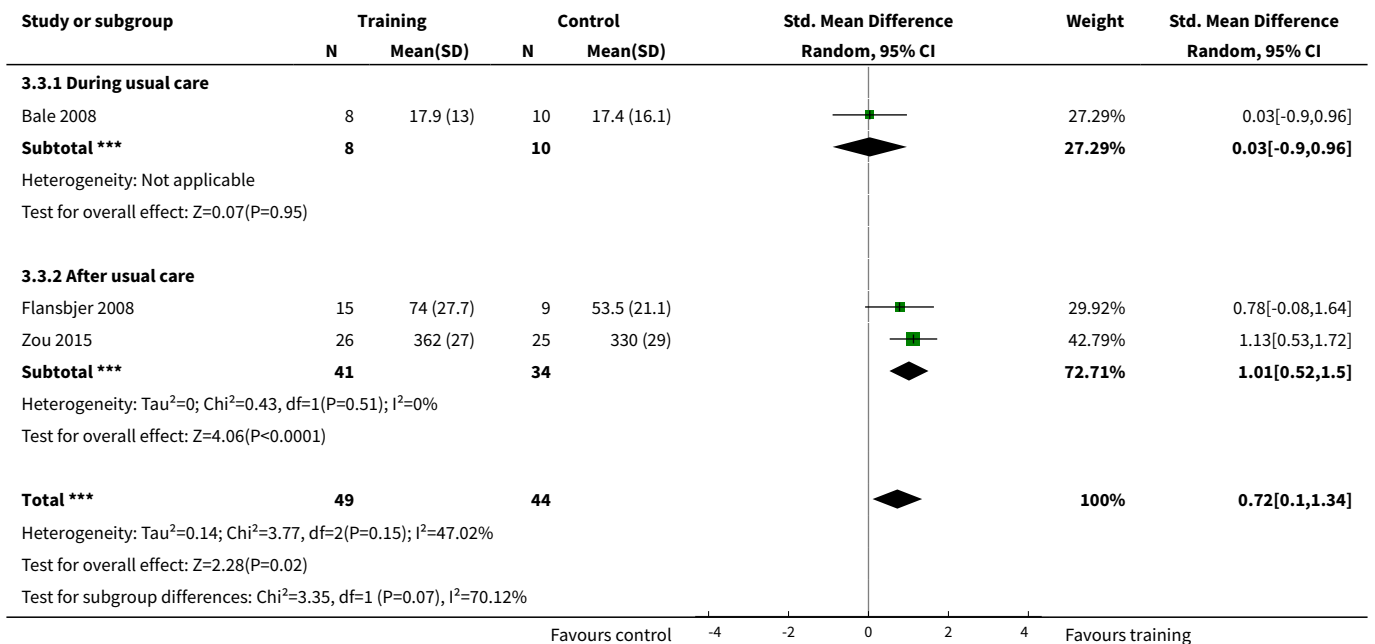


Analysis 3.2. Comparison 3 Resistance training versus control - end of intervention, Outcome 2 Physical fitness - composite measure of muscle strength.

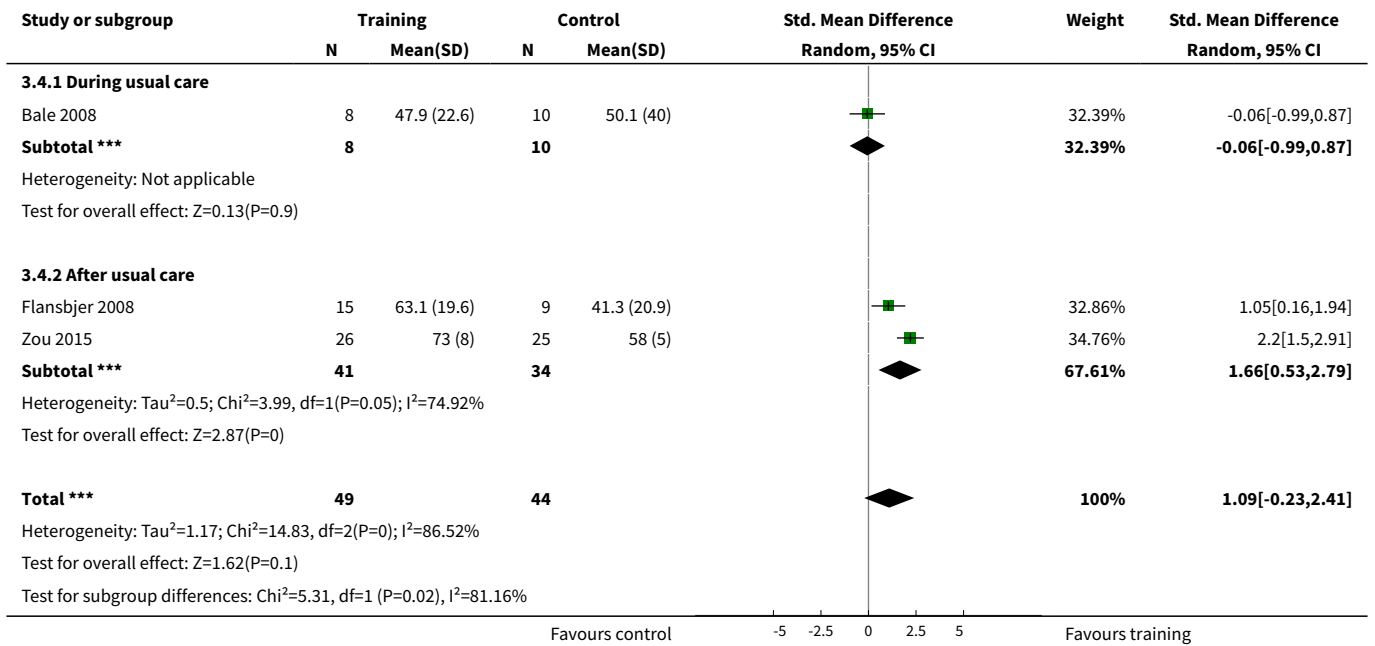




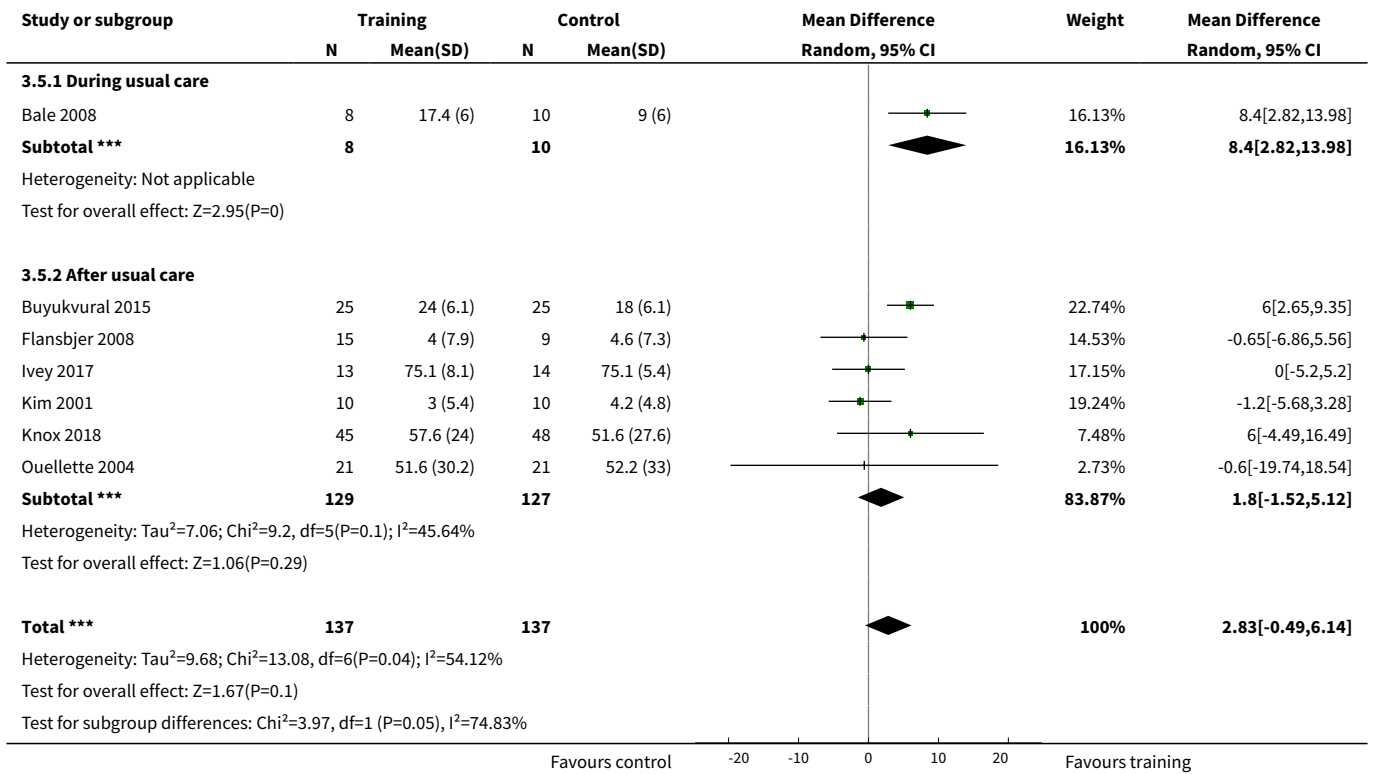
Analysis 3.3. Comparison 3 Resistance training versus control - end of intervention, Outcome 3 Physical fitness - muscle strength, paretic knee flexion.



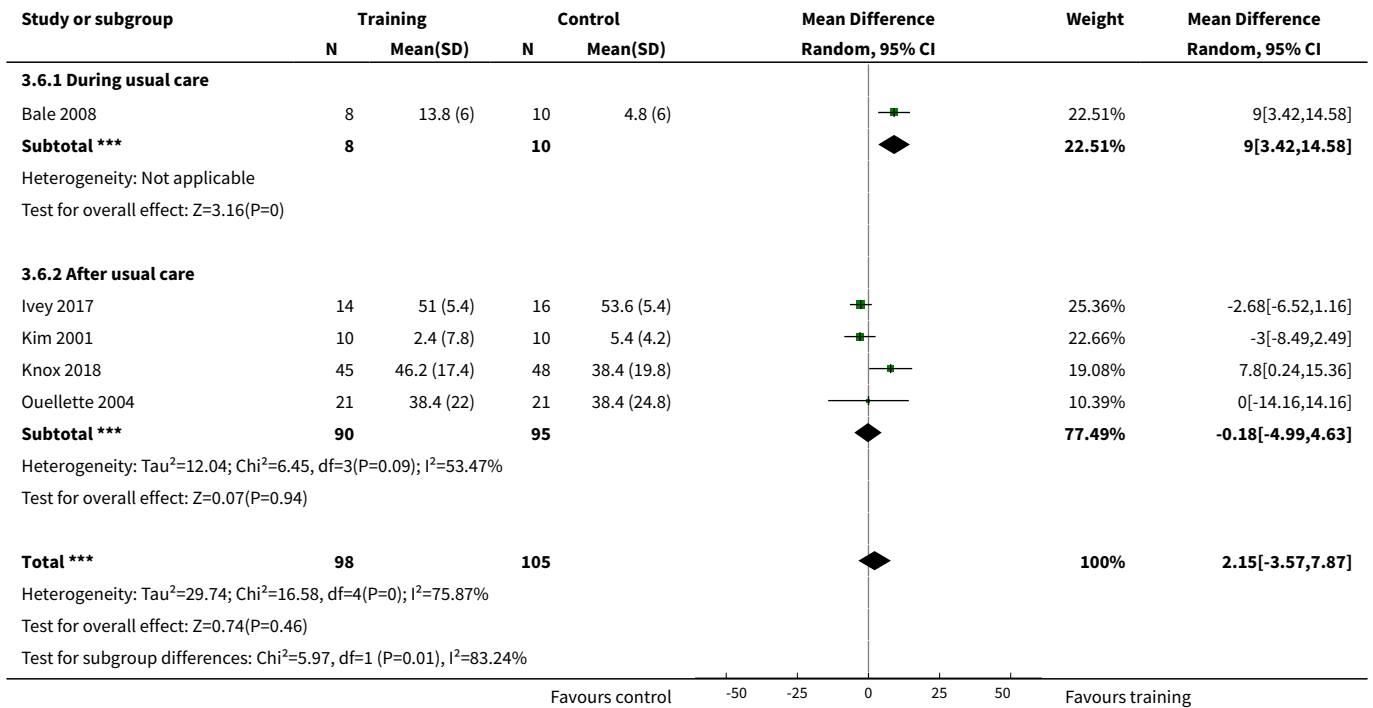
Analysis 3.4. Comparison 3 Resistance training versus control - end of intervention, Outcome 4 Physical fitness - muscle strength, paretic knee extension.



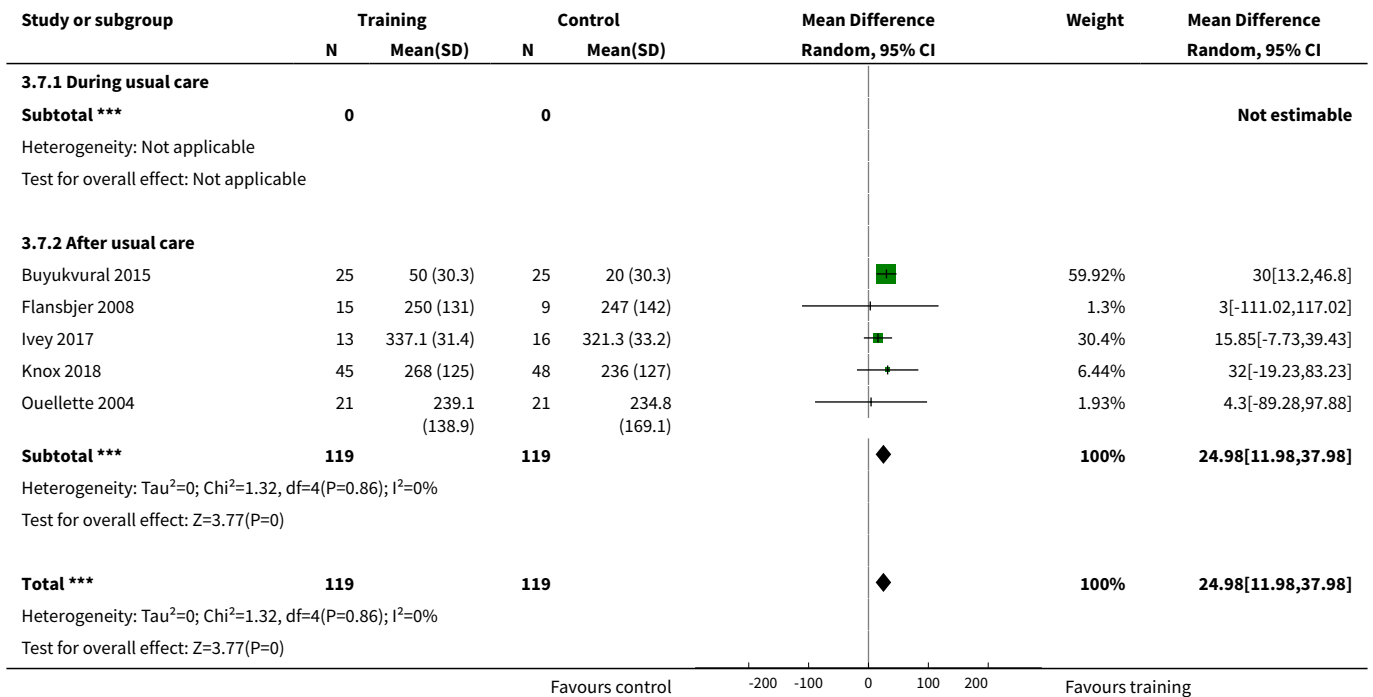
Analysis 3.5. Comparison 3 Resistance training versus control - end of intervention, Outcome 5 Mobility - walking maximal speed (m/min).



Analysis 3.6. Comparison 3 Resistance training versus control - end of intervention, Outcome 6 Mobility - walking preferred speed (m/min).



Analysis 3.7. Comparison 3 Resistance training versus control - end of intervention, Outcome 7 Mobility - walking capacity (6-MWT metres).



Study or subgroup	Training		Control		Mean Difference Random, 95% CI	Weight	Mean Difference Random, 95% CI
	N	Mean(SD)	N	Mean(SD)			

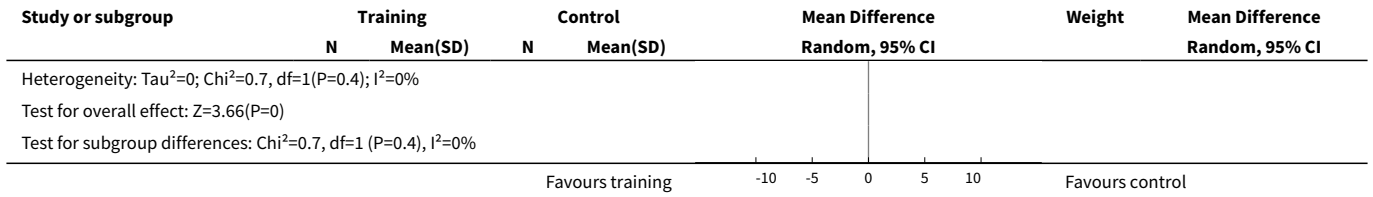
Test for subgroup differences: Not applicable

Analysis 3.8. Comparison 3 Resistance training versus control - end of intervention, Outcome 8 Physical function - Berg Balance Scale (score 0 to 56).

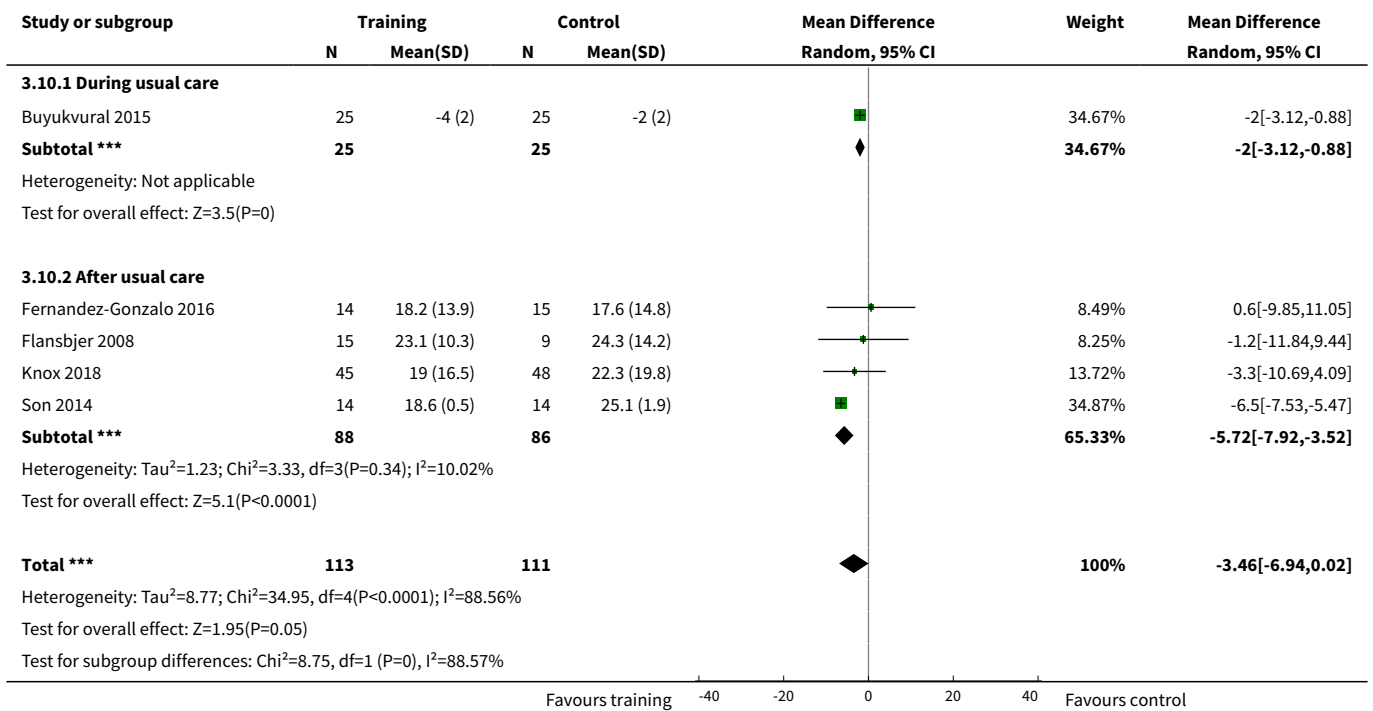
Study or subgroup	Training		Control		Mean Difference Random, 95% CI	Weight	Mean Difference Random, 95% CI
	N	Mean(SD)	N	Mean(SD)			
3.8.1 During usual care							
Arabzadeh 2018	10	50.5 (4.1)	10	46.8 (4.1)		9.67%	3.7[0.11,7.29]
Subtotal ***	10		10			9.67%	3.7[0.11,7.29]
Heterogeneity: Not applicable Test for overall effect: Z=2.02(P=0.04)							
3.8.2 After usual care							
Buyukvural 2015	25	7 (3)	25	4 (3)		44.27%	3[1.32,4.68]
Fernandez-Gonzalo 2016	14	45.9 (9.1)	15	44 (9.6)		2.7%	1.9[-4.91,8.71]
Knox 2018	45	50 (9)	48	46 (10)		8.37%	4[0.14,7.86]
Son 2014	14	37.2 (2.6)	14	33.8 (2.5)		34.99%	3.41[1.52,5.3]
Subtotal ***	98		102			90.33%	3.22[2.04,4.39]
Heterogeneity: Tau ² =0; Chi ² =0.41, df=3(P=0.94); I ² =0% Test for overall effect: Z=5.36(P<0.0001)							
Total ***	108		112			100%	3.27[2.15,4.38]
Heterogeneity: Tau ² =0; Chi ² =0.47, df=4(P=0.98); I ² =0% Test for overall effect: Z=5.73(P<0.0001) Test for subgroup differences: Chi ² =0.06, df=1 (P=0.8), I ² =0%							

Analysis 3.9. Comparison 3 Resistance training versus control - end of intervention, Outcome 9 Physical function - stair climbing, maximal (sec/step).

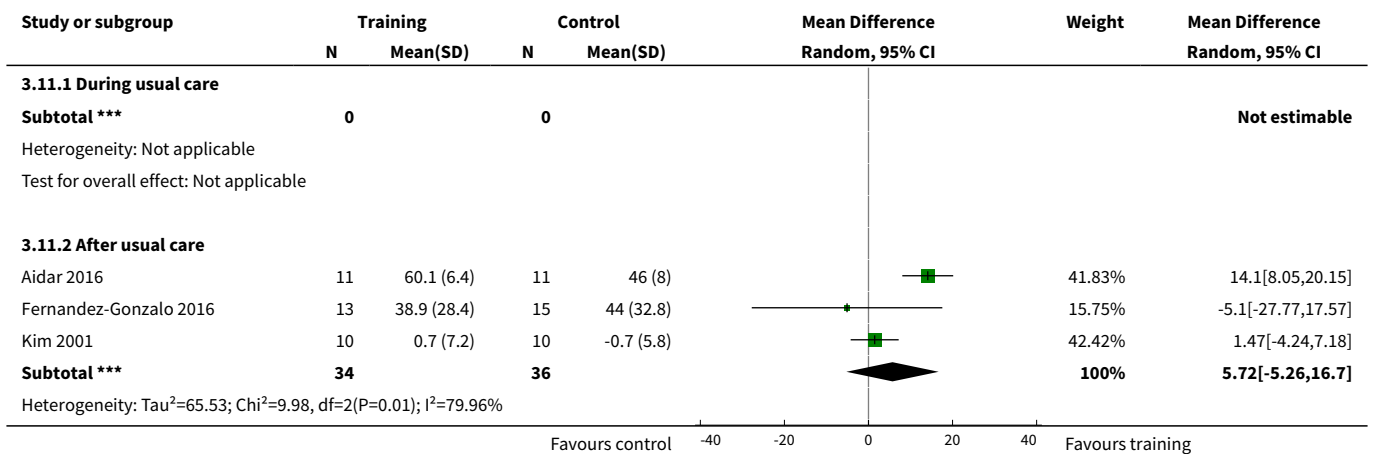
Study or subgroup	Training		Control		Mean Difference Random, 95% CI	Weight	Mean Difference Random, 95% CI
	N	Mean(SD)	N	Mean(SD)			
3.9.1 During usual care							
Buyukvural 2015	25	-4 (2)	25	-2 (2)		97.97%	-2[-3.12,-0.88]
Subtotal ***	25		25			97.97%	-2[-3.12,-0.88]
Heterogeneity: Not applicable Test for overall effect: Z=3.5(P=0)							
3.9.2 After usual care							
Ouellette 2004	20	23.2 (11.2)	21	28.5 (14.1)		2.03%	-5.36[-13.13,2.41]
Subtotal ***	20		21			2.03%	-5.36[-13.13,2.41]
Heterogeneity: Not applicable Test for overall effect: Z=1.35(P=0.18)							
Total ***	45		46			100%	-2.07[-3.18,-0.96]

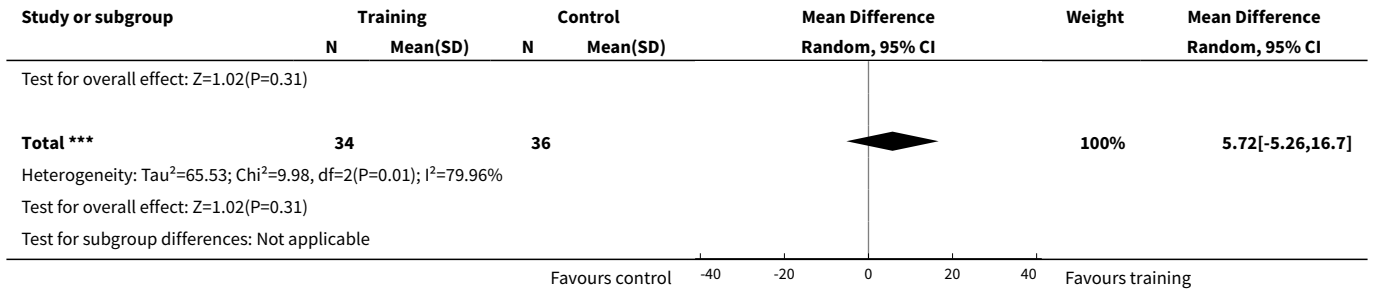


Analysis 3.10. Comparison 3 Resistance training versus control - end of intervention, Outcome 10 Physical function - Timed Up and Go (sec).

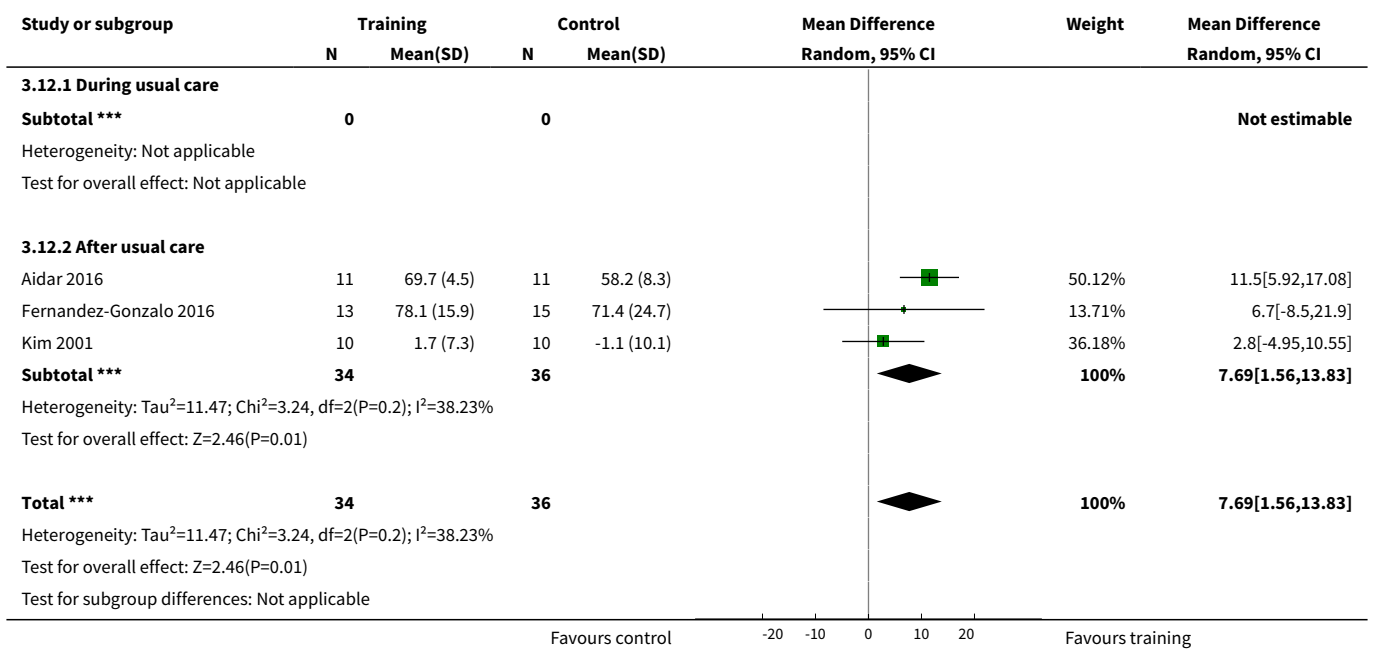


Analysis 3.11. Comparison 3 Resistance training versus control - end of intervention, Outcome 11 Health-related QoL - SF-36 physical functioning (PF) scale.

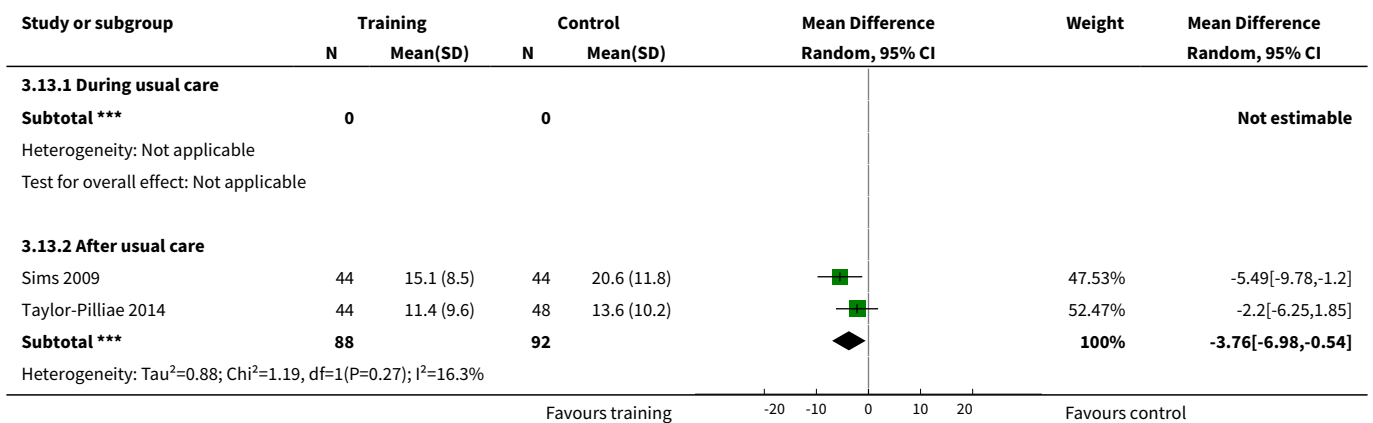


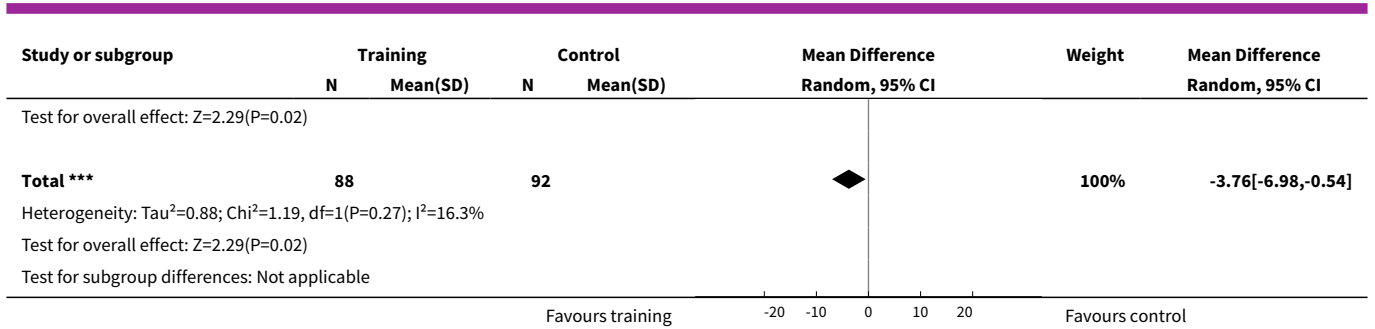


Analysis 3.12. Comparison 3 Resistance training versus control - end of intervention, Outcome 12 Health-related QoL - SF-36 mental health (MH) scale.

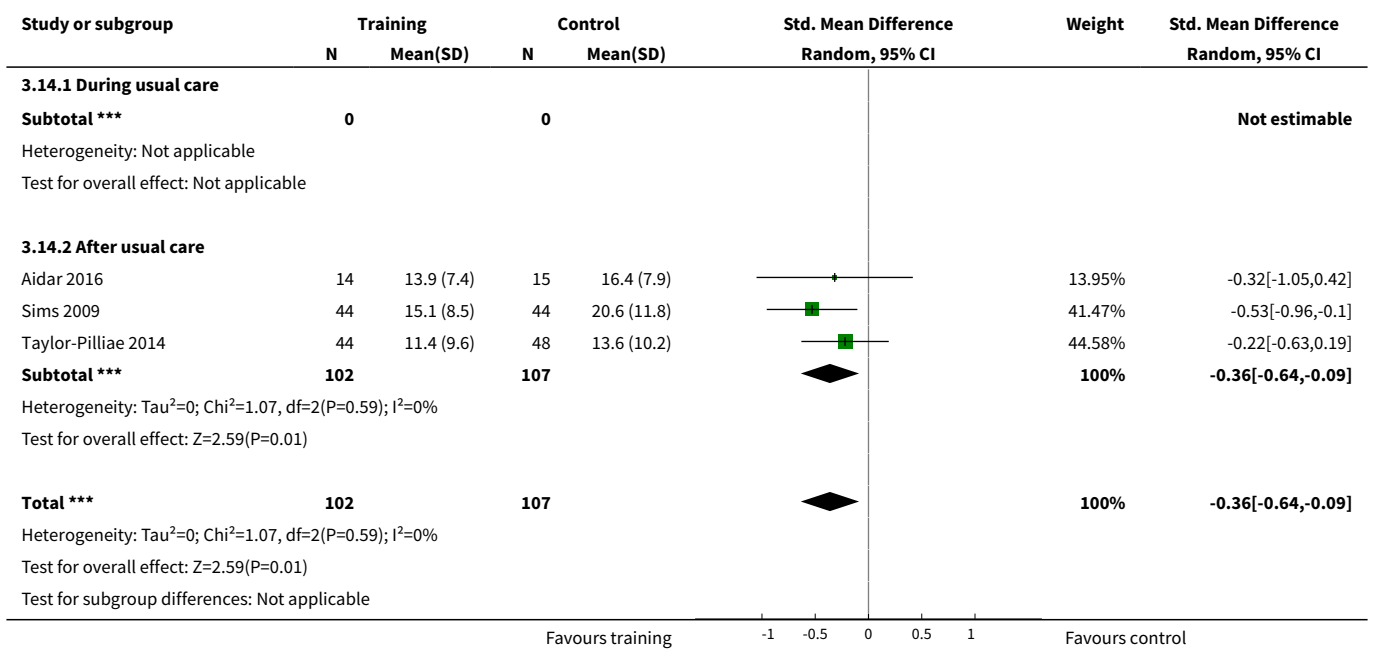


Analysis 3.13. Comparison 3 Resistance training versus control - end of intervention, Outcome 13 Mood - Centre for Epidemiologic Studies for Depression scale (CES-D).





Analysis 3.14. Comparison 3 Resistance training versus control - end of intervention, Outcome 14 Mood - combined depression scales.

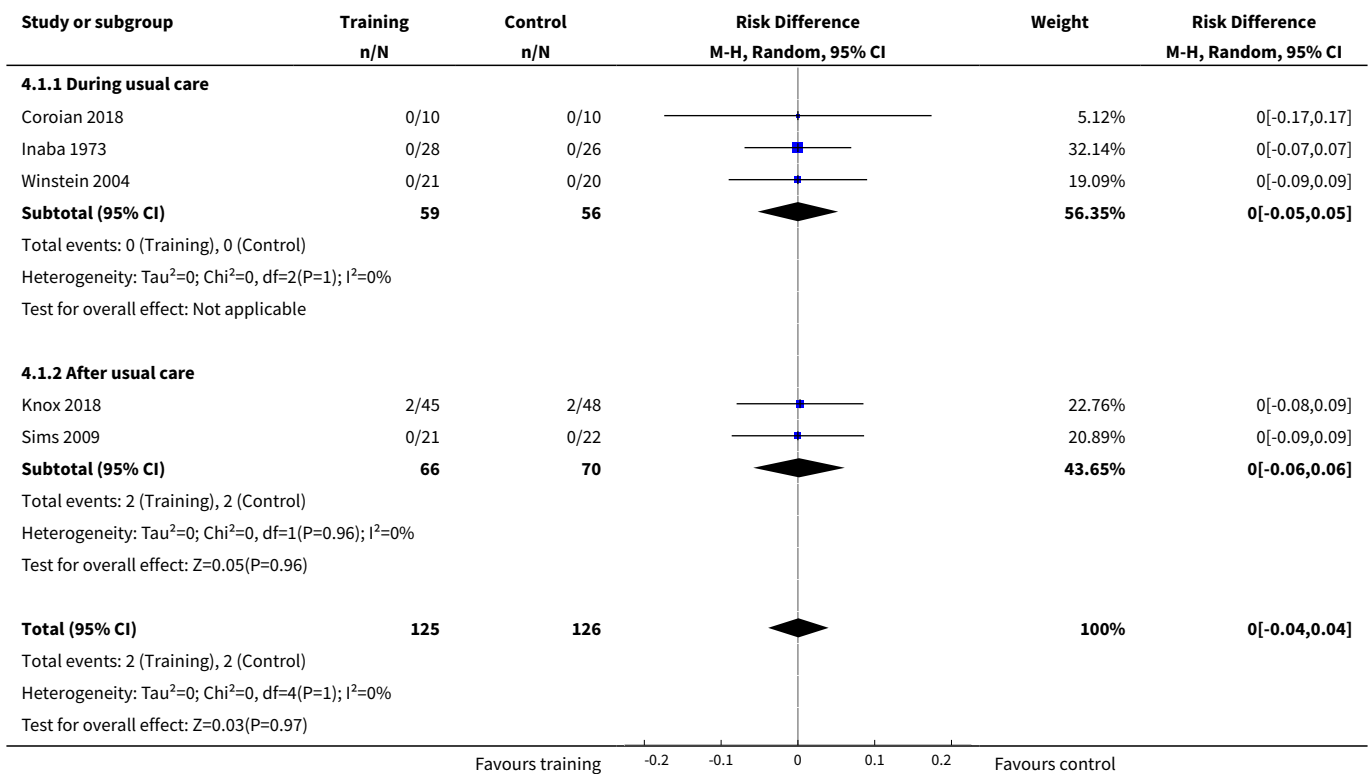


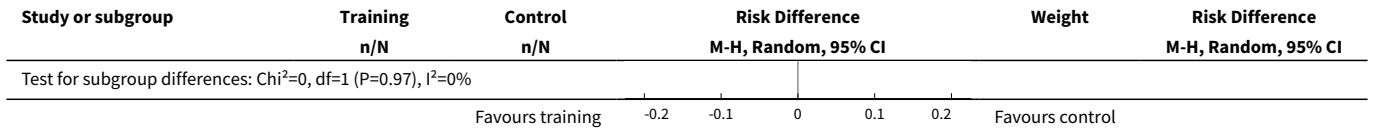
Comparison 4. Resistance training versus control - end of retention follow-up

Outcome or subgroup title	No. of studies	No. of participants	Statistical method	Effect size
1 Death	5	251	Risk Difference (M-H, Random, 95% CI)	0.00 [-0.04, 0.04]
1.1 During usual care	3	115	Risk Difference (M-H, Random, 95% CI)	0.0 [-0.05, 0.05]
1.2 After usual care	2	136	Risk Difference (M-H, Random, 95% CI)	0.00 [-0.06, 0.06]
2 Mobility - walking maximal speed (m/min)	2	117	Mean Difference (IV, Random, 95% CI)	7.80 [-3.32, 18.91]

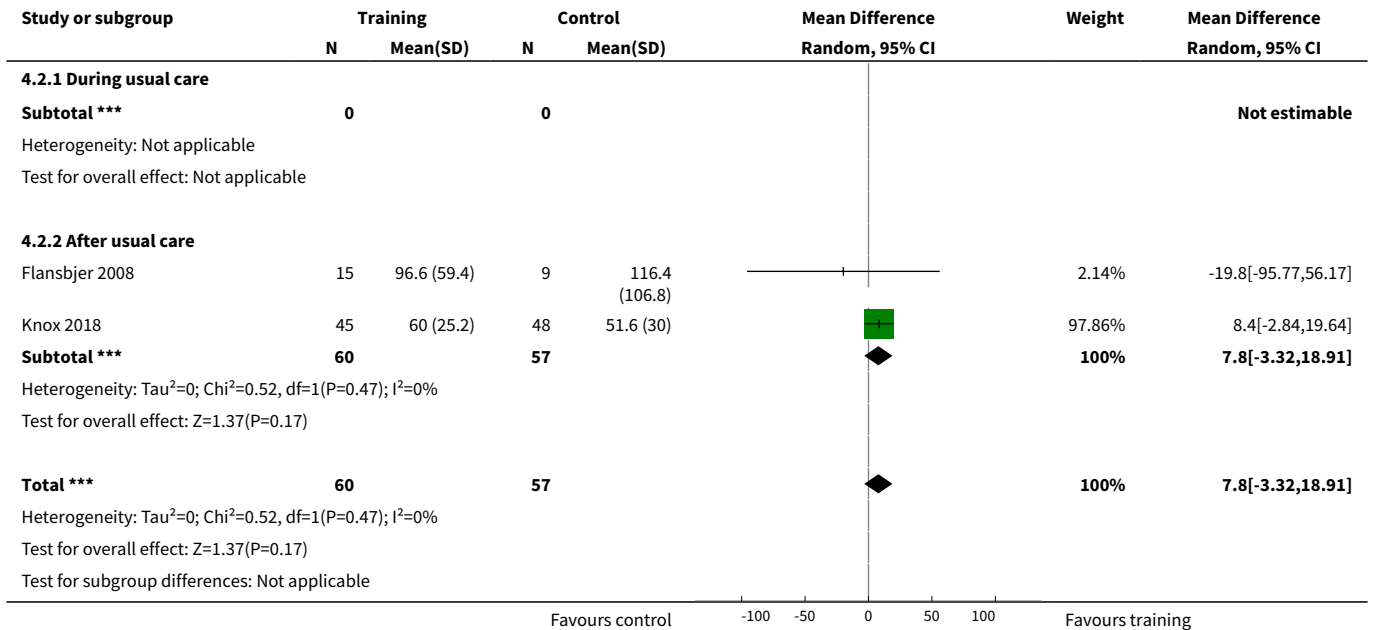
Outcome or subgroup title	No. of studies	No. of participants	Statistical method	Effect size
2.1 During usual care	0	0	Mean Difference (IV, Random, 95% CI)	0.0 [0.0, 0.0]
2.2 After usual care	2	117	Mean Difference (IV, Random, 95% CI)	7.80 [-3.32, 18.91]
3 Mobility - walking capacity (6-MWT metres)	2	117	Mean Difference (IV, Random, 95% CI)	22.41 [-27.87, 72.69]
3.1 During usual care	0	0	Mean Difference (IV, Random, 95% CI)	0.0 [0.0, 0.0]
3.2 After usual care	2	117	Mean Difference (IV, Random, 95% CI)	22.41 [-27.87, 72.69]
4 Physical function - Timed Up and Go (sec)	2	117	Mean Difference (IV, Random, 95% CI)	-2.64 [-9.24, 3.95]
4.1 During usual care	0	0	Mean Difference (IV, Random, 95% CI)	0.0 [0.0, 0.0]
4.2 After usual care	2	117	Mean Difference (IV, Random, 95% CI)	-2.64 [-9.24, 3.95]

Analysis 4.1. Comparison 4 Resistance training versus control - end of retention follow-up, Outcome 1 Death.

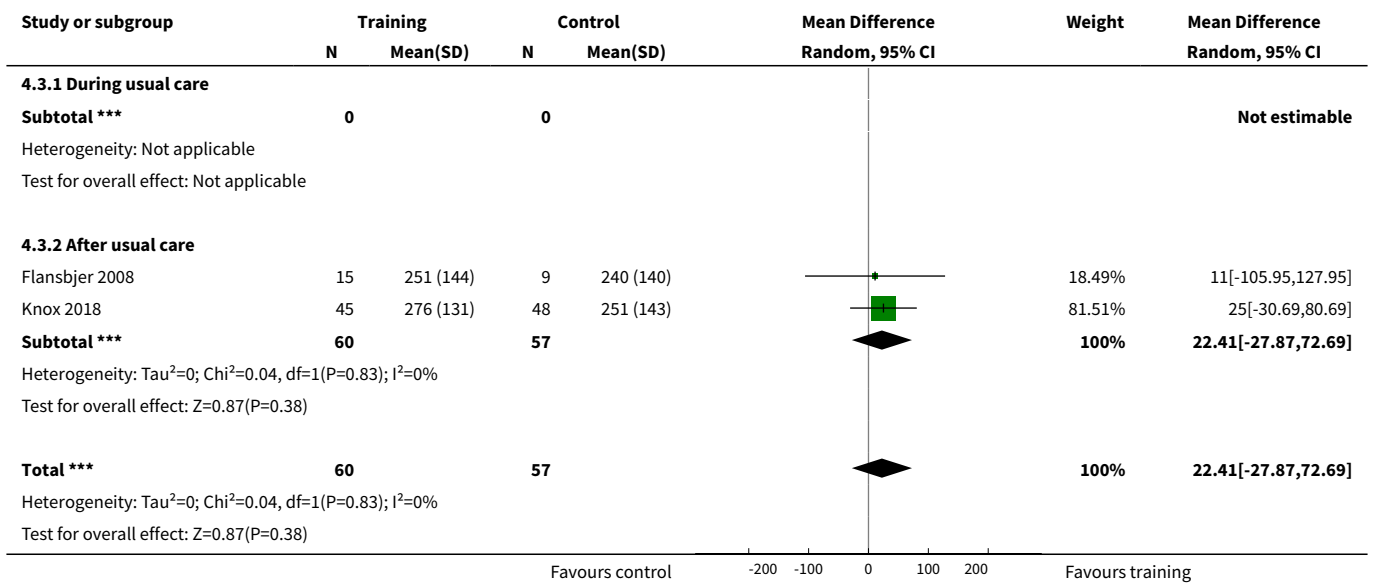


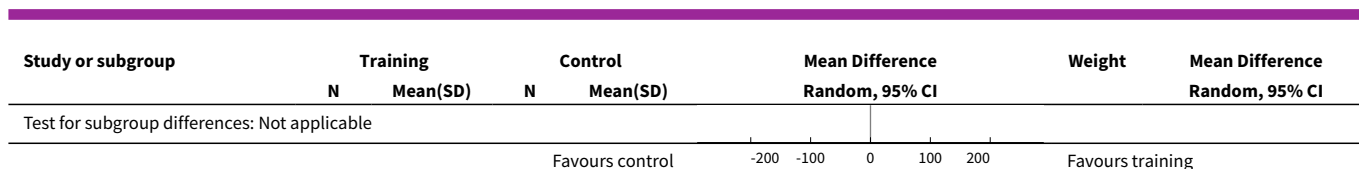


Analysis 4.2. Comparison 4 Resistance training versus control - end of retention follow-up, Outcome 2 Mobility - walking maximal speed (m/min).

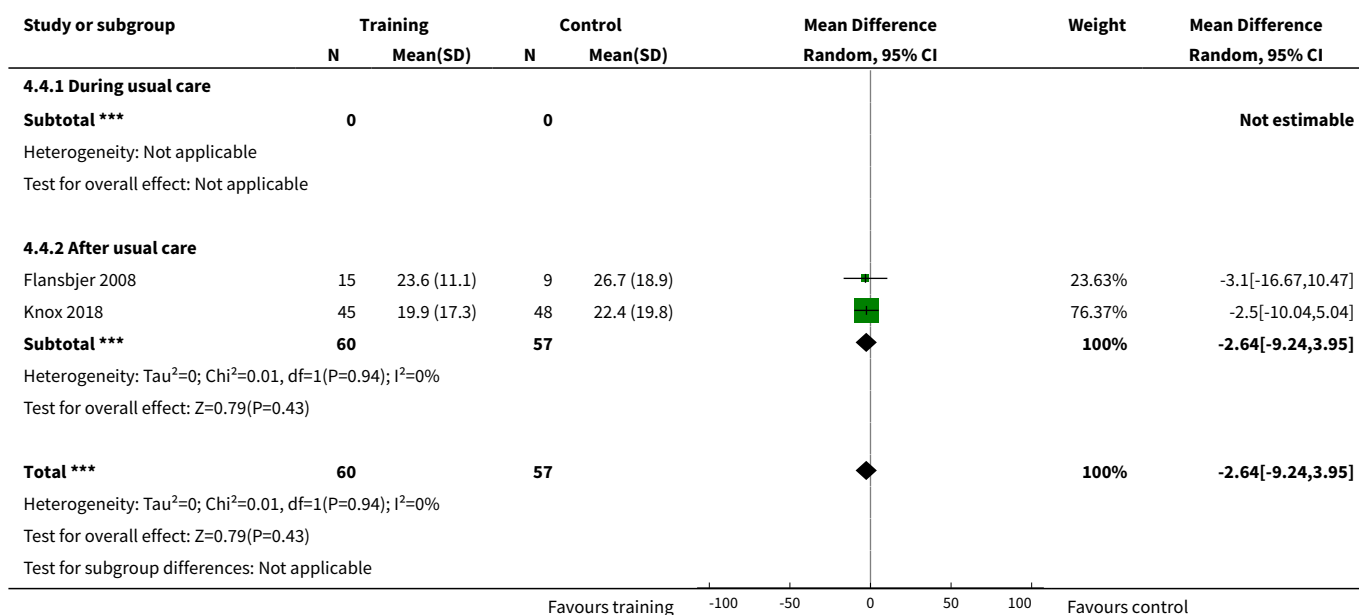


Analysis 4.3. Comparison 4 Resistance training versus control - end of retention follow-up, Outcome 3 Mobility - walking capacity (6-MWT metres).





Analysis 4.4. Comparison 4 Resistance training versus control - end of retention follow-up, Outcome 4 Physical function - Timed Up and Go (sec).



Comparison 5. Mixed training versus control - end of intervention

Outcome or subgroup title	No. of studies	No. of participants	Statistical method	Effect size
1 Death	23	1231	Risk Difference (M-H, Random, 95% CI)	-0.00 [-0.02, 0.01]
1.1 During usual care	10	344	Risk Difference (M-H, Random, 95% CI)	0.0 [-0.03, 0.03]
1.2 After usual care	13	887	Risk Difference (M-H, Random, 95% CI)	-0.01 [-0.02, 0.01]
2 Disability - Barthel Index (BI)	6	256	Mean Difference (IV, Random, 95% CI)	2.84 [-0.48, 6.17]
2.1 During usual care	3	78	Mean Difference (IV, Random, 95% CI)	5.44 [-2.12, 13.00]
2.2 After usual care	3	178	Mean Difference (IV, Random, 95% CI)	1.99 [-2.32, 6.29]

Outcome or subgroup title	No. of studies	No. of participants	Statistical method	Effect size
3 Disability - Lawton IADL	2	113	Mean Difference (IV, Random, 95% CI)	0.83 [-0.51, 2.17]
3.1 During usual care	0	0	Mean Difference (IV, Random, 95% CI)	0.0 [0.0, 0.0]
3.2 After usual care	2	113	Mean Difference (IV, Random, 95% CI)	0.83 [-0.51, 2.17]
4 Disability - Rivermead Mobility Index (RMI)	3	348	Mean Difference (IV, Random, 95% CI)	0.41 [-0.02, 0.84]
4.1 During usual care	0	0	Mean Difference (IV, Random, 95% CI)	0.0 [0.0, 0.0]
4.2 After usual care	3	348	Mean Difference (IV, Random, 95% CI)	0.41 [-0.02, 0.84]
5 Disability - combined disability scales	9	604	Std. Mean Difference (IV, Random, 95% CI)	0.23 [0.03, 0.42]
5.1 During usual care	3	78	Std. Mean Difference (IV, Random, 95% CI)	0.39 [-0.06, 0.84]
5.2 After usual care	6	526	Std. Mean Difference (IV, Random, 95% CI)	0.17 [-0.09, 0.43]
6 Risk factors - blood pressure, systolic	2	68	Mean Difference (IV, Random, 95% CI)	4.98 [-2.70, 12.66]
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	68	Mean Difference (IV, Random, 95% CI)	4.98 [-2.70, 12.66]
7 Risk factors - blood pressure, diastolic	2	68	Mean Difference (IV, Random, 95% CI)	-3.49 [-9.51, 2.53]
7.1 During usual care	0	0	Mean Difference (IV, Random, 95% CI)	0.0 [0.0, 0.0]
7.2 After usual care	2	68	Mean Difference (IV, Random, 95% CI)	-3.49 [-9.51, 2.53]
8 Physical fitness - peak VO ₂ (mL/kg/min)	2	140	Mean Difference (IV, Random, 95% CI)	1.40 [-0.19, 2.99]
8.1 During usual care	0	0	Mean Difference (IV, Random, 95% CI)	0.0 [0.0, 0.0]
8.2 After usual care	2	140	Mean Difference (IV, Random, 95% CI)	1.40 [-0.19, 2.99]

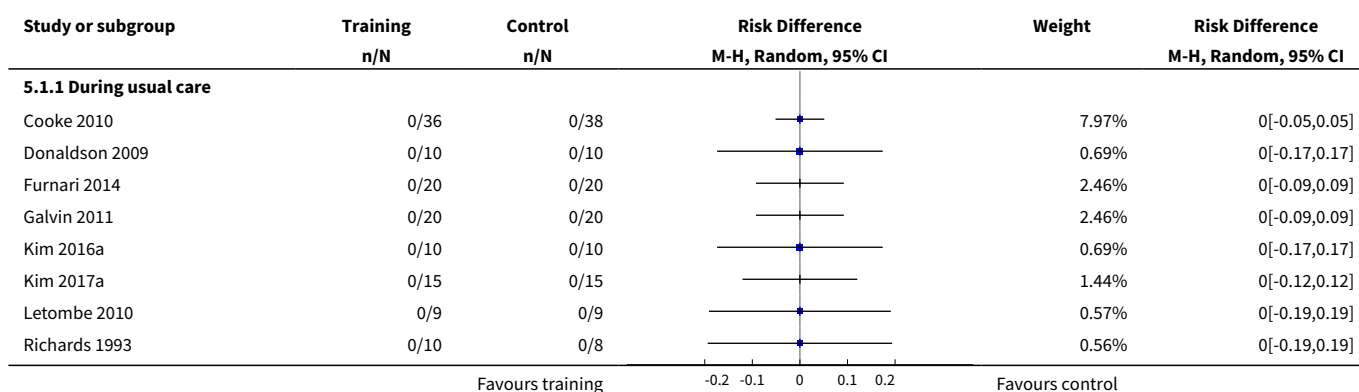
Outcome or subgroup title	No. of studies	No. of participants	Statistical method	Effect size
9 Physical fitness - gait economy, VO ₂ (mL/kg/metre)	1	66	Mean Difference (IV, Random, 95% CI)	-0.01 [-0.03, -0.00]
9.1 During usual care	0	0	Mean Difference (IV, Random, 95% CI)	0.0 [0.0, 0.0]
9.2 After usual 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, grip strength (paretic hand)	3	147	Mean Difference (IV, Random, 95% CI)	0.32 [-0.88, 1.52]
12.1 During usual care	2	47	Mean Difference (IV, Random, 95% CI)	0.32 [-1.12, 1.76]
12.2 After usual care	1	100	Mean Difference (IV, Random, 95% CI)	0.32 [-1.85, 2.49]
13 Mobility - walking maximum speed	3	168	Mean Difference (IV, Random, 95% CI)	8.48 [1.76, 15.20]
13.1 During usual care	1	29	Mean Difference (IV, Random, 95% CI)	8.00 [-5.06, 21.06]
13.2 After usual care	2	139	Mean Difference (IV, Random, 95% CI)	8.65 [0.82, 16.48]
14 Mobility - walking preferred speed (m/min)	10	738	Mean Difference (IV, Random, 95% CI)	4.71 [1.32, 8.10]
14.1 During usual care	3	153	Mean Difference (IV, Random, 95% CI)	3.37 [-2.63, 9.37]
14.2 After usual care	7	585	Mean Difference (IV, Random, 95% CI)	5.13 [1.16, 9.10]

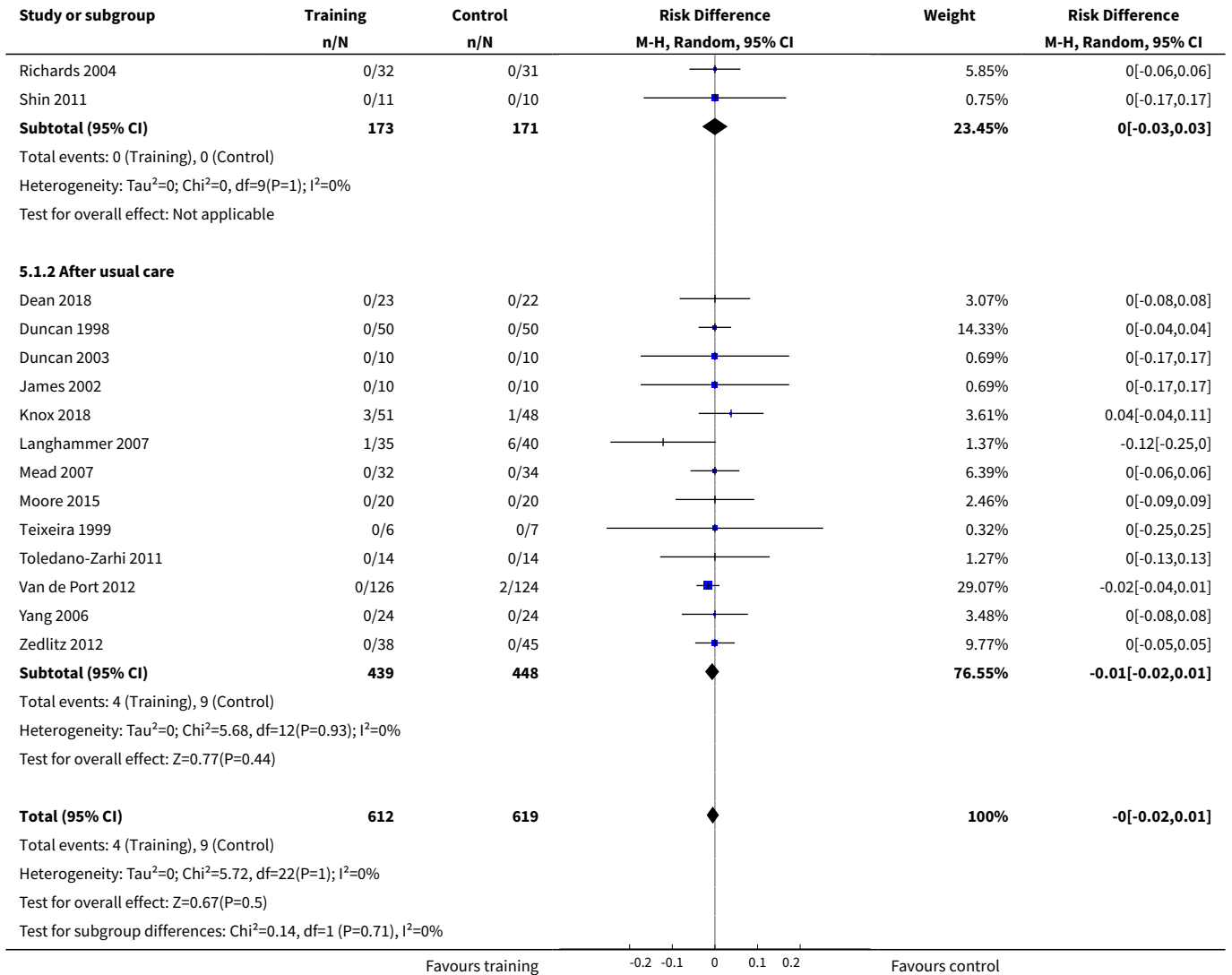
Outcome or subgroup title	No. of studies	No. of participants	Statistical method	Effect size
15 Mobility - walking capacity (6-MWT metres)	10	720	Mean Difference (IV, Random, 95% CI)	35.00 [15.91, 54.09]
15.1 During usual care	2	60	Mean Difference (IV, Random, 95% CI)	13.21 [-75.07, 101.49]
15.2 After usual care	8	660	Mean Difference (IV, Random, 95% CI)	40.37 [24.82, 55.92]
16 Mobility - Community Ambulation Speed (> 0.8 m/sec)	3	232	Odds Ratio (M-H, Random, 95% CI)	1.38 [0.78, 2.42]
16.1 During usual care	1	67	Odds Ratio (M-H, Random, 95% CI)	1.75 [0.46, 6.65]
16.2 After usual care	2	165	Odds Ratio (M-H, Random, 95% CI)	1.31 [0.70, 2.44]
17 Physical function - balance - Berg Balance scale	9	419	Mean Difference (IV, Random, 95% CI)	2.12 [0.82, 3.41]
17.1 During usual care	5	160	Mean Difference (IV, Random, 95% CI)	0.50 [-3.00, 4.01]
17.2 After usual care	4	259	Mean Difference (IV, Random, 95% CI)	2.64 [1.34, 3.95]
18 Physical function - balance - functional reach	2	166	Std. Mean Difference (IV, Random, 95% CI)	0.14 [-0.22, 0.50]
18.1 During usual care	0	0	Std. Mean Difference (IV, Random, 95% CI)	0.0 [0.0, 0.0]
18.2 After usual care	2	166	Std. Mean Difference (IV, Random, 95% CI)	0.14 [-0.22, 0.50]
19 Physical function - balance - combined outcome data	12	755	Std. Mean Difference (IV, Random, 95% CI)	0.28 [0.11, 0.45]
19.1 During usual care	5	160	Std. Mean Difference (IV, Random, 95% CI)	0.10 [-0.23, 0.43]
19.2 After usual care	7	595	Std. Mean Difference (IV, Random, 95% CI)	0.35 [0.15, 0.54]
20 Physical function - Timed Up and Go (sec)	7	586	Mean Difference (IV, Random, 95% CI)	-2.21 [-4.43, 0.02]
20.1 During usual care	2	91	Mean Difference (IV, Random, 95% CI)	-8.17 [-20.66, 4.33]
20.2 After usual care	5	495	Mean Difference (IV, Random, 95% CI)	-1.45 [-2.66, -0.24]

Outcome or subgroup title	No. of studies	No. of participants	Statistical method	Effect size
21 Health-related QoL - SF-36 physical functioning	2	112	Std. Mean Difference (IV, Random, 95% CI)	0.48 [0.10, 0.85]
21.1 During usual care	0	0	Std. Mean Difference (IV, Random, 95% CI)	0.0 [0.0, 0.0]
21.2 After usual care	2	112	Std. Mean Difference (IV, Random, 95% CI)	0.48 [0.10, 0.85]
22 Health-related QoL - SF-36 physical role functioning	3	178	Std. Mean Difference (IV, Random, 95% CI)	0.56 [0.26, 0.86]
22.1 During usual care	0	0	Std. Mean Difference (IV, Random, 95% CI)	0.0 [0.0, 0.0]
22.2 After usual care	3	178	Std. Mean Difference (IV, Random, 95% CI)	0.56 [0.26, 0.86]
23 Health-related QoL - SF-36 social role functioning	2	112	Std. Mean Difference (IV, Random, 95% CI)	0.48 [-0.22, 1.17]
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	112	Std. Mean Difference (IV, Random, 95% CI)	0.48 [-0.22, 1.17]
24 Mood - Hospital Anxiety and Depression Scale (HADS) - anxiety score	3	391	Mean Difference (IV, Random, 95% CI)	-0.28 [-0.95, 0.40]
24.1 During usual care	0	0	Mean Difference (IV, Random, 95% CI)	0.0 [0.0, 0.0]
24.2 After usual care	3	391	Mean Difference (IV, Random, 95% CI)	-0.28 [-0.95, 0.40]
25 Mood - Hospital Anxiety and Depression Scale (HADS) - depression score	3	391	Mean Difference (IV, Random, 95% CI)	0.59 [-0.08, 1.26]
25.1 During usual care	0	0	Mean Difference (IV, Random, 95% CI)	0.0 [0.0, 0.0]
25.2 After usual care	3	391	Mean Difference (IV, Random, 95% CI)	0.59 [-0.08, 1.26]
26 Mood - Stroke Impact Scale emotion score	2	335	Mean Difference (IV, Random, 95% CI)	2.87 [-3.40, 9.14]
26.1 During usual care	0	0	Mean Difference (IV, Random, 95% CI)	0.0 [0.0, 0.0]
26.2 After usual care	2	335	Mean Difference (IV, Random, 95% CI)	2.87 [-3.40, 9.14]

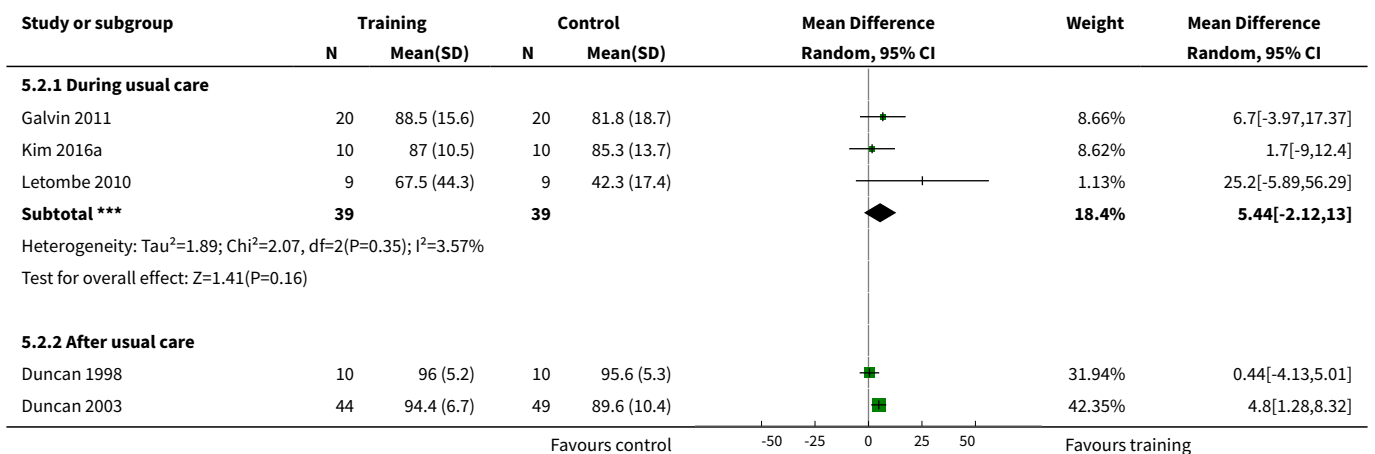
Outcome or subgroup title	No. of studies	No. of participants	Statistical method	Effect size
27 Mood - combined depression scales	4	484	Std. Mean Difference (IV, Random, 95% CI)	-0.01 [-0.39, 0.37]
27.1 During usual care	0	0	Std. Mean Difference (IV, Random, 95% CI)	0.0 [0.0, 0.0]
27.2 After usual care	4	484	Std. Mean Difference (IV, Random, 95% CI)	-0.01 [-0.39, 0.37]
28 Cognitive function - FIM cognitive score	2	159	Mean Difference (IV, Random, 95% CI)	-0.08 [-0.47, 0.31]
28.1 During usual care	0	0	Mean Difference (IV, Random, 95% CI)	0.0 [0.0, 0.0]
28.2 After usual care	2	159	Mean Difference (IV, Random, 95% CI)	-0.08 [-0.47, 0.31]
29 Cognitive function - SIS memory and thinking	2	133	Mean Difference (IV, Random, 95% CI)	1.57 [-10.56, 13.70]
29.1 During usual care	0	0	Mean Difference (IV, Random, 95% CI)	0.0 [0.0, 0.0]
29.2 After usual care	2	133	Mean Difference (IV, Random, 95% CI)	1.57 [-10.56, 13.70]
30 Cognitive function - SIS communication	2	133	Mean Difference (IV, Random, 95% CI)	-1.19 [-12.06, 9.67]
30.1 During usual care	0	0	Mean Difference (IV, Random, 95% CI)	0.0 [0.0, 0.0]
30.2 After usual care	2	133	Mean Difference (IV, Random, 95% CI)	-1.19 [-12.06, 9.67]

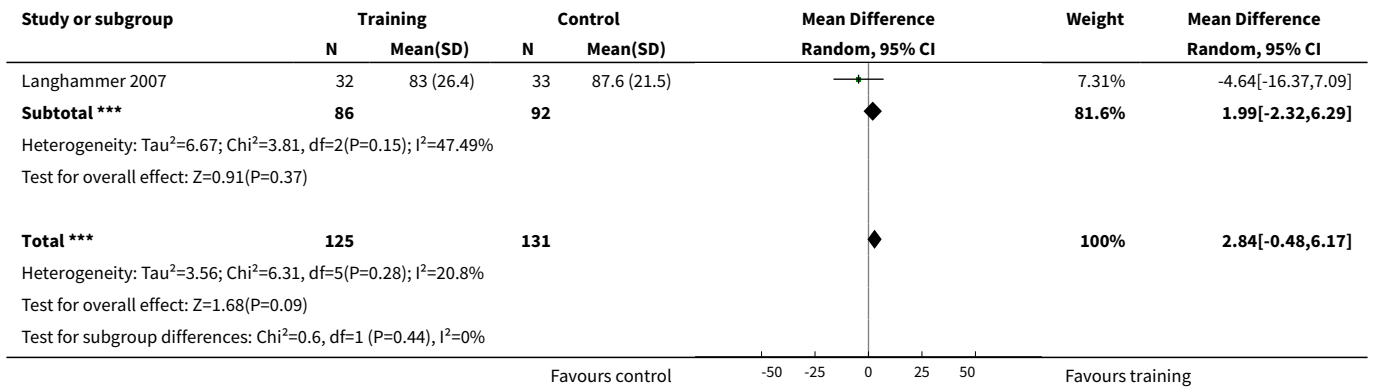
Analysis 5.1. Comparison 5 Mixed training versus control - end of intervention, Outcome 1 Death.



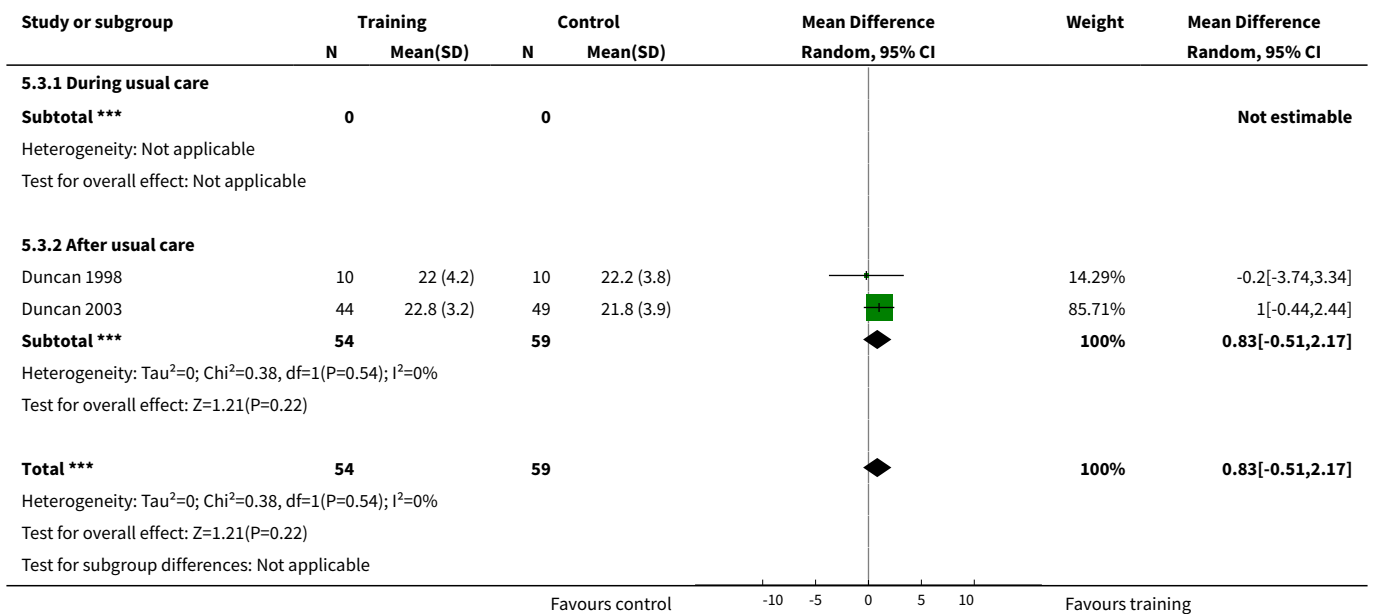


Analysis 5.2. Comparison 5 Mixed training versus control - end of intervention, Outcome 2 Disability - Barthel Index (BI).

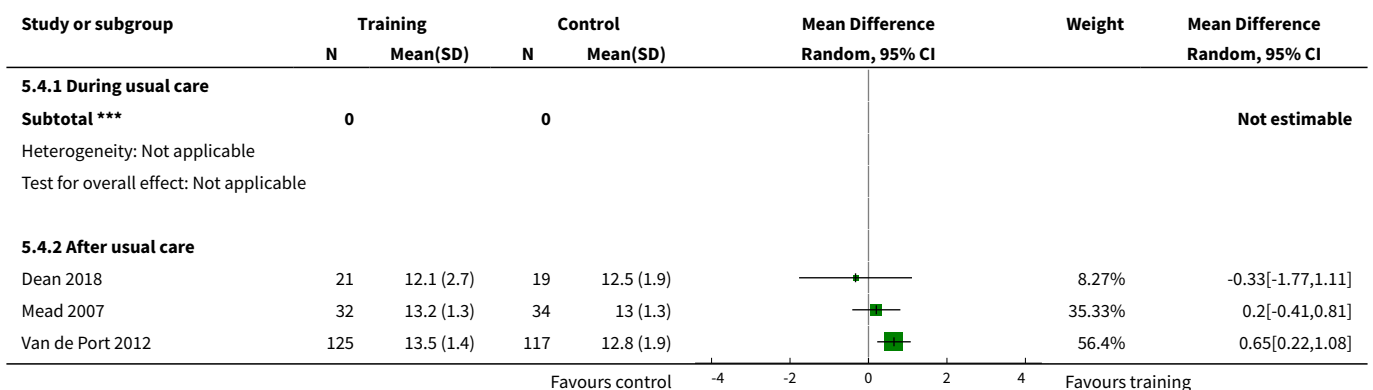


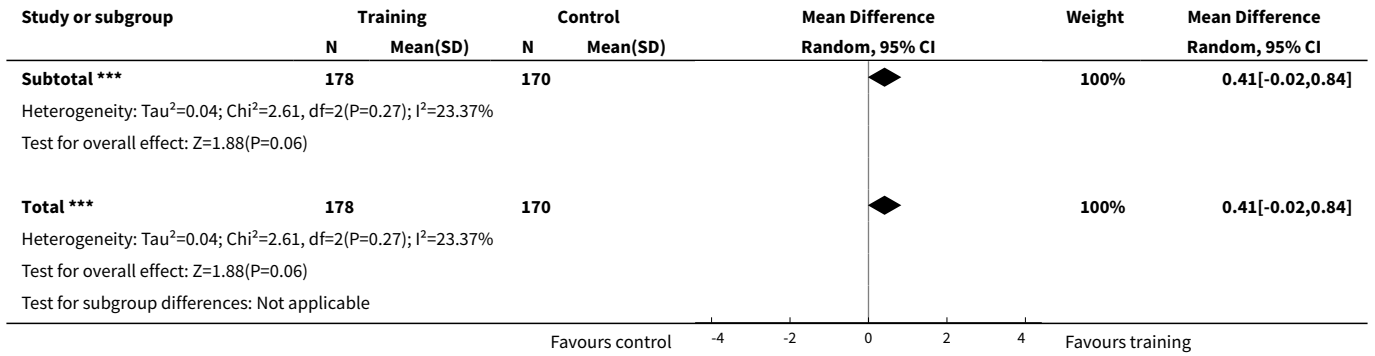


Analysis 5.3. Comparison 5 Mixed training versus control - end of intervention, Outcome 3 Disability - Lawton IADL.

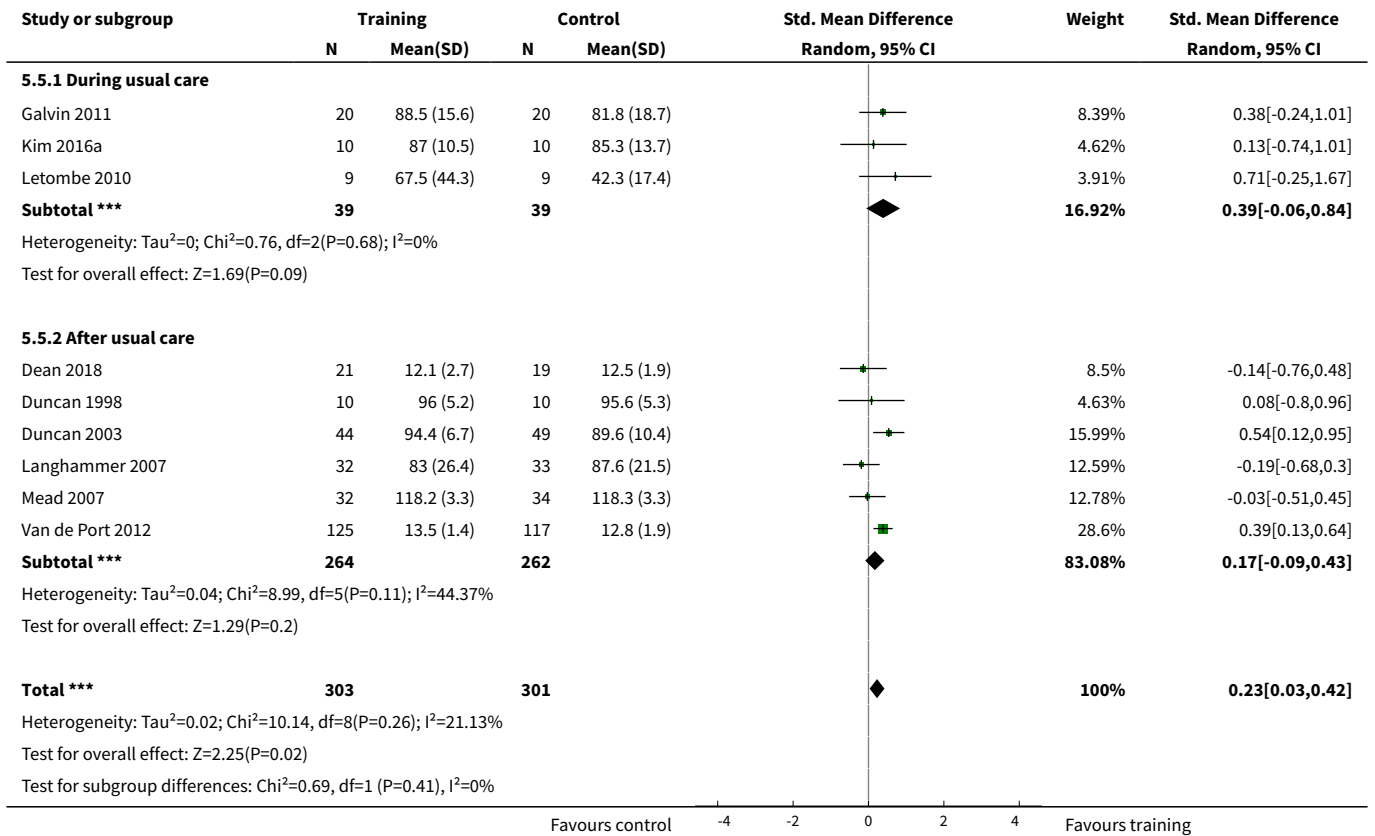


Analysis 5.4. Comparison 5 Mixed training versus control - end of intervention, Outcome 4 Disability - Rivermead Mobility Index (RMI).

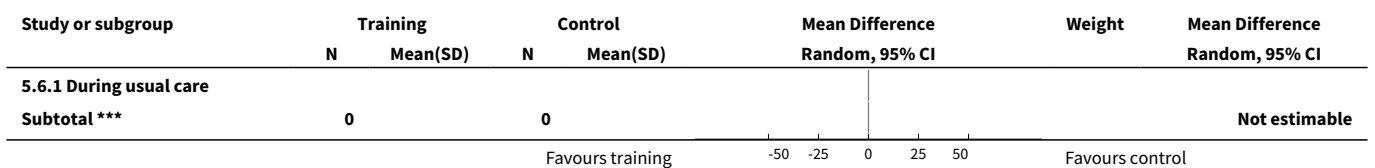


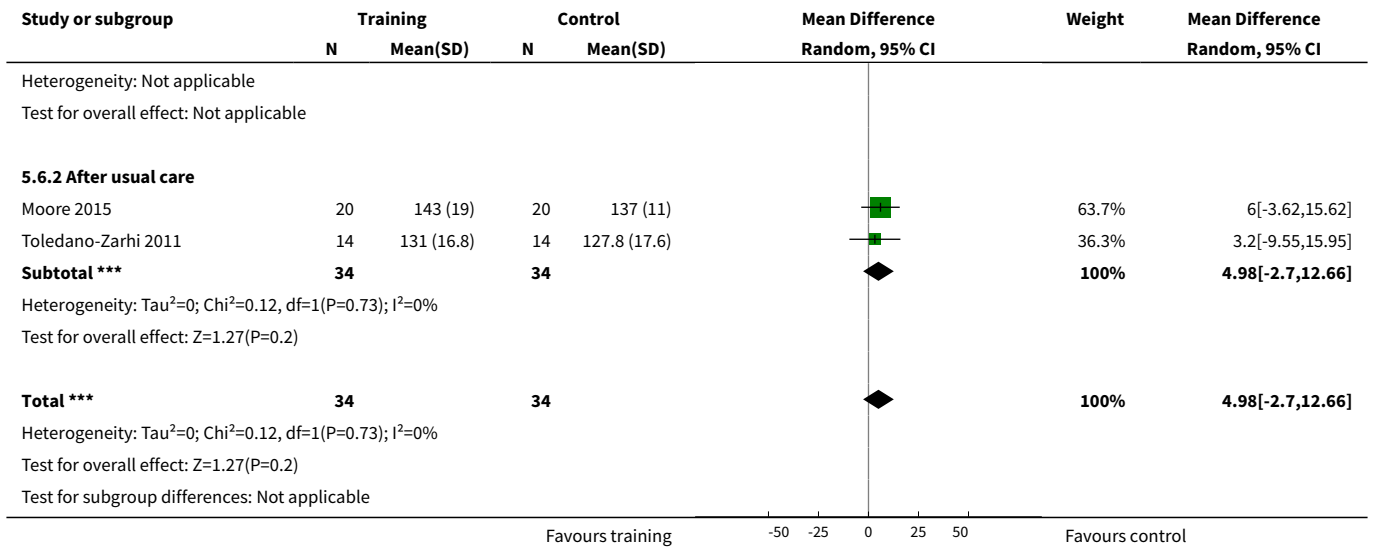


Analysis 5.5. Comparison 5 Mixed training versus control - end of intervention, Outcome 5 Disability - combined disability scales.

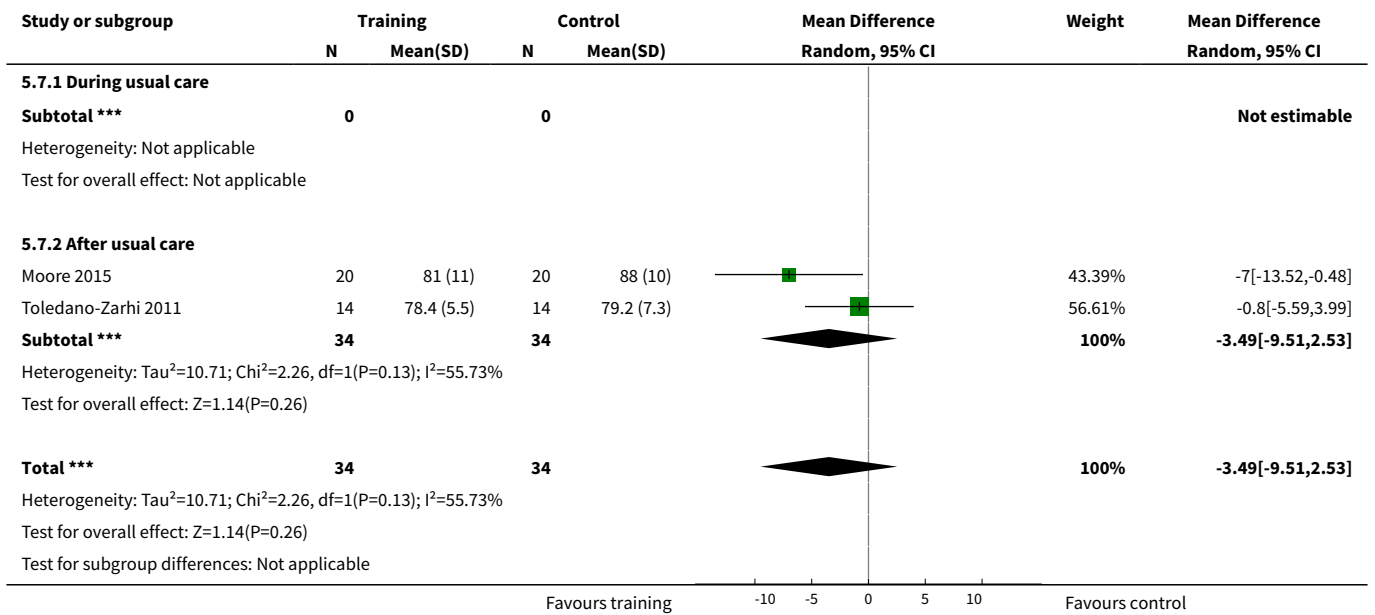


Analysis 5.6. Comparison 5 Mixed training versus control - end of intervention, Outcome 6 Risk factors - blood pressure, systolic.

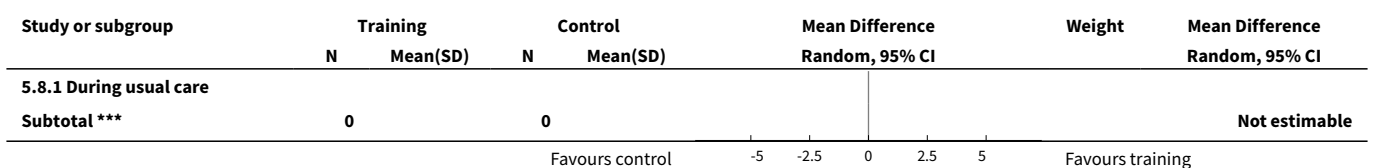


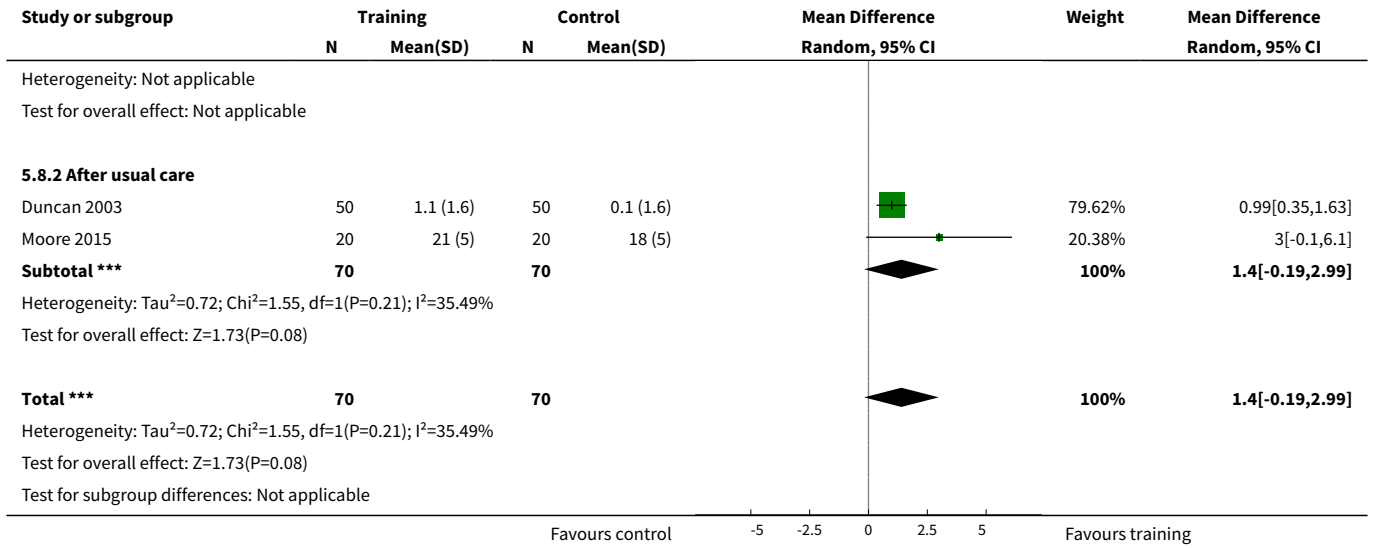


Analysis 5.7. Comparison 5 Mixed training versus control - end of intervention, Outcome 7 Risk factors - blood pressure, diastolic.

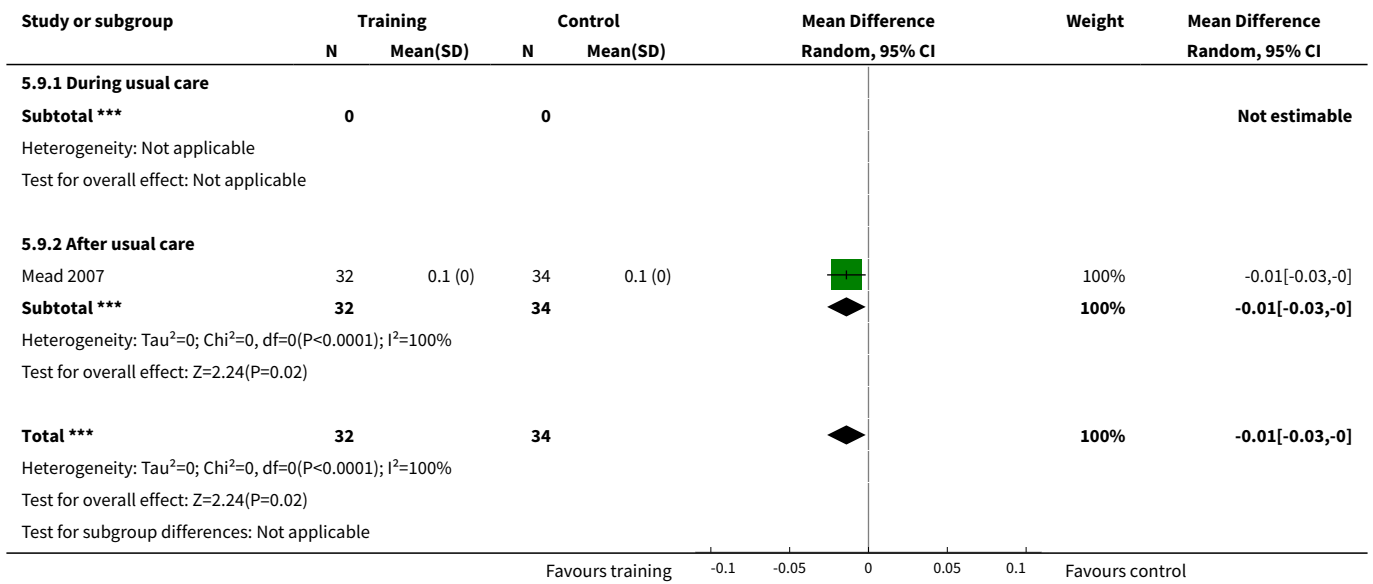


Analysis 5.8. Comparison 5 Mixed training versus control - end of intervention, Outcome 8 Physical fitness - peak VO₂ (mL/kg/min).

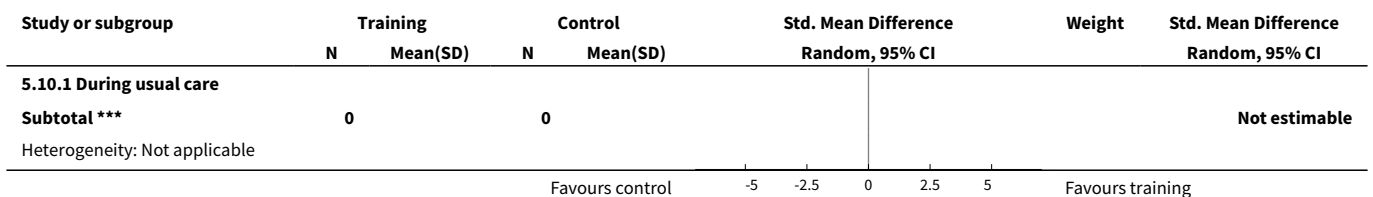


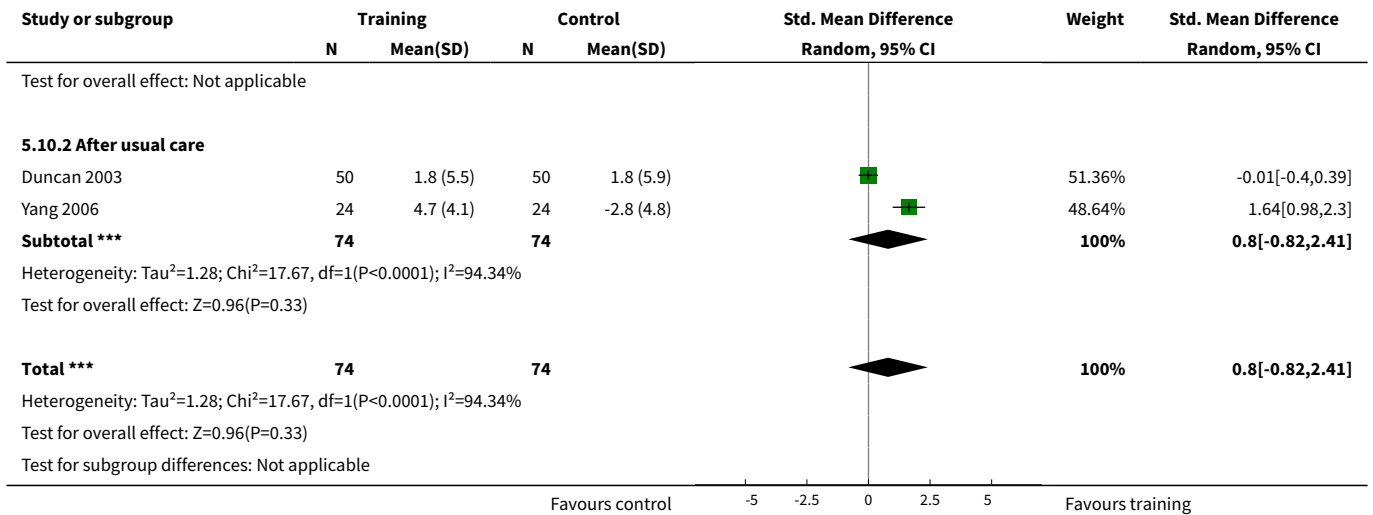


Analysis 5.9. Comparison 5 Mixed training versus control - end of intervention, Outcome 9 Physical fitness - gait economy, VO₂ (mL/kg/metre).

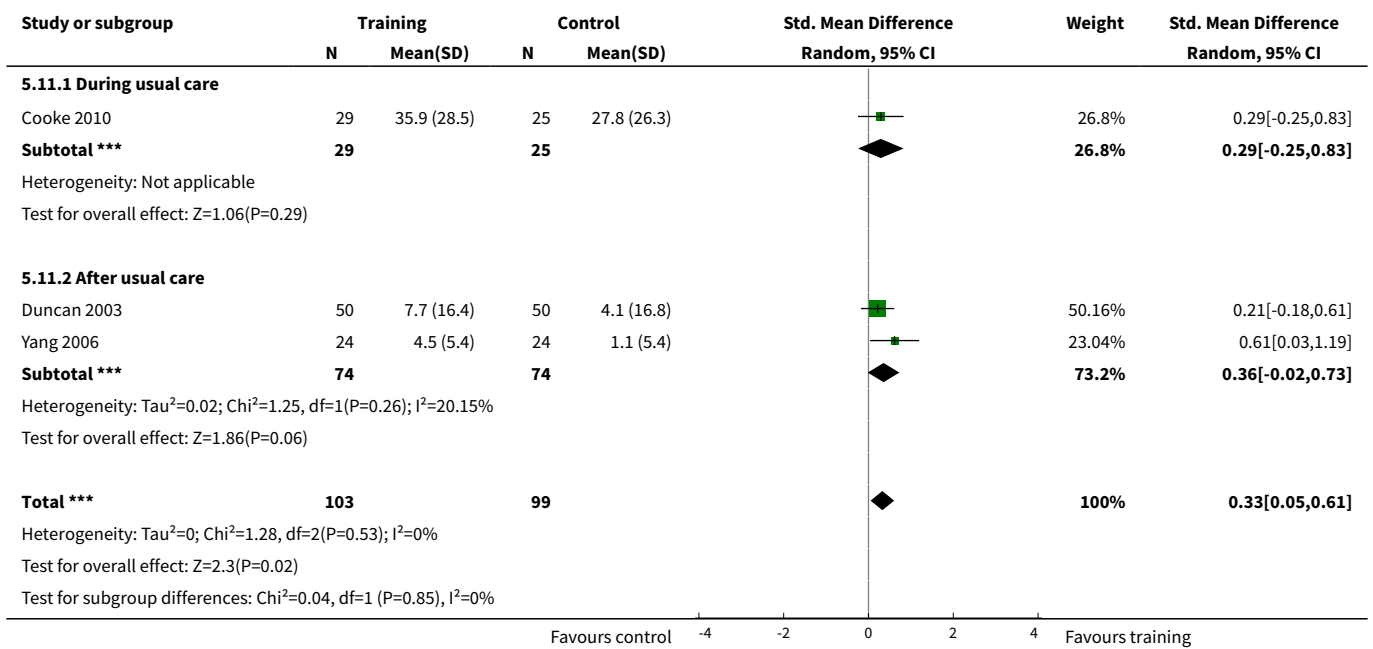


Analysis 5.10. Comparison 5 Mixed training versus control - end of intervention, Outcome 10 Physical fitness - muscle strength, ankle dorsiflexion*.

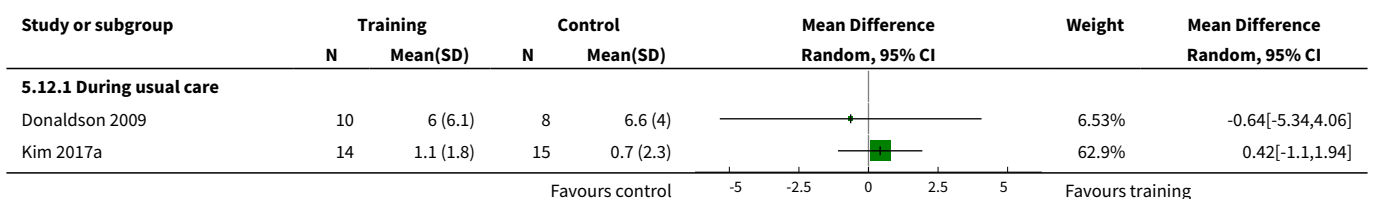


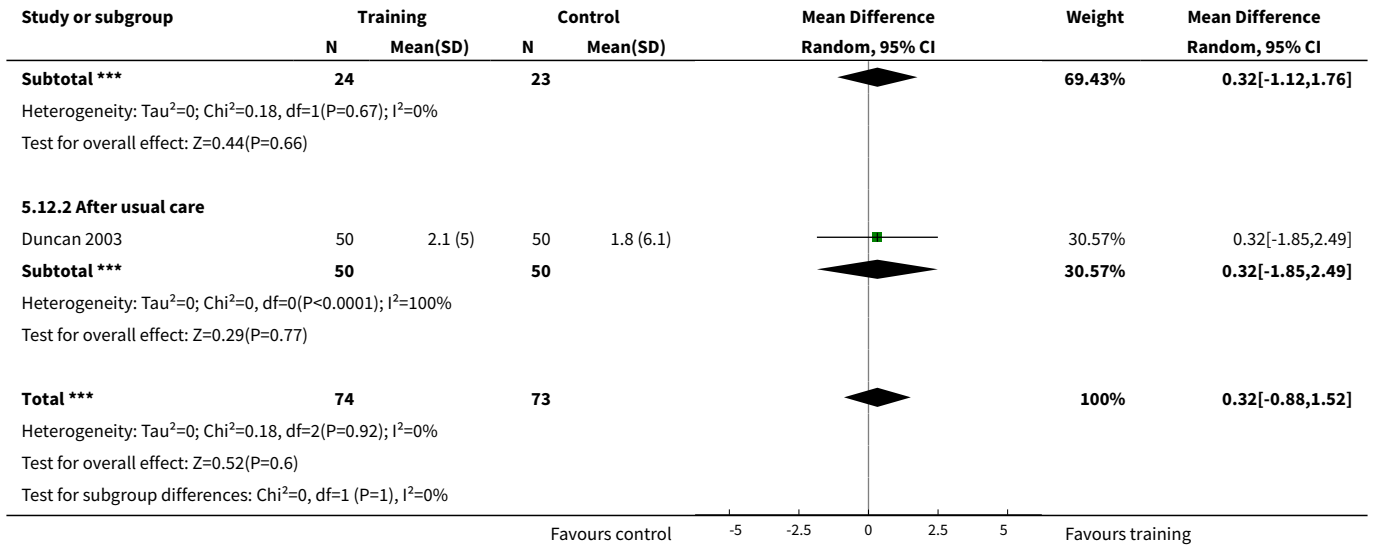


Analysis 5.11. Comparison 5 Mixed training versus control - end of intervention, Outcome 11 Physical fitness - muscle strength, knee extension*.

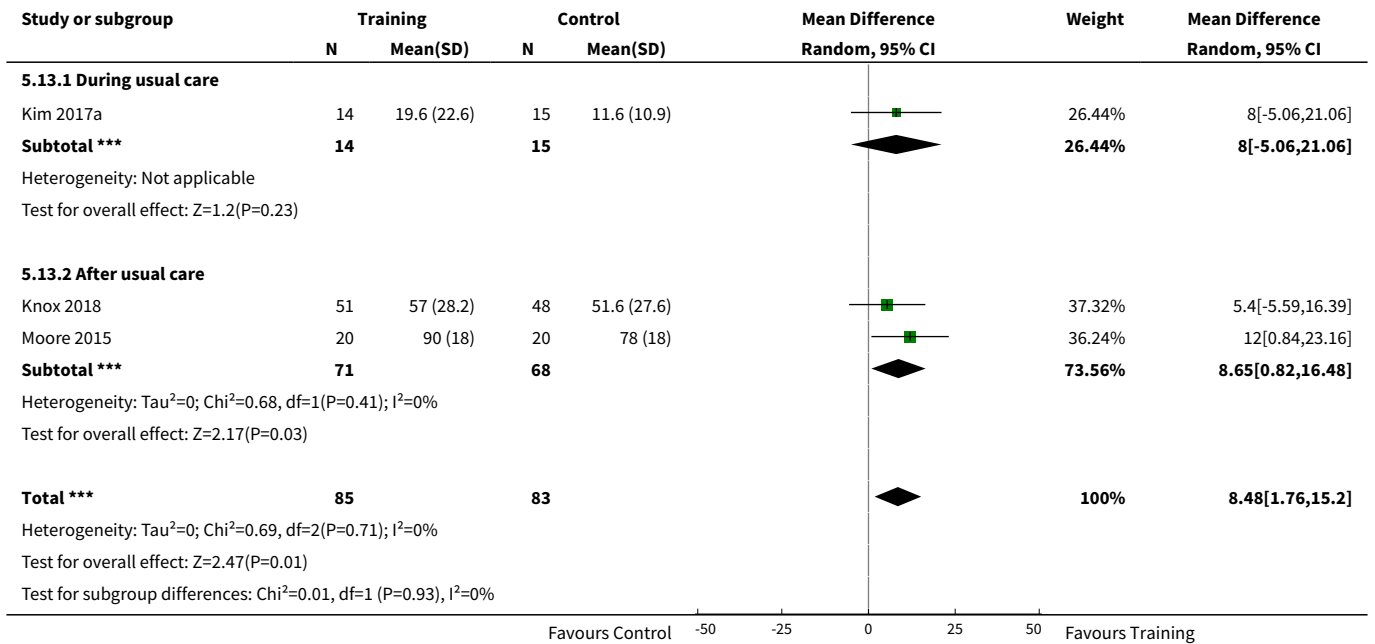


Analysis 5.12. Comparison 5 Mixed training versus control - end of intervention, Outcome 12 Physical fitness - muscle strength, grip strength (paretic hand).

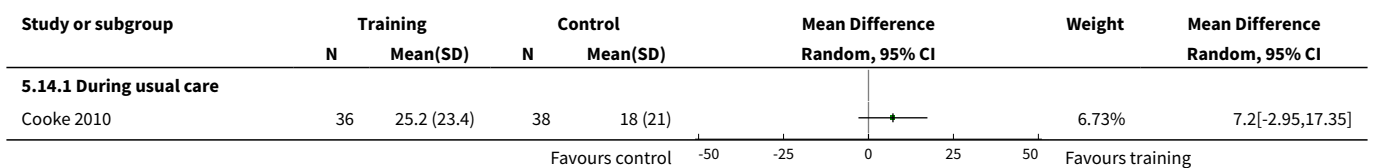


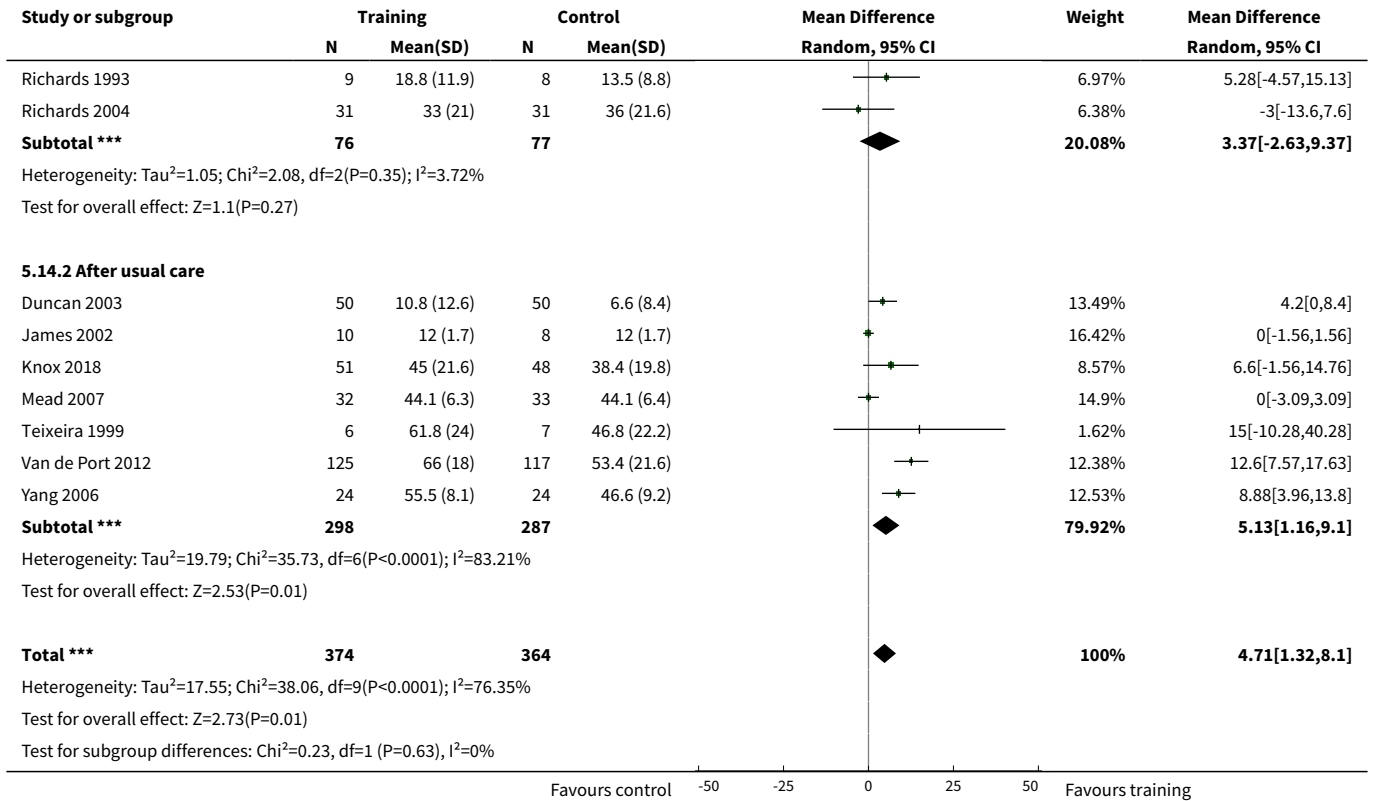


Analysis 5.13. Comparison 5 Mixed training versus control - end of intervention, Outcome 13 Mobility - walking maximum speed.

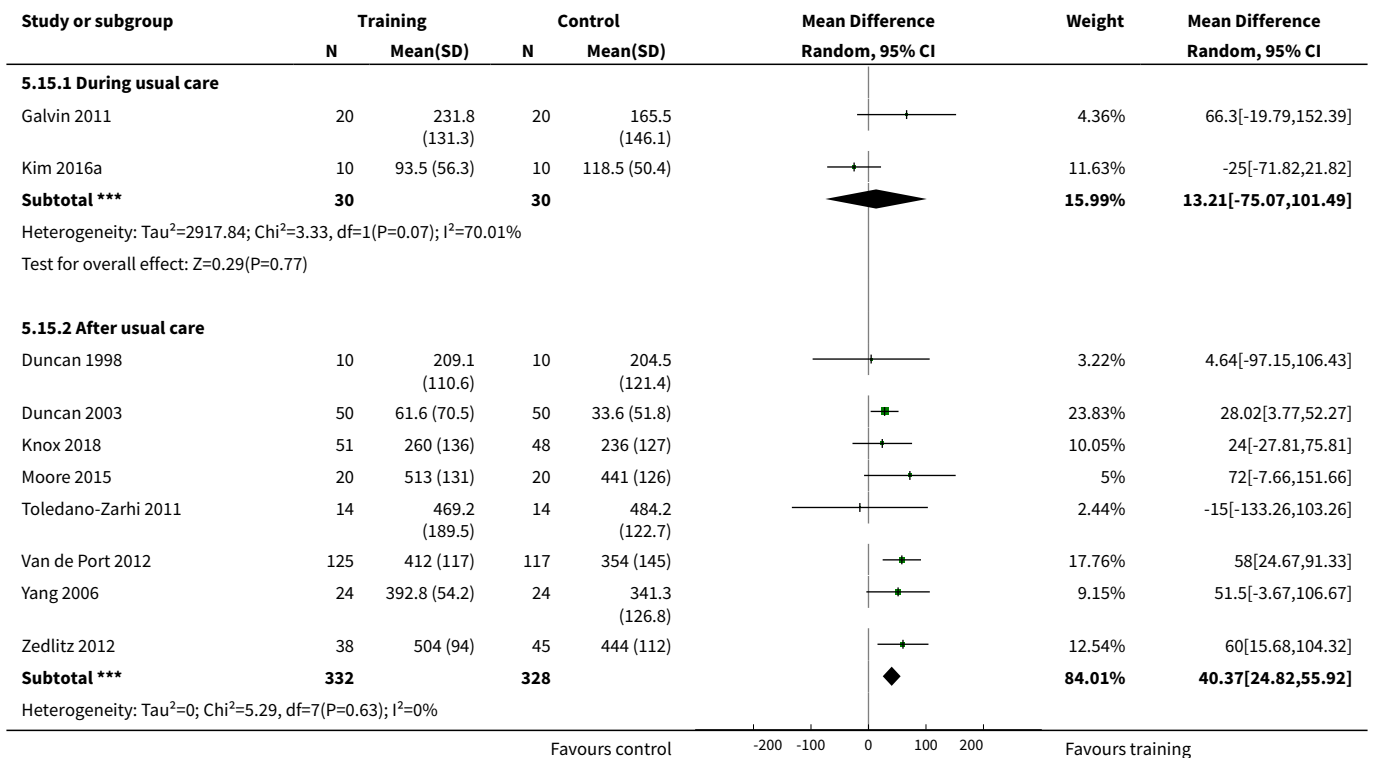


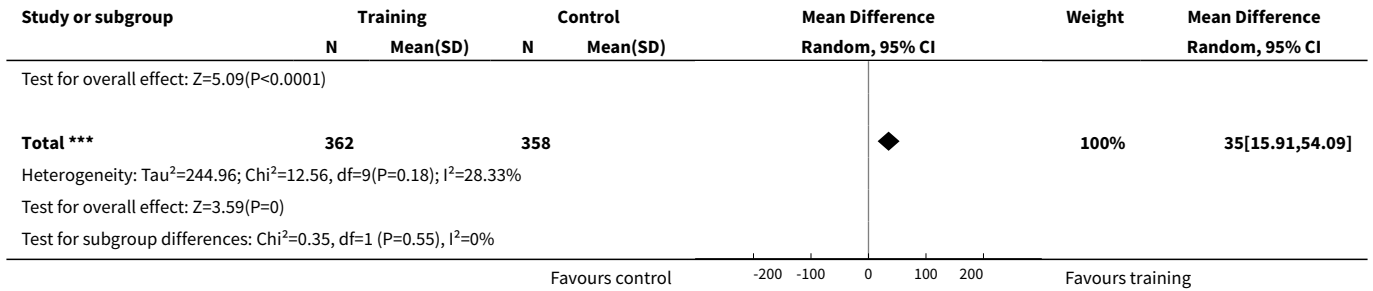
Analysis 5.14. Comparison 5 Mixed training versus control - end of intervention, Outcome 14 Mobility - walking preferred speed (m/min).



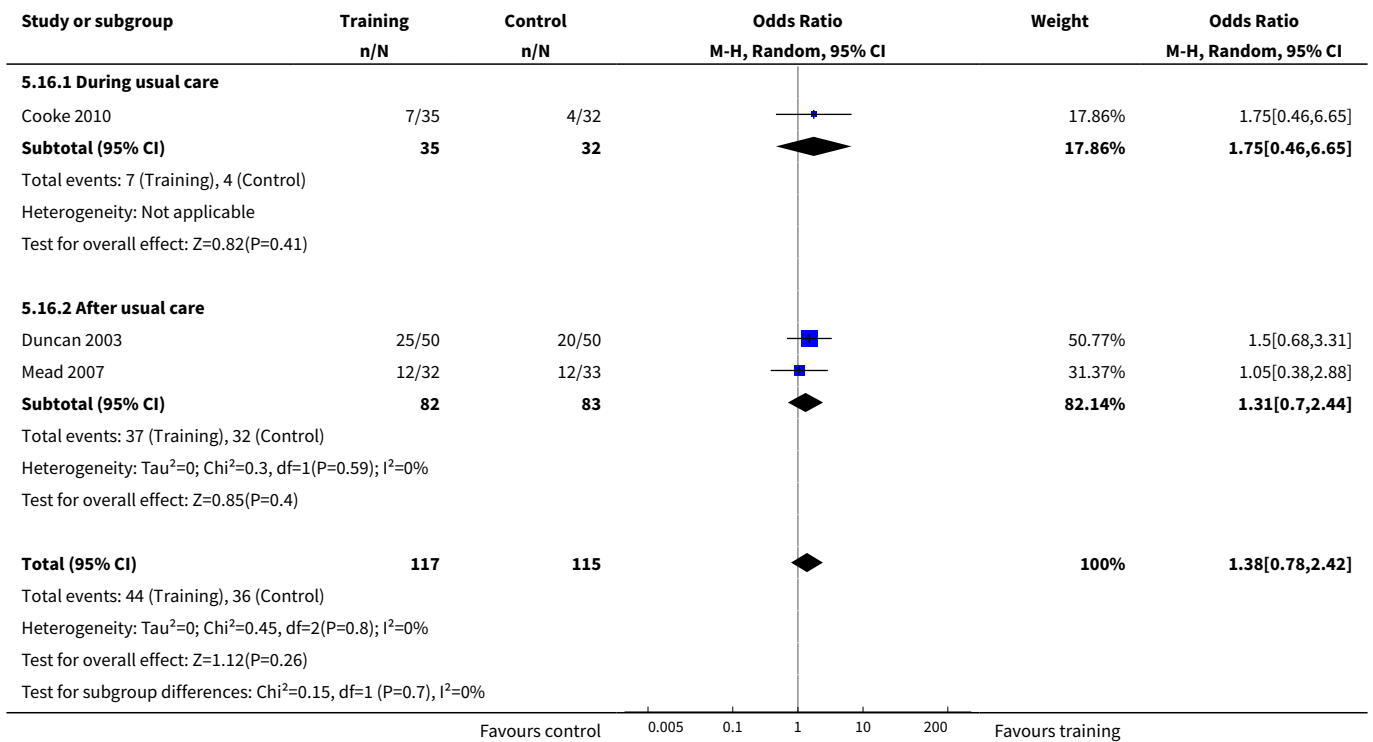


Analysis 5.15. Comparison 5 Mixed training versus control - end of intervention, Outcome 15 Mobility - walking capacity (6-MWT metres).

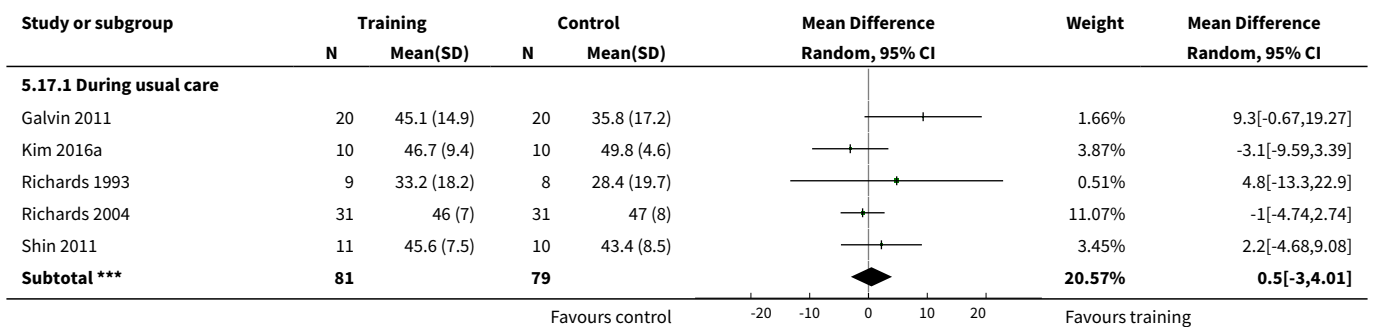


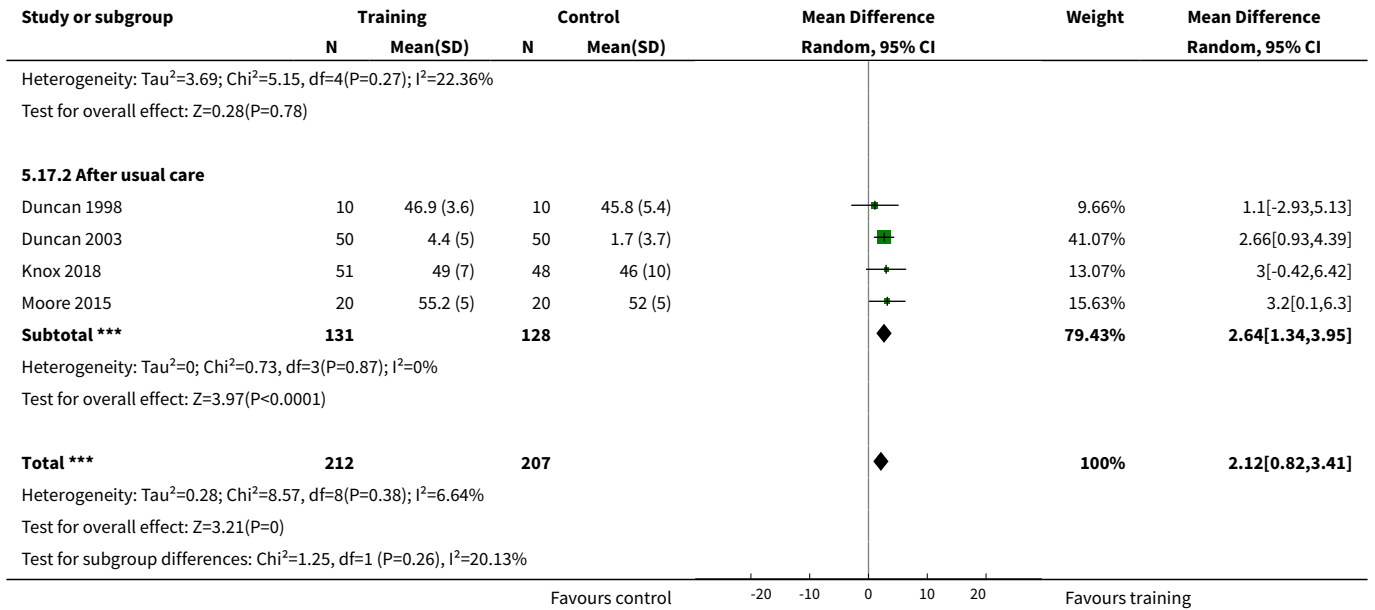


Analysis 5.16. Comparison 5 Mixed training versus control - end of intervention, Outcome 16 Mobility - Community Ambulation Speed (> 0.8 m/sec).

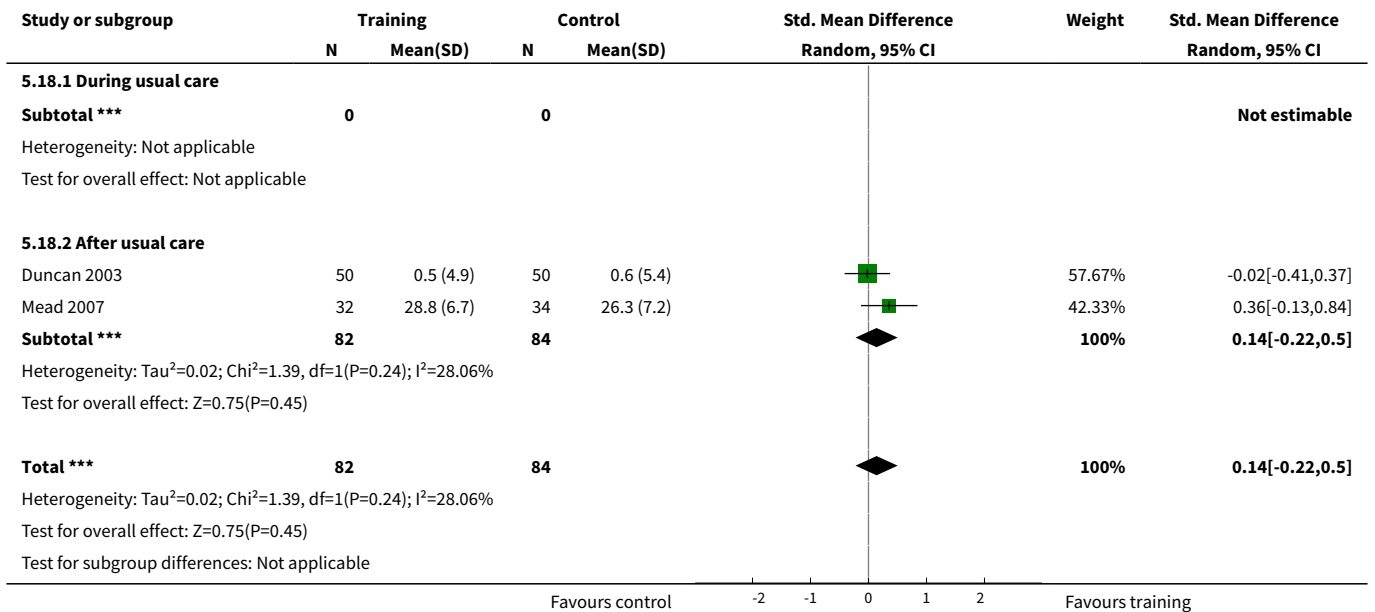


Analysis 5.17. Comparison 5 Mixed training versus control - end of intervention, Outcome 17 Physical function - balance - Berg Balance scale.

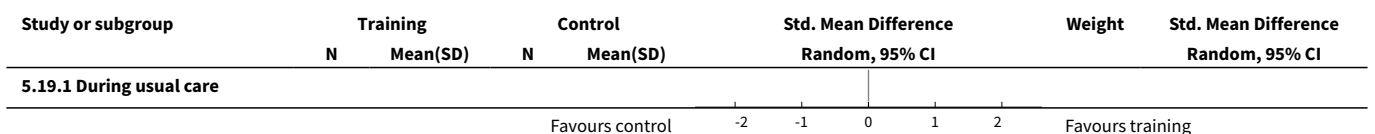


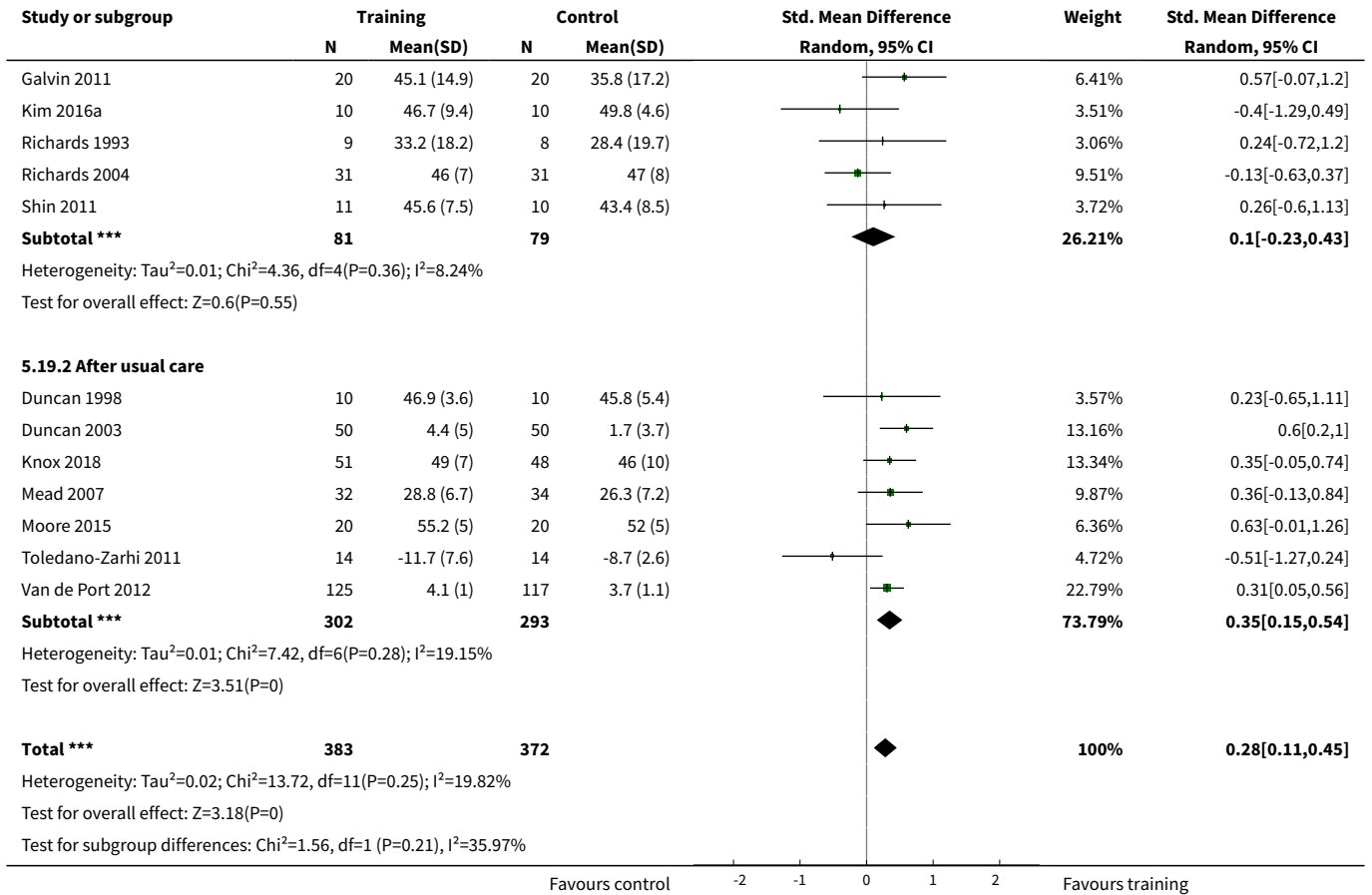


Analysis 5.18. Comparison 5 Mixed training versus control - end of intervention, Outcome 18 Physical function - balance - functional reach.

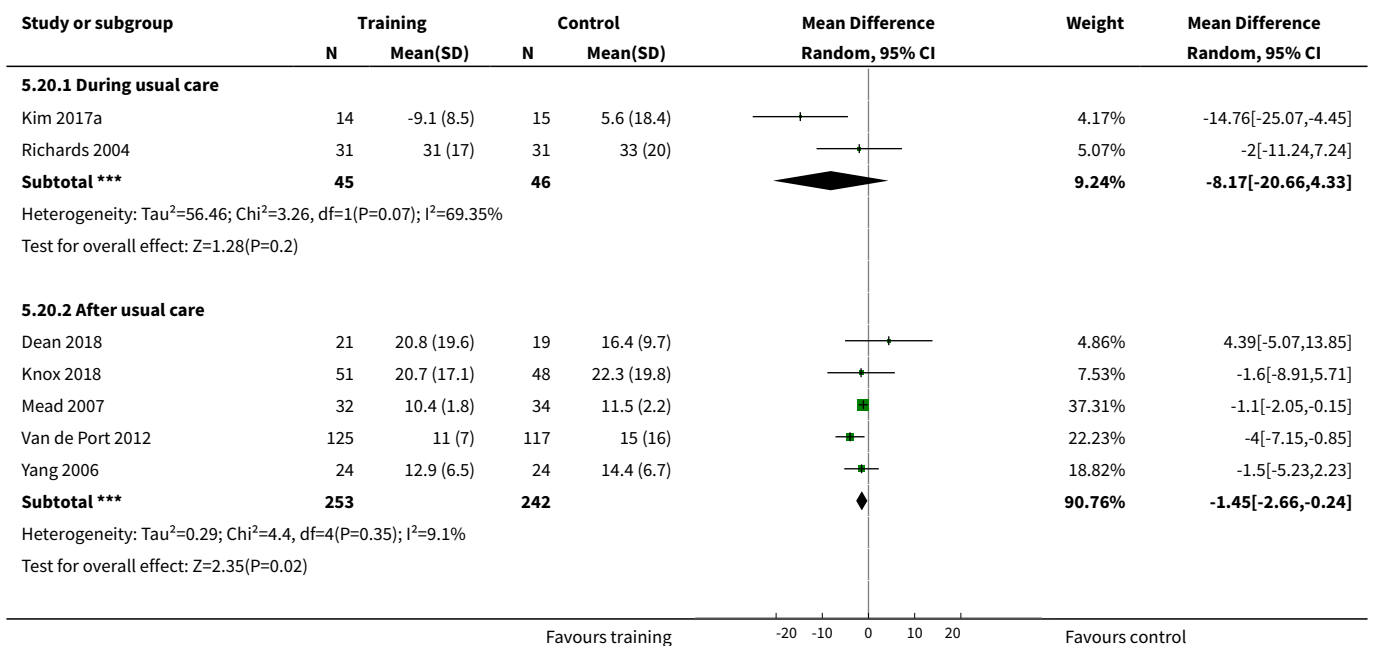


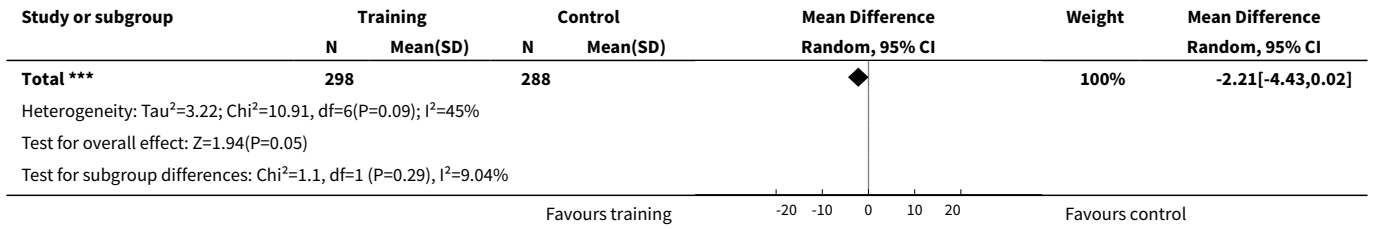
Analysis 5.19. Comparison 5 Mixed training versus control - end of intervention, Outcome 19 Physical function - balance - combined outcome data.



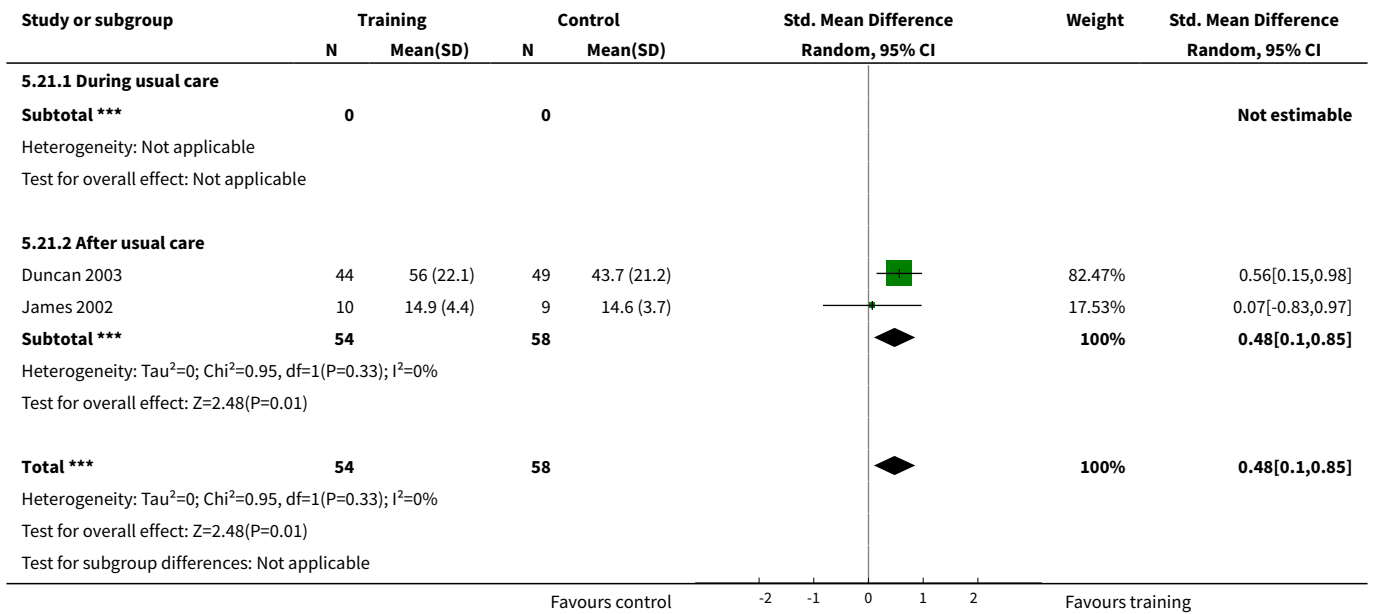


Analysis 5.20. Comparison 5 Mixed training versus control - end of intervention, Outcome 20 Physical function - Timed Up and Go (sec).

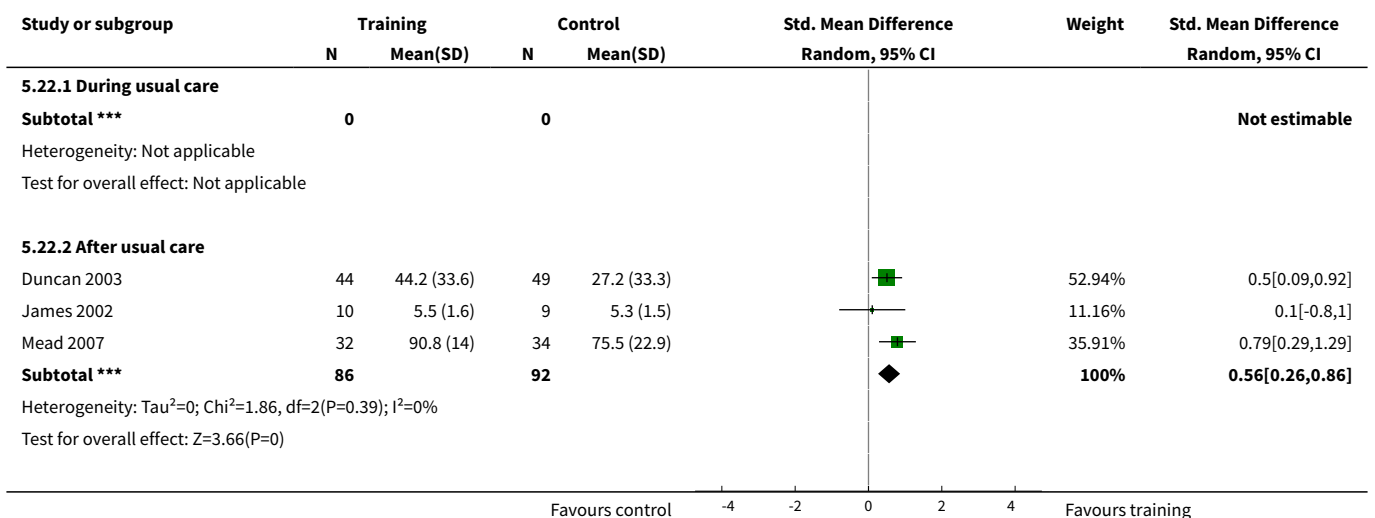


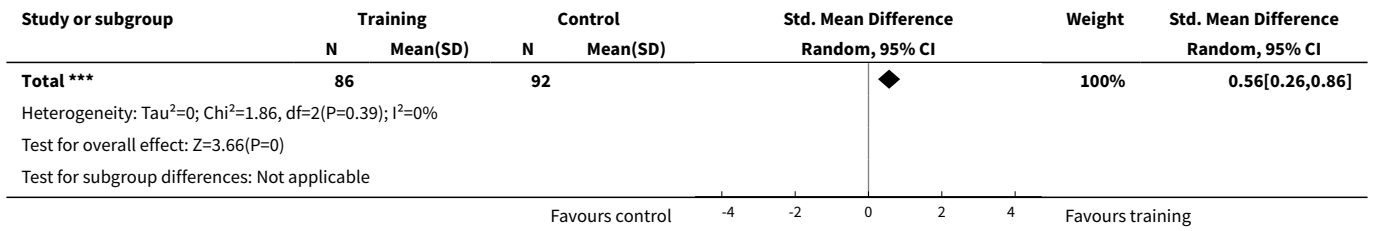


Analysis 5.21. Comparison 5 Mixed training versus control - end of intervention, Outcome 21 Health-related QoL - SF-36 physical functioning.

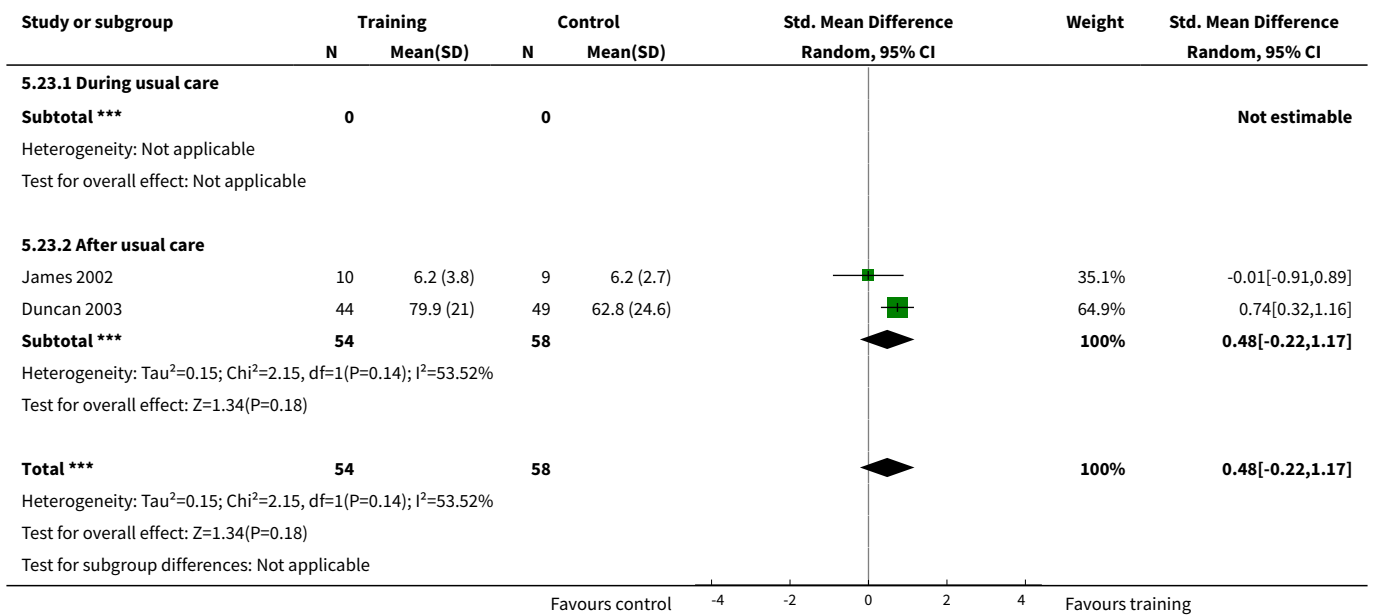


Analysis 5.22. Comparison 5 Mixed training versus control - end of intervention, Outcome 22 Health-related QoL - SF-36 physical role functioning.

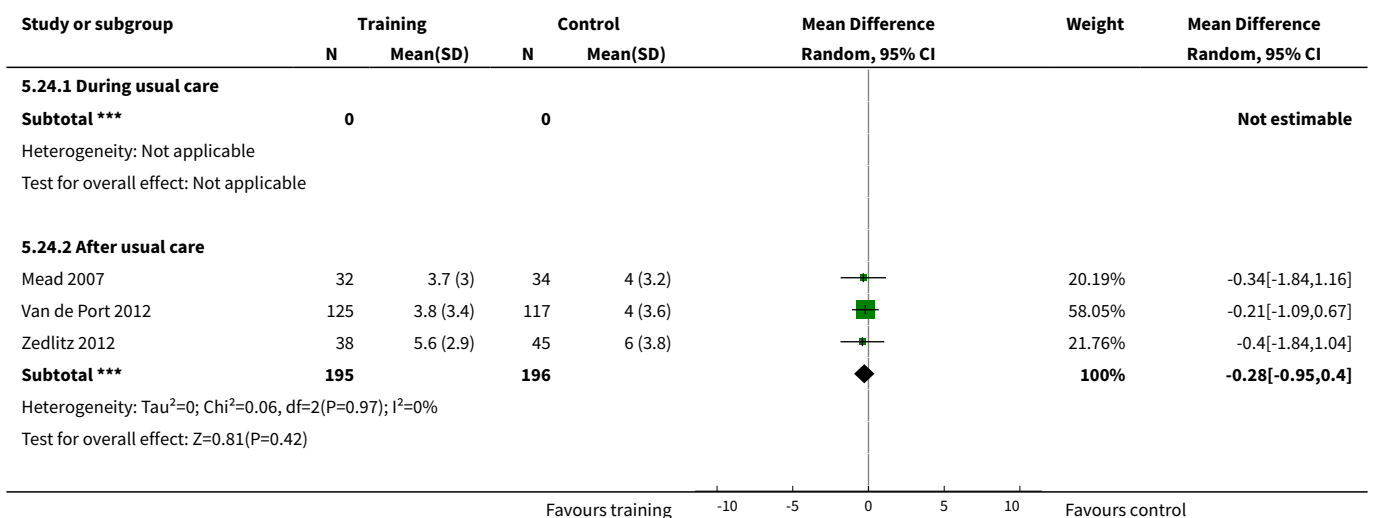


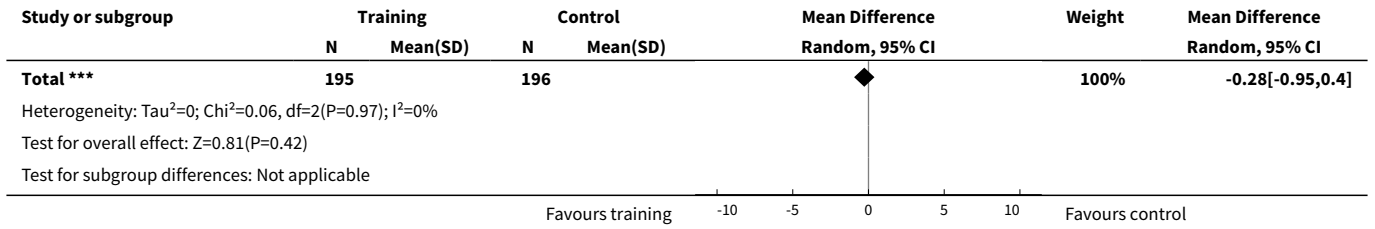


Analysis 5.23. Comparison 5 Mixed training versus control - end of intervention, Outcome 23 Health-related QoL - SF-36 social role functioning.

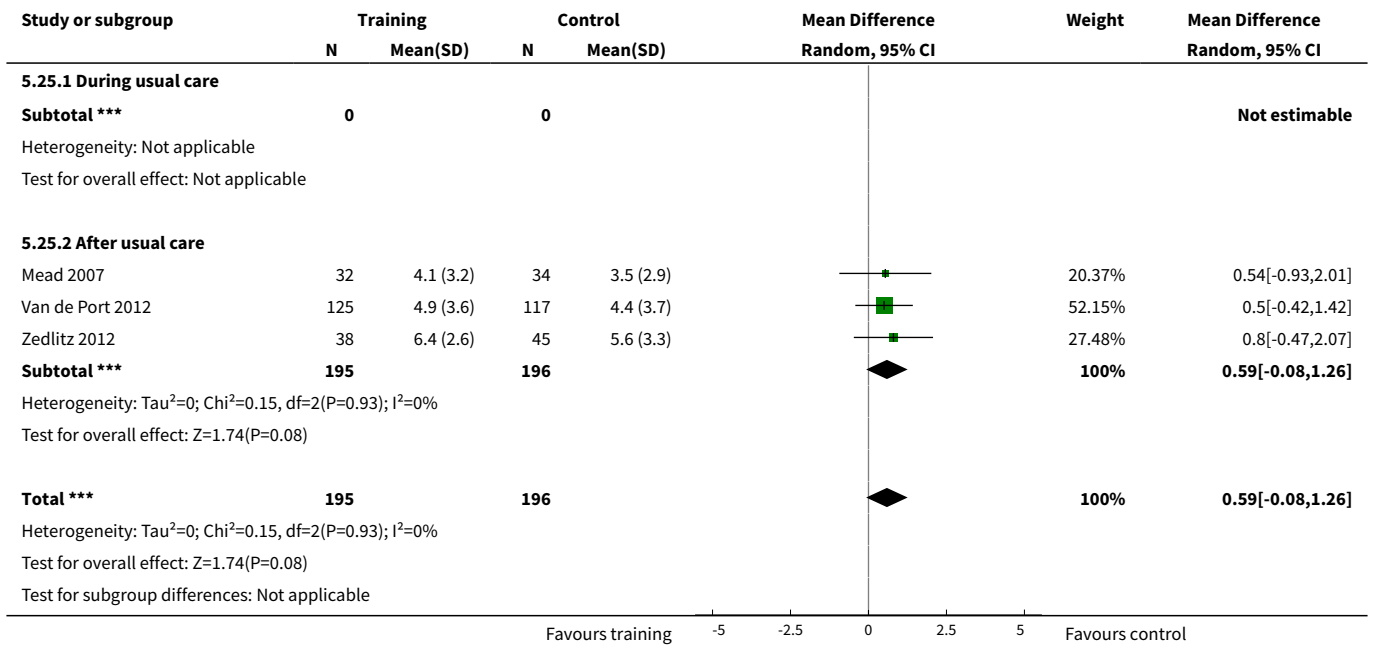


Analysis 5.24. Comparison 5 Mixed training versus control - end of intervention, Outcome 24 Mood - Hospital Anxiety and Depression Scale (HADS) - anxiety score.

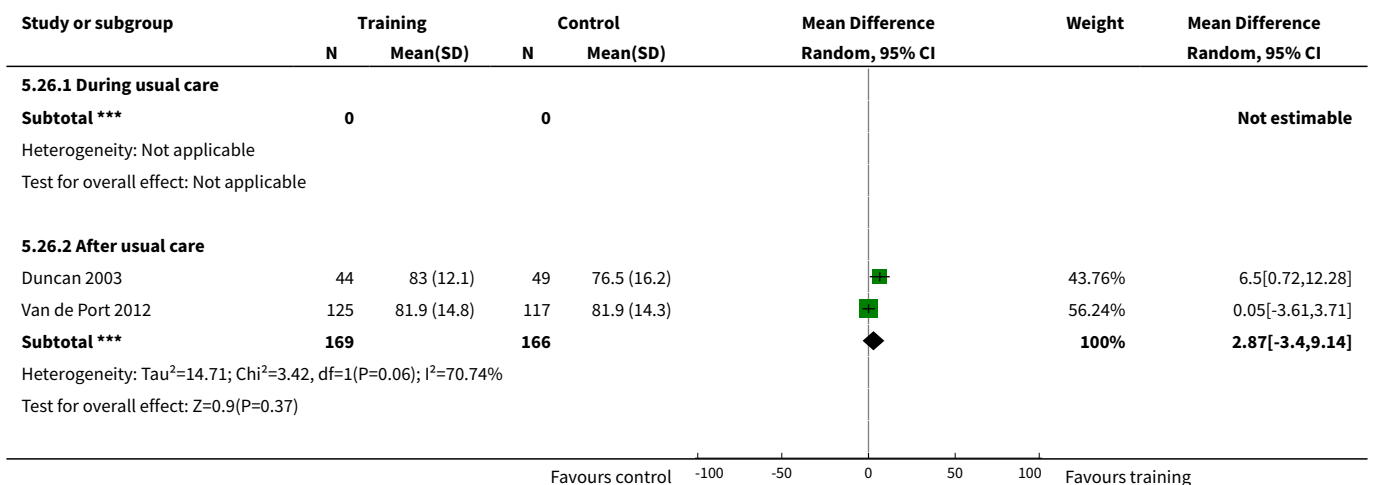


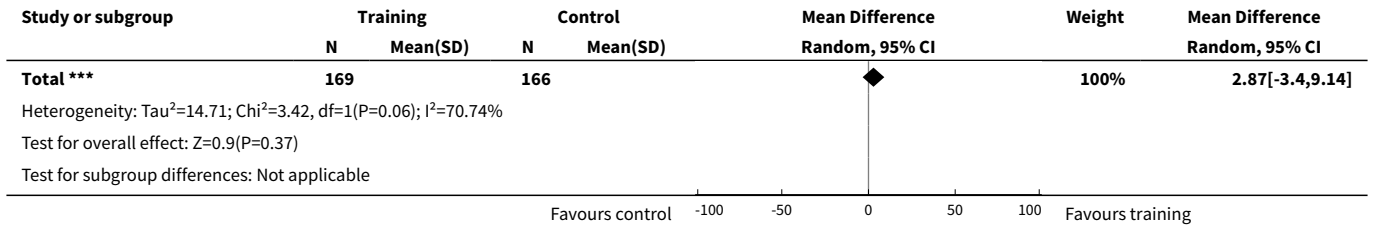


Analysis 5.25. Comparison 5 Mixed training versus control - end of intervention, Outcome 25 Mood - Hospital Anxiety and Depression Scale (HADS) - depression score.

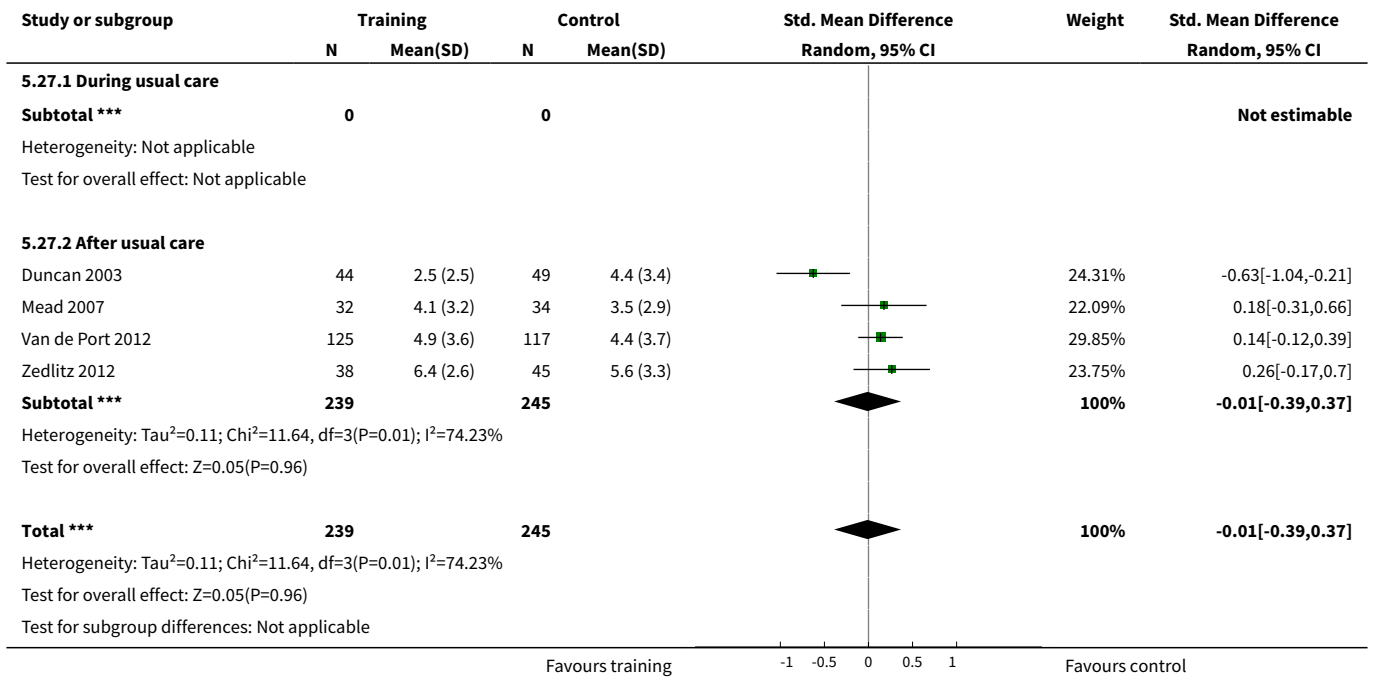


Analysis 5.26. Comparison 5 Mixed training versus control - end of intervention, Outcome 26 Mood - Stroke Impact Scale emotion score.

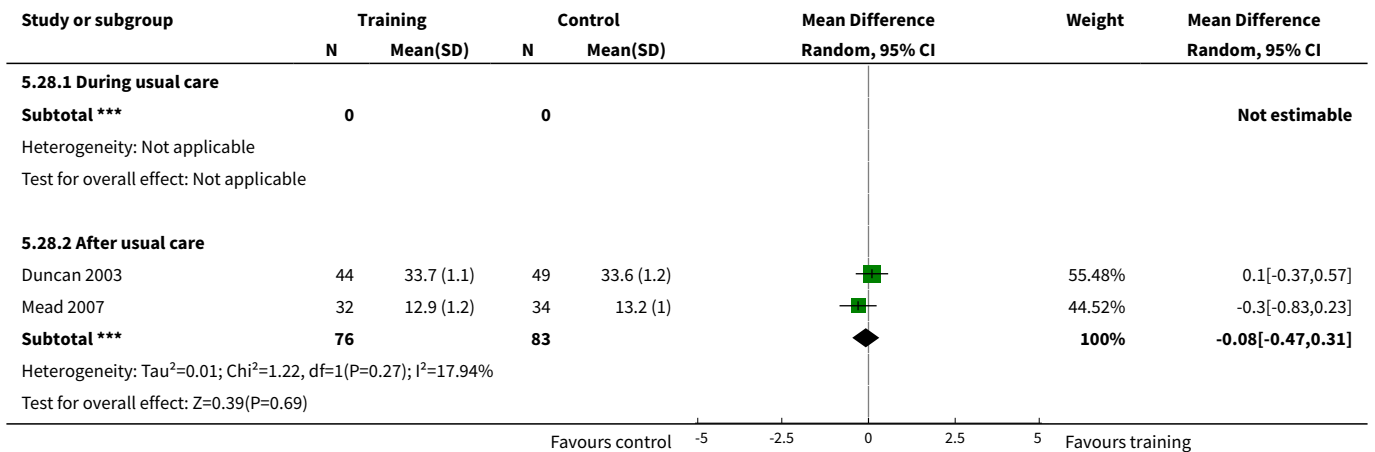


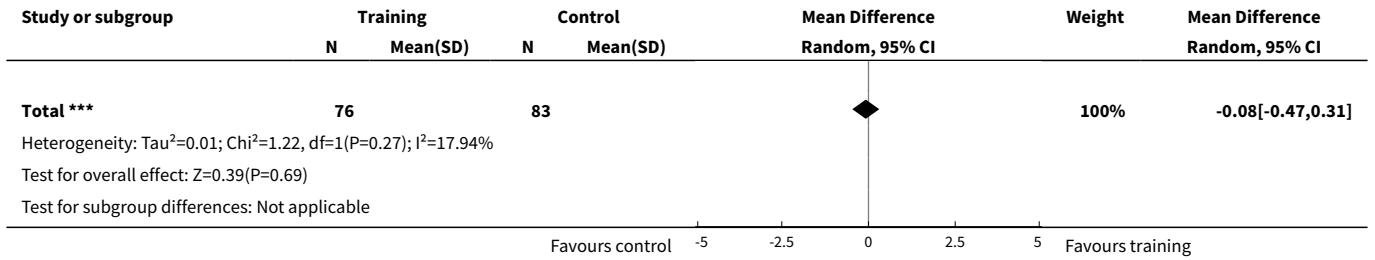


Analysis 5.27. Comparison 5 Mixed training versus control - end of intervention, Outcome 27 Mood - combined depression scales.

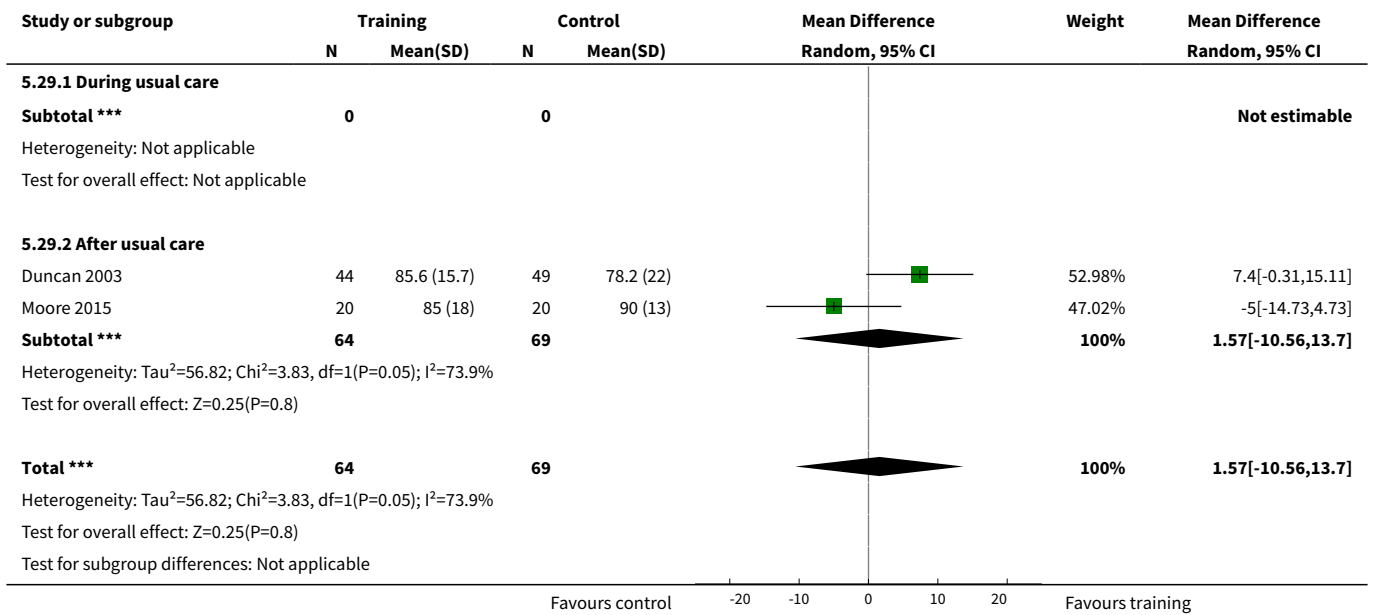


Analysis 5.28. Comparison 5 Mixed training versus control - end of intervention, Outcome 28 Cognitive function - FIM cognitive score.

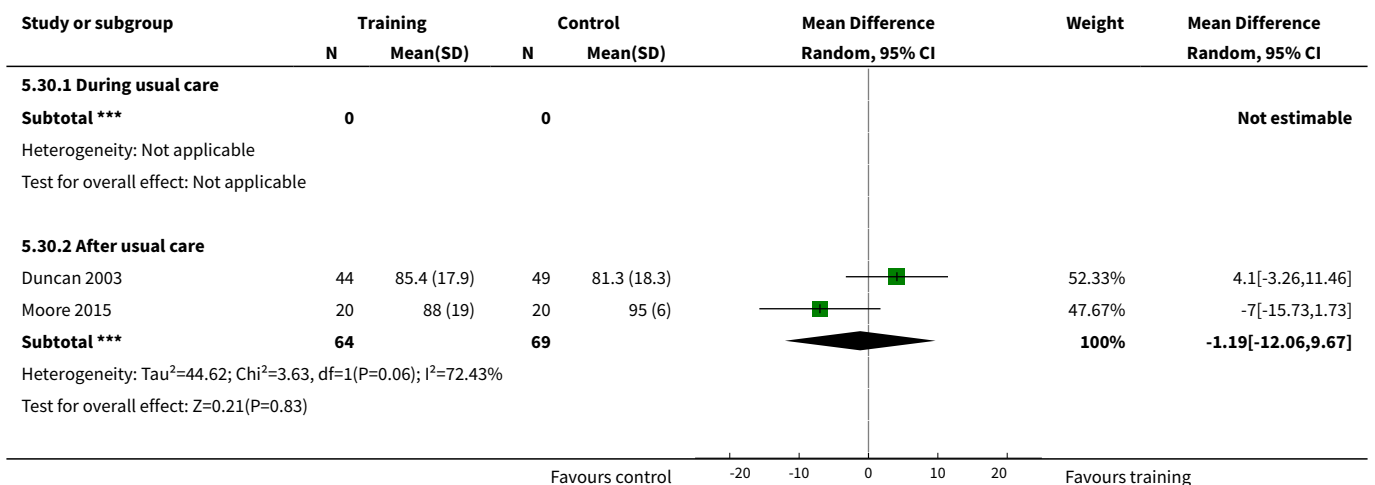


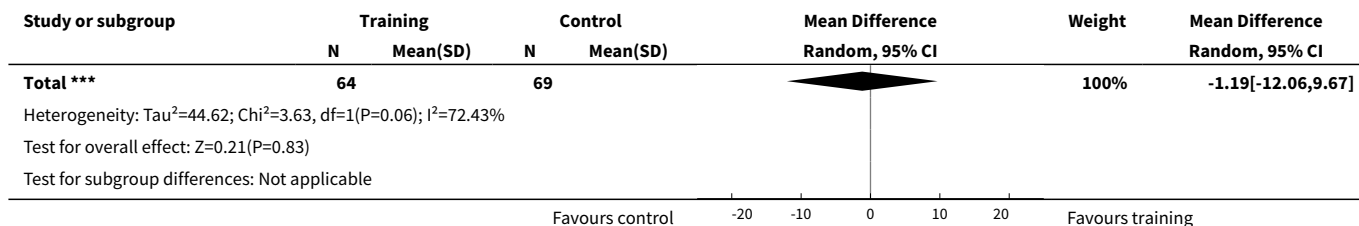


Analysis 5.29. Comparison 5 Mixed training versus control - end of intervention, Outcome 29 Cognitive function - SIS memory and thinking.



Analysis 5.30. Comparison 5 Mixed training versus control - end of intervention, Outcome 30 Cognitive function - SIS communication.





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

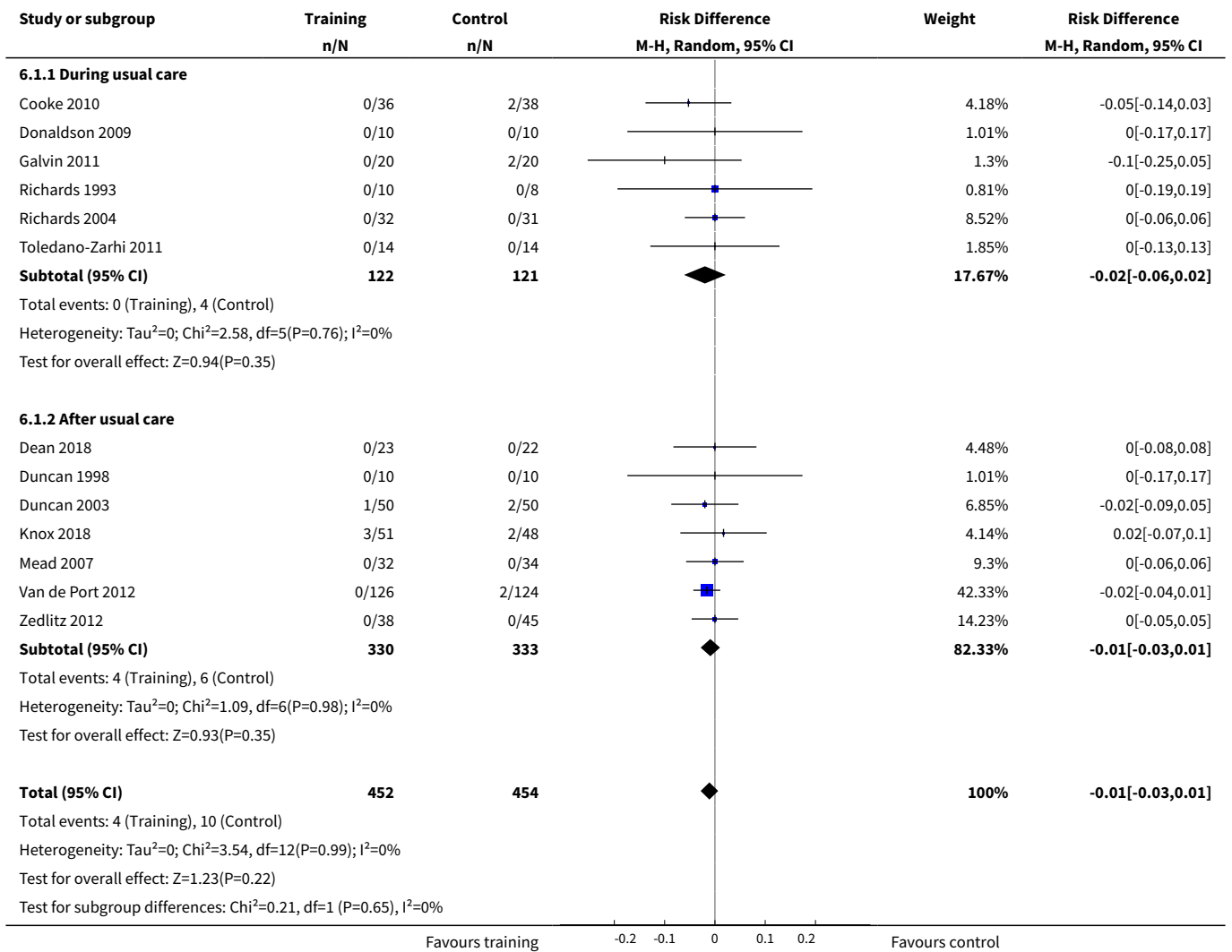
Outcome or subgroup title	No. of studies	No. of participants	Statistical method	Effect size
1 Death	13	906	Risk Difference (M-H, Random, 95% CI)	-0.01 [-0.03, 0.01]
1.1 During usual care	6	243	Risk Difference (M-H, Random, 95% CI)	-0.02 [-0.06, 0.02]
1.2 After usual care	7	663	Risk Difference (M-H, Random, 95% CI)	-0.01 [-0.03, 0.01]
2 Disability - Barthel Index (BI)	2	103	Mean Difference (IV, Random, 95% CI)	1.82 [-13.69, 17.33]
2.1 During usual care	1	40	Mean Difference (IV, Random, 95% CI)	9.0 [-1.29, 19.29]
2.2 After usual care	1	63	Mean Difference (IV, Random, 95% CI)	-6.90 [-21.05, 7.25]
3 Disability - Nottingham Extended ADL	2	106	Mean Difference (IV, Random, 95% CI)	3.10 [-5.20, 11.40]
3.1 During usual care	1	40	Mean Difference (IV, Random, 95% CI)	9.5 [-1.83, 20.83]
3.2 After usual care	1	66	Mean Difference (IV, Random, 95% CI)	0.30 [-0.93, 1.53]
4 Disability - Rivermead Mobility Index (RMI)	3	349	Mean Difference (IV, Random, 95% CI)	0.35 [0.02, 0.69]
4.1 During usual care	0	0	Mean Difference (IV, Random, 95% CI)	0.0 [0.0, 0.0]
4.2 After usual care	3	349	Mean Difference (IV, Random, 95% CI)	0.35 [0.02, 0.69]
5 Disability - combined disability scales	5	452	Std. Mean Difference (IV, Random, 95% CI)	0.10 [-0.17, 0.37]
5.1 During usual care	1	40	Std. Mean Difference (IV, Random, 95% CI)	0.53 [-0.10, 1.16]

Outcome or subgroup title	No. of studies	No. of participants	Statistical method	Effect size
5.2 After usual care	4	412	Std. Mean Difference (IV, Random, 95% CI)	0.04 [-0.25, 0.32]
6 Mobility - Functional Ambulation Categories	1	242	Mean Difference (IV, Random, 95% CI)	0.11 [0.00, 0.22]
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	242	Mean Difference (IV, Random, 95% CI)	0.11 [0.00, 0.22]
7 Mobility - walking preferred speed (m/min)	5	542	Mean Difference (IV, Random, 95% CI)	2.54 [-3.65, 8.72]
7.1 During usual care	2	136	Mean Difference (IV, Random, 95% CI)	-1.02 [-8.64, 6.60]
7.2 After usual care	3	406	Mean Difference (IV, Random, 95% CI)	4.29 [-4.46, 13.05]
8 Mobility - walking capacity (6-MWT metres)	4	464	Mean Difference (IV, Random, 95% CI)	47.48 [23.72, 71.23]
8.1 During usual care	1	40	Mean Difference (IV, Random, 95% CI)	109.50 [17.12, 201.88]
8.2 After usual care	3	424	Mean Difference (IV, Random, 95% CI)	43.09 [18.50, 67.67]
9 Mobility - community ambulation speed (> 0.8 m/sec)	3	217	Odds Ratio (M-H, Random, 95% CI)	1.33 [0.70, 2.53]
9.1 During usual care	1	52	Odds Ratio (M-H, Random, 95% CI)	2.14 [0.56, 8.12]
9.2 After usual care	2	165	Odds Ratio (M-H, Random, 95% CI)	1.15 [0.48, 2.76]
10 Physical function - balance - Berg Balance Scale	3	201	Mean Difference (IV, Random, 95% CI)	1.86 [-3.05, 6.78]
10.1 During usual care	2	102	Mean Difference (IV, Random, 95% CI)	2.22 [-7.79, 12.22]
10.2 After usual care	1	99	Mean Difference (IV, Random, 95% CI)	3.0 [-0.54, 6.54]
11 Physical function - balance - functional reach	1	66	Mean Difference (IV, Random, 95% CI)	2.5 [-0.97, 5.97]
11.1 During usual care	0	0	Mean Difference (IV, Random, 95% CI)	0.0 [0.0, 0.0]

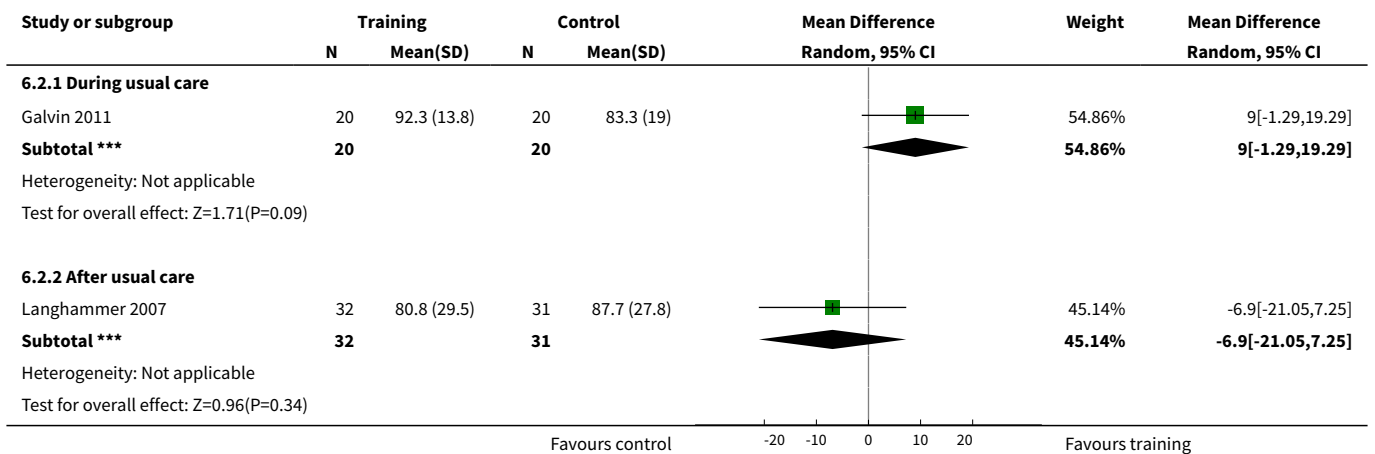
Outcome or subgroup title	No. of studies	No. of participants	Statistical method	Effect size
11.2 After usual care	1	66	Mean Difference (IV, Random, 95% CI)	2.5 [-0.97, 5.97]
12 Physical function - Timed Up and Go (sec)	5	510	Mean Difference (IV, Random, 95% CI)	-1.41 [-3.74, 0.92]
12.1 During usual care	1	62	Mean Difference (IV, Random, 95% CI)	0.0 [-6.97, 6.97]
12.2 After usual care	4	448	Mean Difference (IV, Random, 95% CI)	-1.61 [-4.39, 1.17]
13 Health-related QoL - SF-36 physical functioning	2	146	Mean Difference (IV, Random, 95% CI)	2.46 [-7.20, 12.11]
13.1 During usual care	0	0	Mean Difference (IV, Random, 95% CI)	0.0 [0.0, 0.0]
13.2 After usual care	2	146	Mean Difference (IV, Random, 95% CI)	2.46 [-7.20, 12.11]
14 Health-related QoL - SF-36 physical role functioning	2	146	Mean Difference (IV, Random, 95% CI)	11.61 [2.38, 20.84]
14.1 During usual care	0	0	Mean Difference (IV, Random, 95% CI)	0.0 [0.0, 0.0]
14.2 After usual care	2	146	Mean Difference (IV, Random, 95% CI)	11.61 [2.38, 20.84]
15 Mood - Stroke Impact Scale emotion score	2	322	Mean Difference (IV, Random, 95% CI)	0.13 [-3.26, 3.51]
15.1 During usual care	0	0	Mean Difference (IV, Random, 95% CI)	0.0 [0.0, 0.0]
15.2 After usual care	2	322	Mean Difference (IV, Random, 95% CI)	0.13 [-3.26, 3.51]
16 Mood - Geriatric Depression Scale	1	80	Mean Difference (IV, Random, 95% CI)	-1.4 [-2.54, -0.26]
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	80	Mean Difference (IV, Random, 95% CI)	-1.4 [-2.54, -0.26]
17 Mood - Hospital Anxiety and Depression Scale (HADS) - anxiety score	3	391	Mean Difference (IV, Random, 95% CI)	-0.11 [-0.78, 0.57]
17.1 During usual care	0	0	Mean Difference (IV, Random, 95% CI)	0.0 [0.0, 0.0]

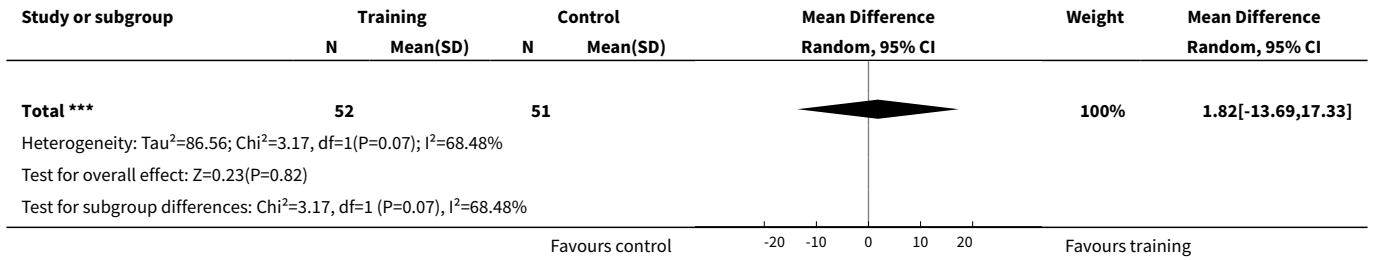
Outcome or subgroup title	No. of studies	No. of participants	Statistical method	Effect size
17.2 After usual care	3	391	Mean Difference (IV, Random, 95% CI)	-0.11 [-0.78, 0.57]
18 Mood - Hospital Anxiety and Depression Scale (HADS) - depression score	3	391	Mean Difference (IV, Random, 95% CI)	0.26 [-0.43, 0.96]
18.1 During usual care	0	0	Mean Difference (IV, Random, 95% CI)	0.0 [0.0, 0.0]
18.2 After usual care	3	391	Mean Difference (IV, Random, 95% CI)	0.26 [-0.43, 0.96]
19 Mood - combined depression scales	4	471	Std. Mean Difference (IV, Random, 95% CI)	-0.06 [-0.33, 0.22]
19.1 During usual care	0	0	Std. Mean Difference (IV, Random, 95% CI)	0.0 [0.0, 0.0]
19.2 After usual care	4	471	Std. Mean Difference (IV, Random, 95% CI)	-0.06 [-0.33, 0.22]
20 Cognitive function - FIM cognitive score	1	93	Mean Difference (IV, Random, 95% CI)	0.40 [-0.19, 0.99]
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	93	Mean Difference (IV, Random, 95% CI)	0.40 [-0.19, 0.99]
21 Cognitive function - SIS memory and thinking	1	93	Mean Difference (IV, Random, 95% CI)	4.30 [-3.32, 11.92]
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	93	Mean Difference (IV, Random, 95% CI)	4.30 [-3.32, 11.92]
22 Cognitive function - SIS communication	1	93	Mean Difference (IV, Random, 95% CI)	2.90 [-4.16, 9.96]
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	93	Mean Difference (IV, Random, 95% CI)	2.90 [-4.16, 9.96]

Analysis 6.1. Comparison 6 Mixed training versus control - end of retention follow-up, Outcome 1 Death.

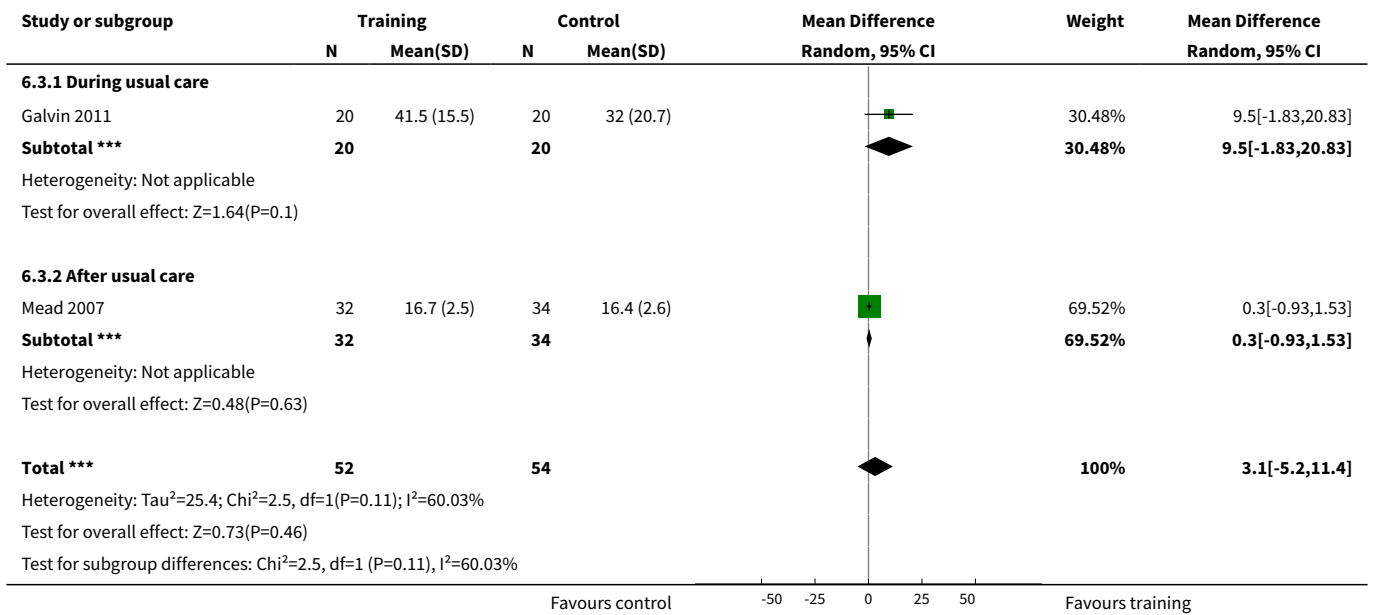


Analysis 6.2. Comparison 6 Mixed training versus control - end of retention follow-up, Outcome 2 Disability - Barthel Index (BI).

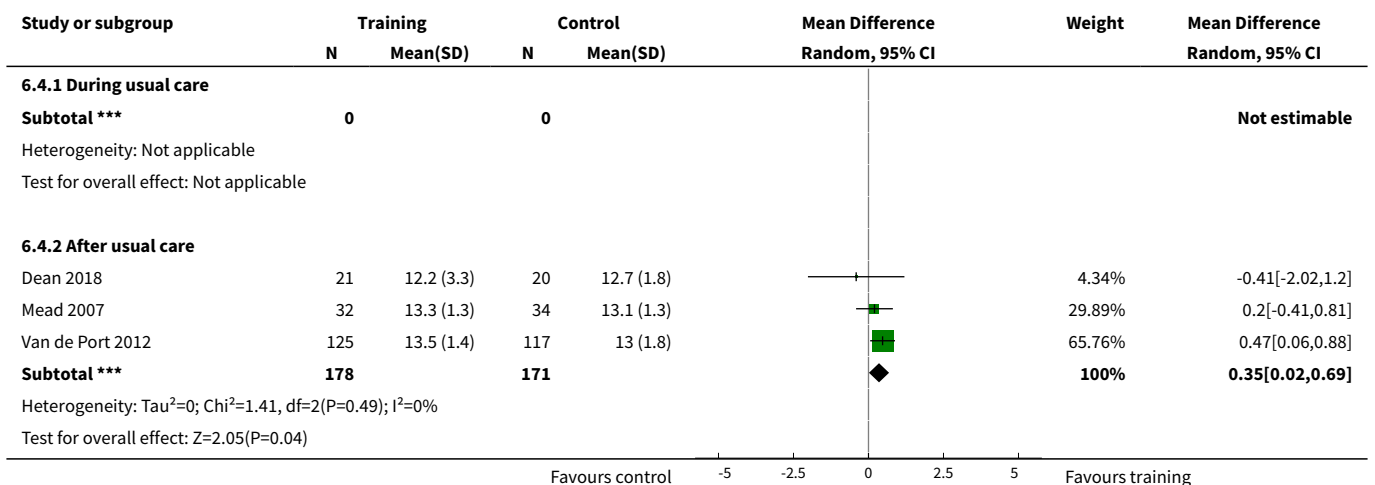


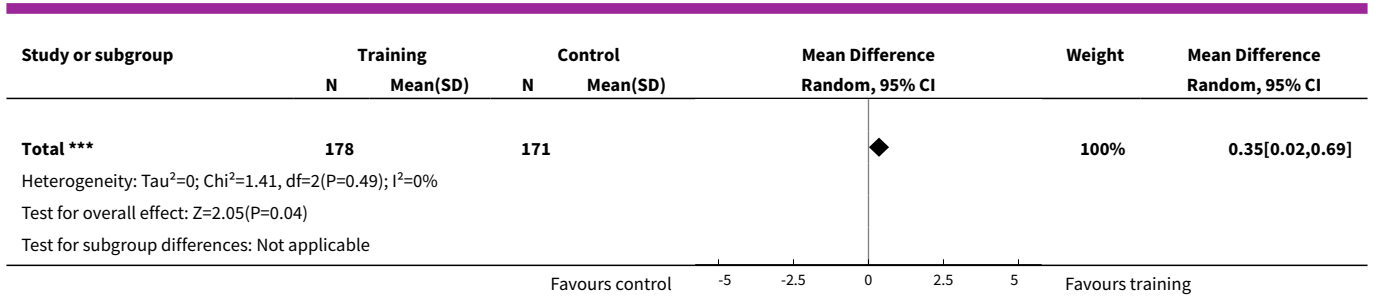


Analysis 6.3. Comparison 6 Mixed training versus control - end of retention follow-up, Outcome 3 Disability - Nottingham Extended ADL.

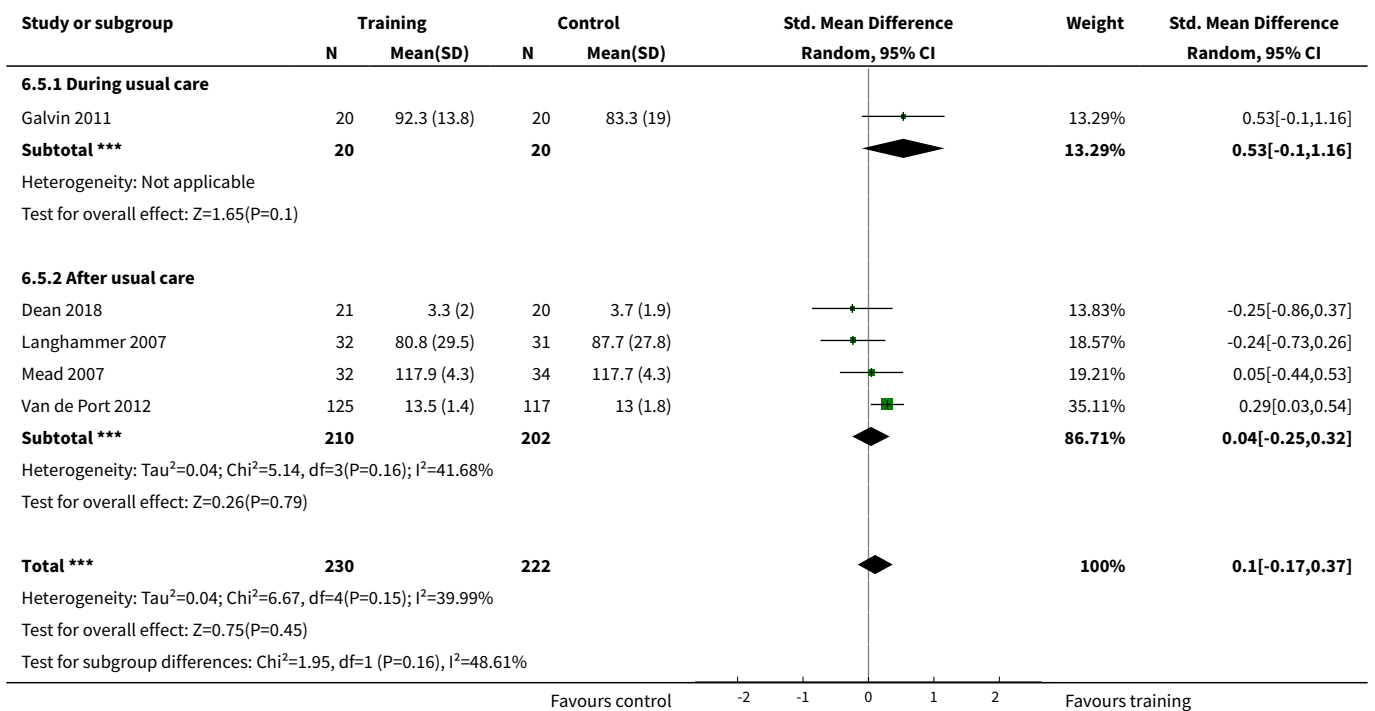


Analysis 6.4. Comparison 6 Mixed training versus control - end of retention follow-up, Outcome 4 Disability - Rivermead Mobility Index (RMI).

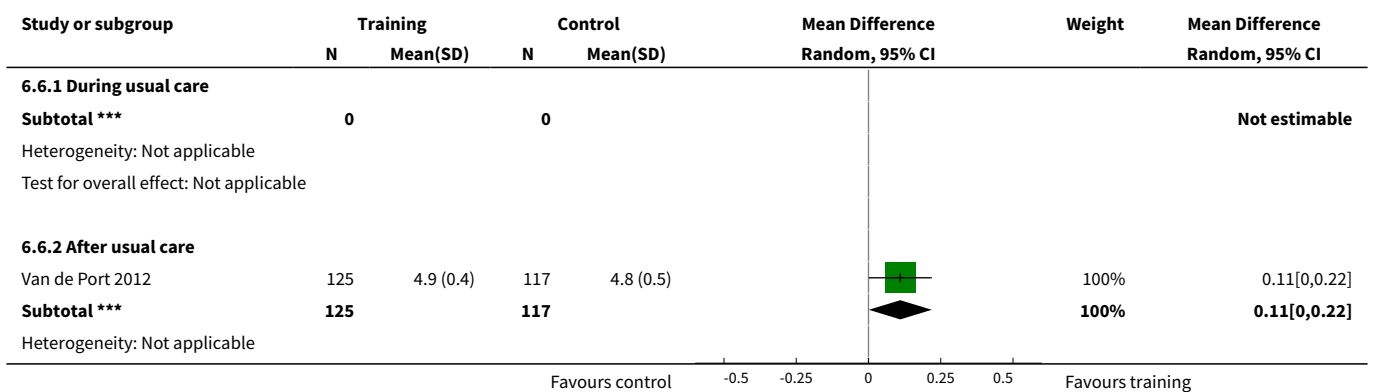


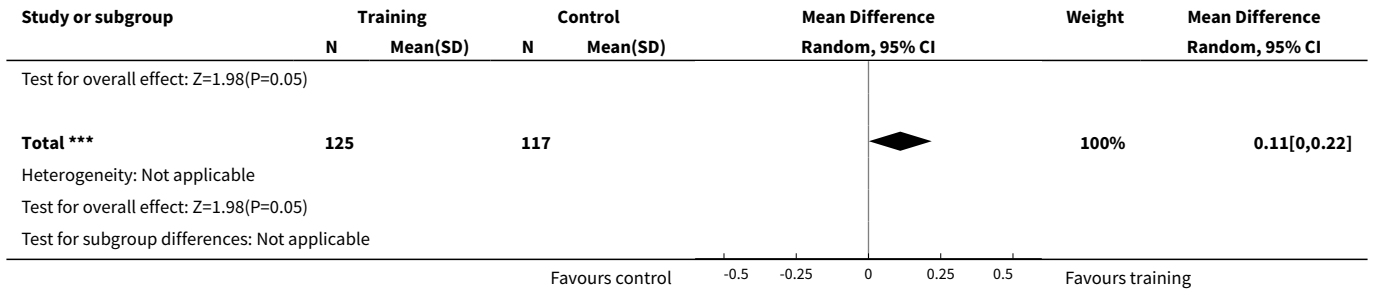


Analysis 6.5. Comparison 6 Mixed training versus control - end of retention follow-up, Outcome 5 Disability - combined disability scales.

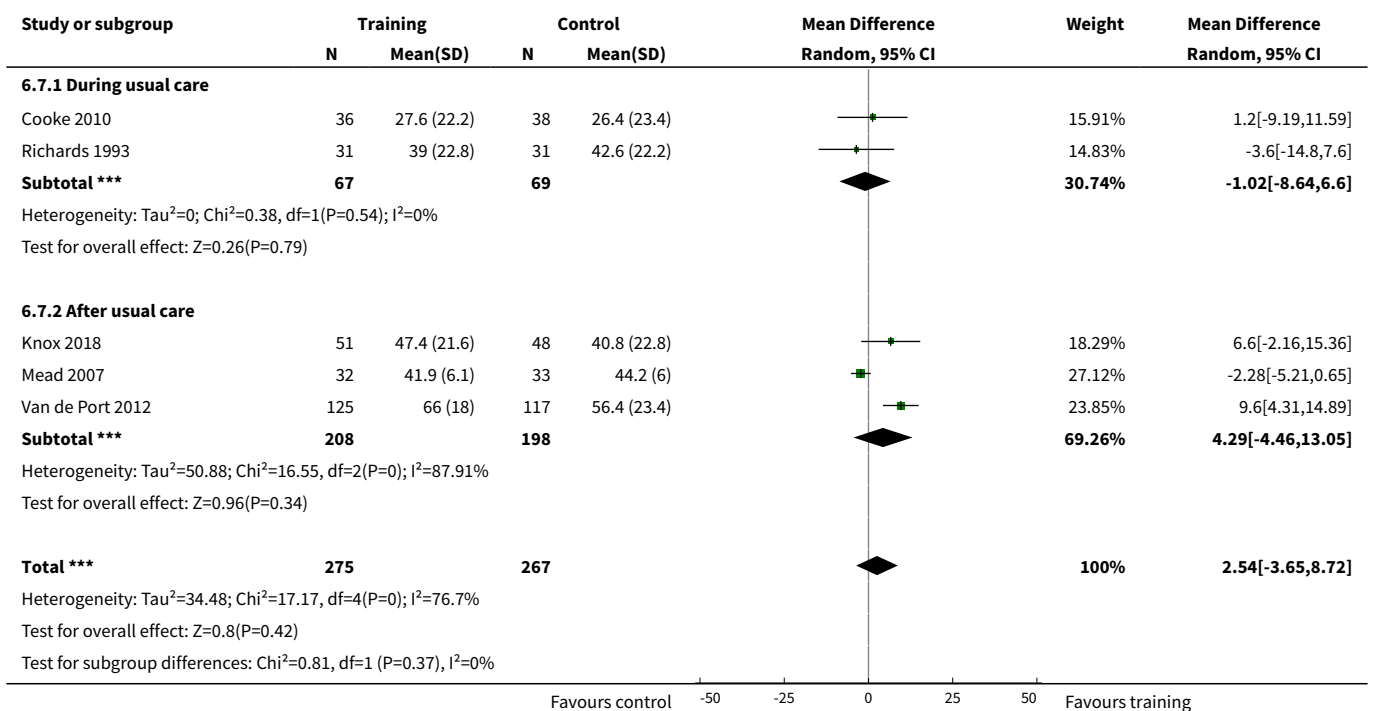


Analysis 6.6. Comparison 6 Mixed training versus control - end of retention follow-up, Outcome 6 Mobility - Functional Ambulation Categories.

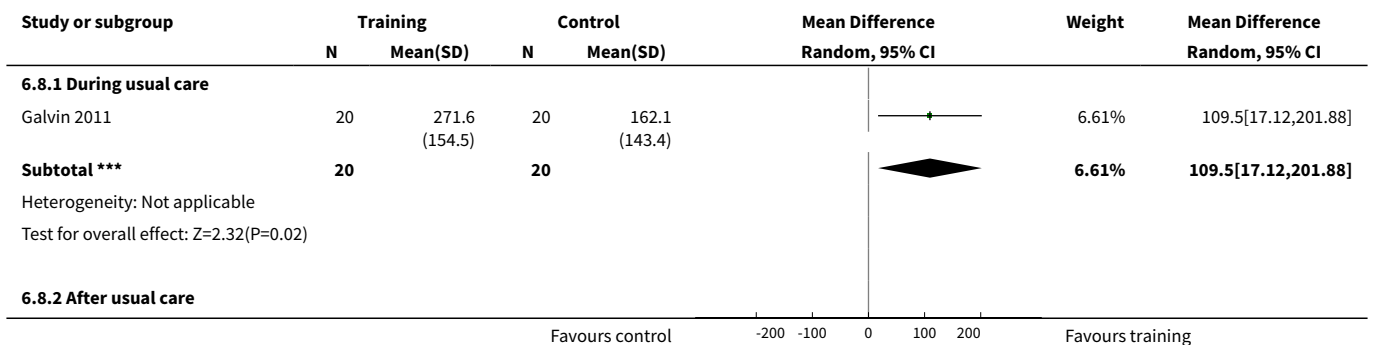


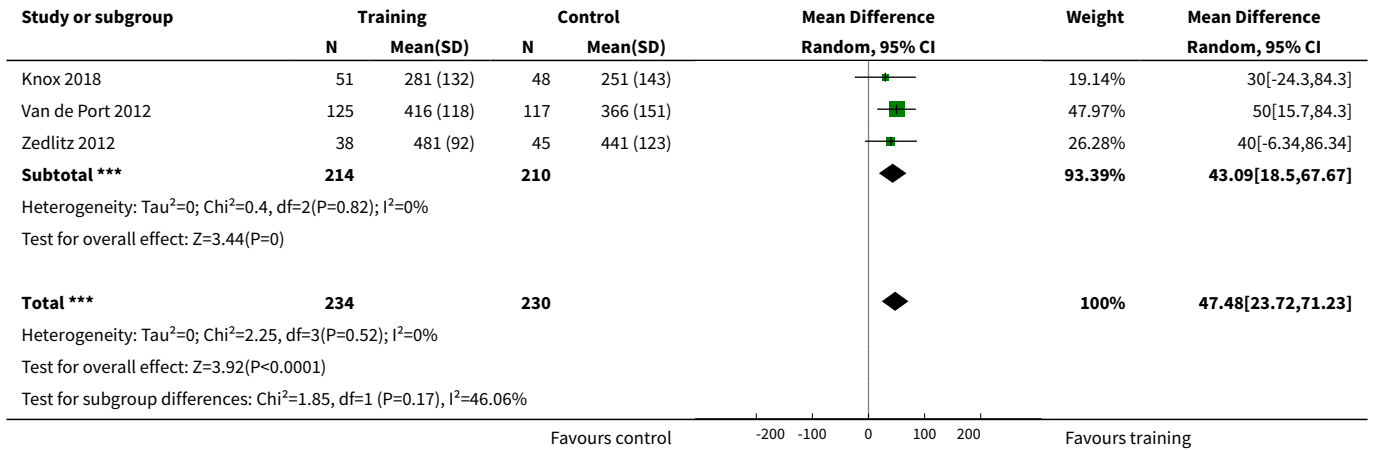


Analysis 6.7. Comparison 6 Mixed training versus control - end of retention follow-up, Outcome 7 Mobility - walking preferred speed (m/min).

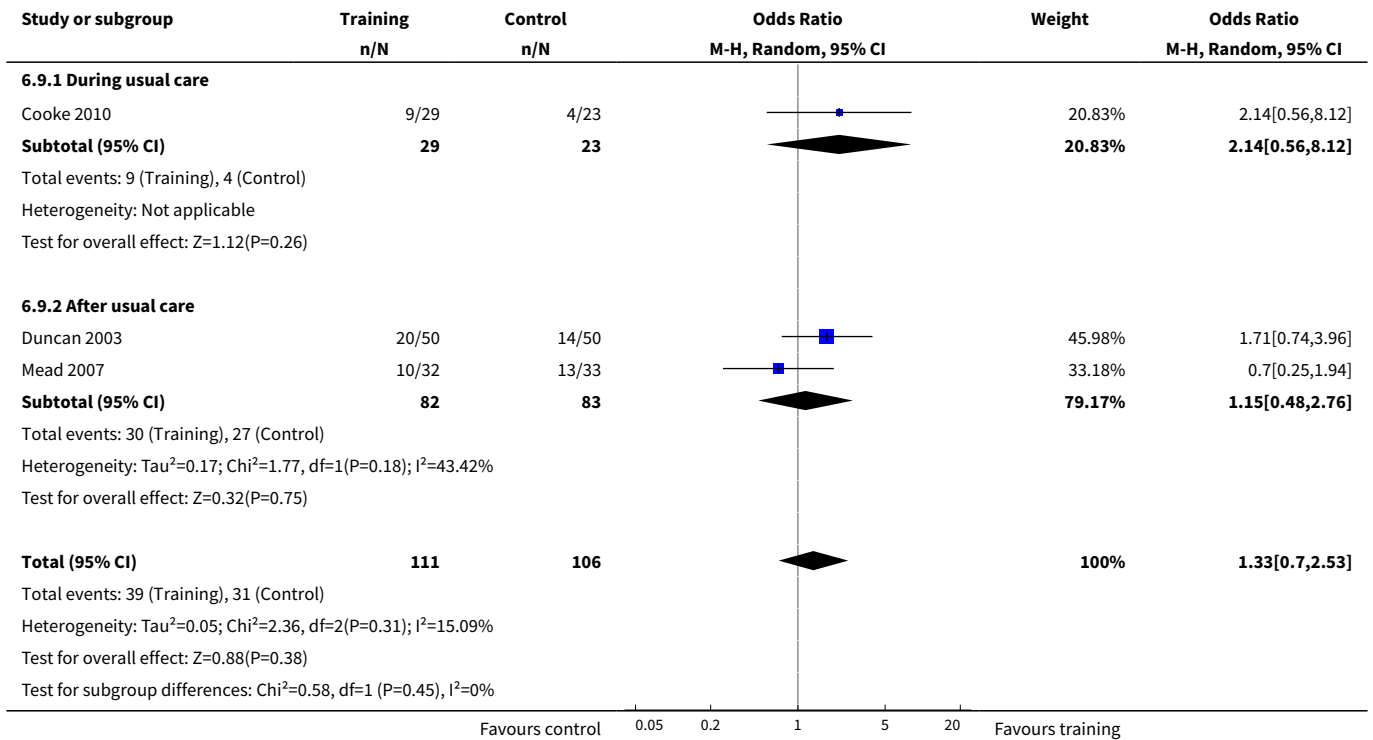


Analysis 6.8. Comparison 6 Mixed training versus control - end of retention follow-up, Outcome 8 Mobility - walking capacity (6-MWT metres).

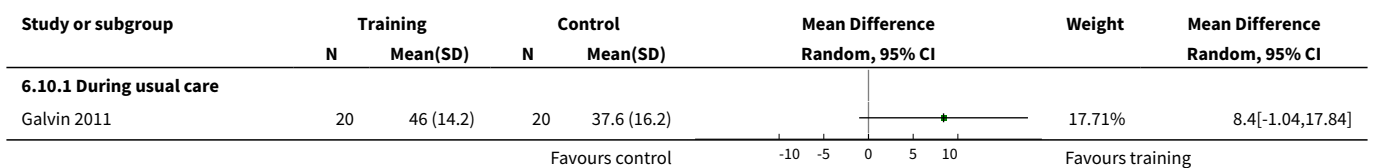


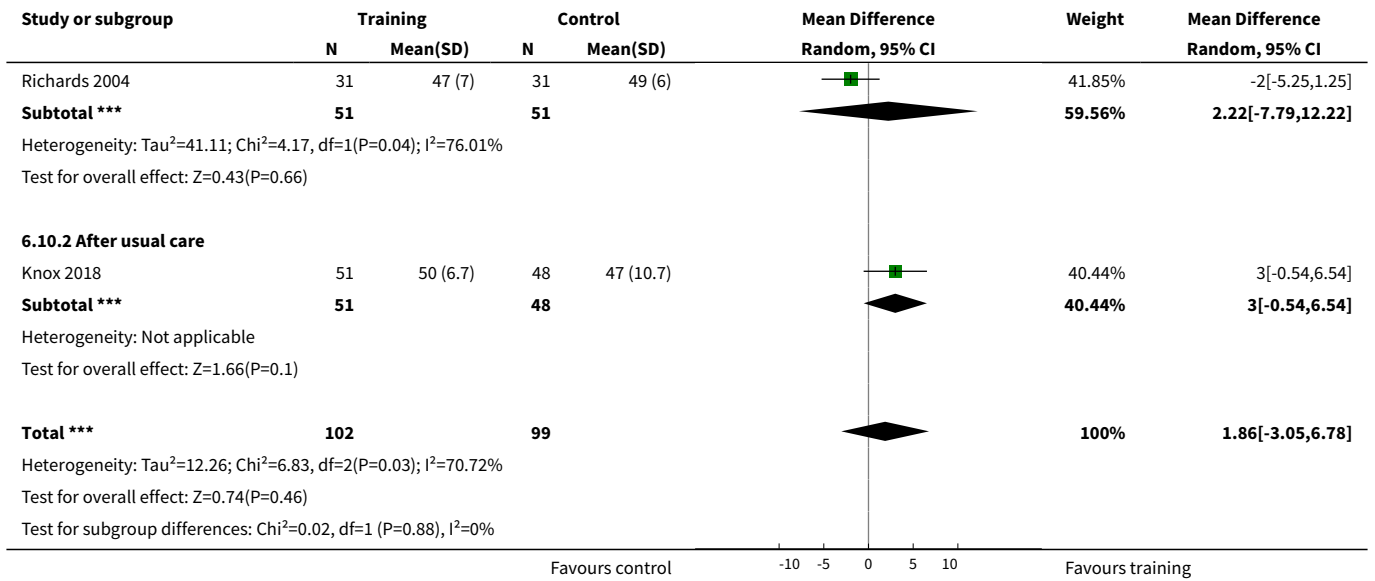


Analysis 6.9. Comparison 6 Mixed training versus control - end of retention follow-up, Outcome 9 Mobility - community ambulation speed (> 0.8 m/sec).

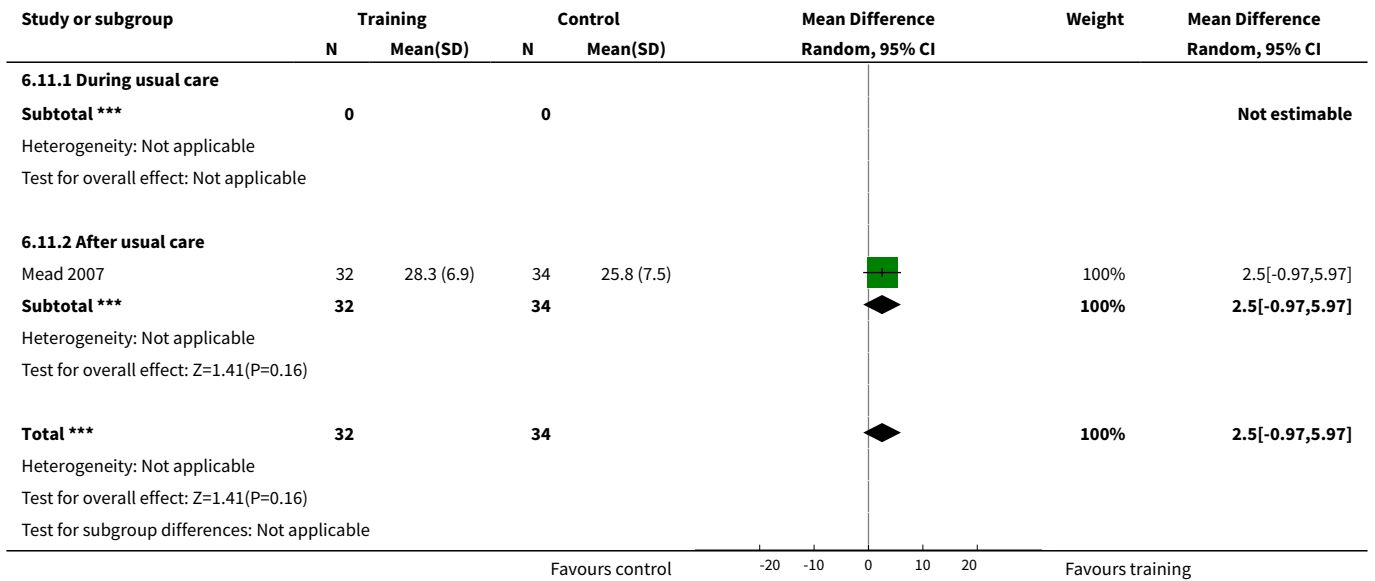


Analysis 6.10. Comparison 6 Mixed training versus control - end of retention follow-up, Outcome 10 Physical function - balance - Berg Balance Scale.

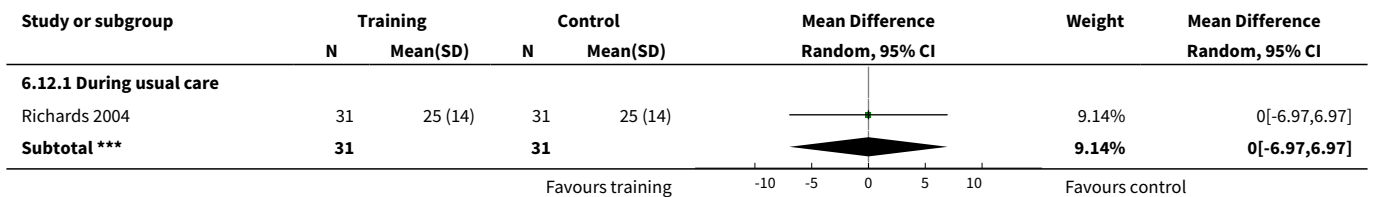


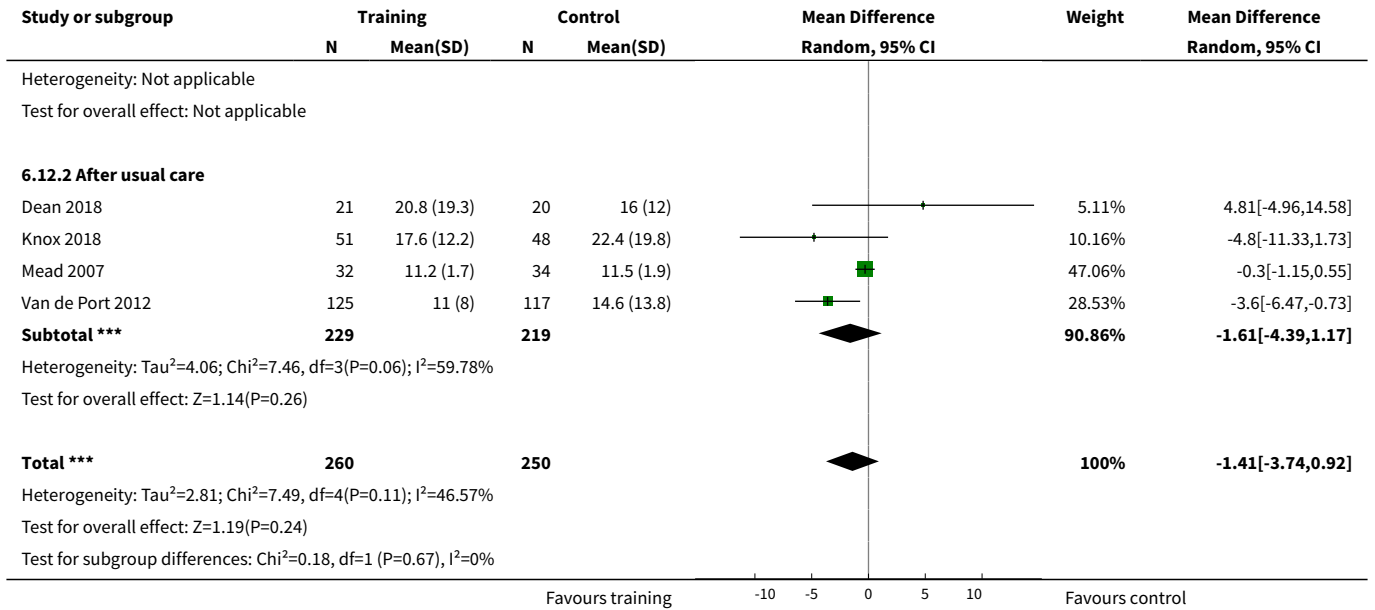


Analysis 6.11. Comparison 6 Mixed training versus control - end of retention follow-up, Outcome 11 Physical function - balance - functional reach.

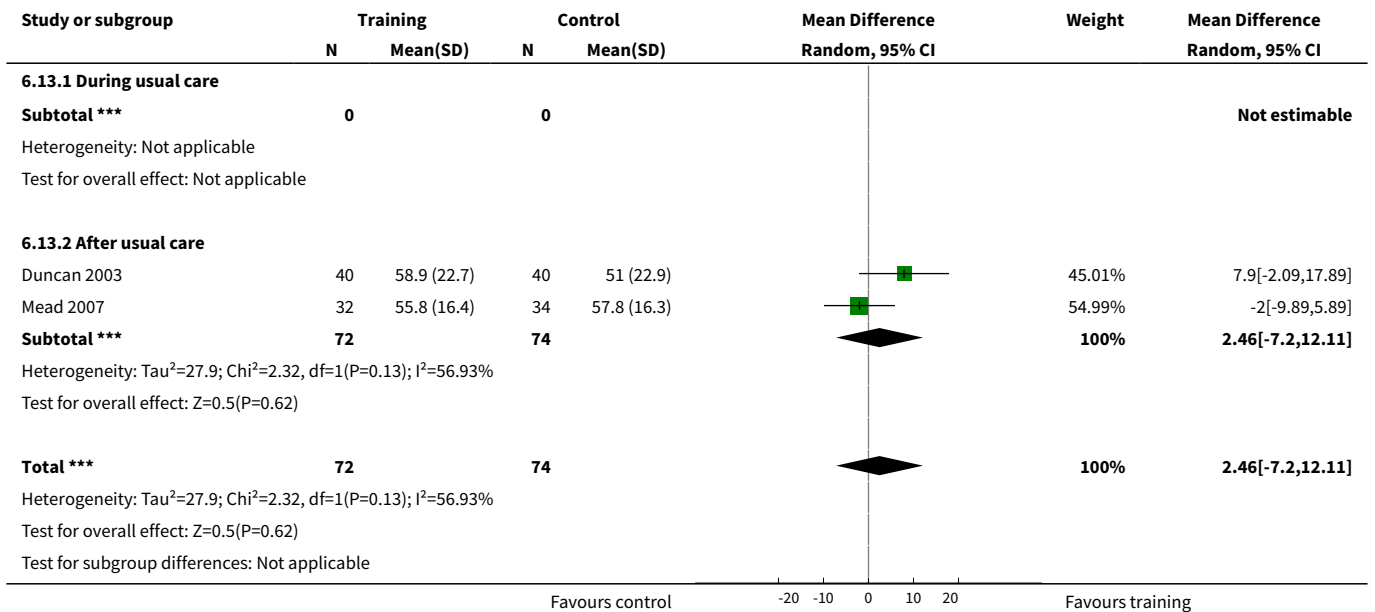


Analysis 6.12. Comparison 6 Mixed training versus control - end of retention follow-up, Outcome 12 Physical function - Timed Up and Go (sec).

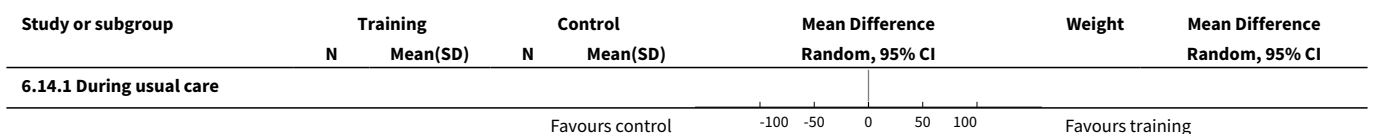


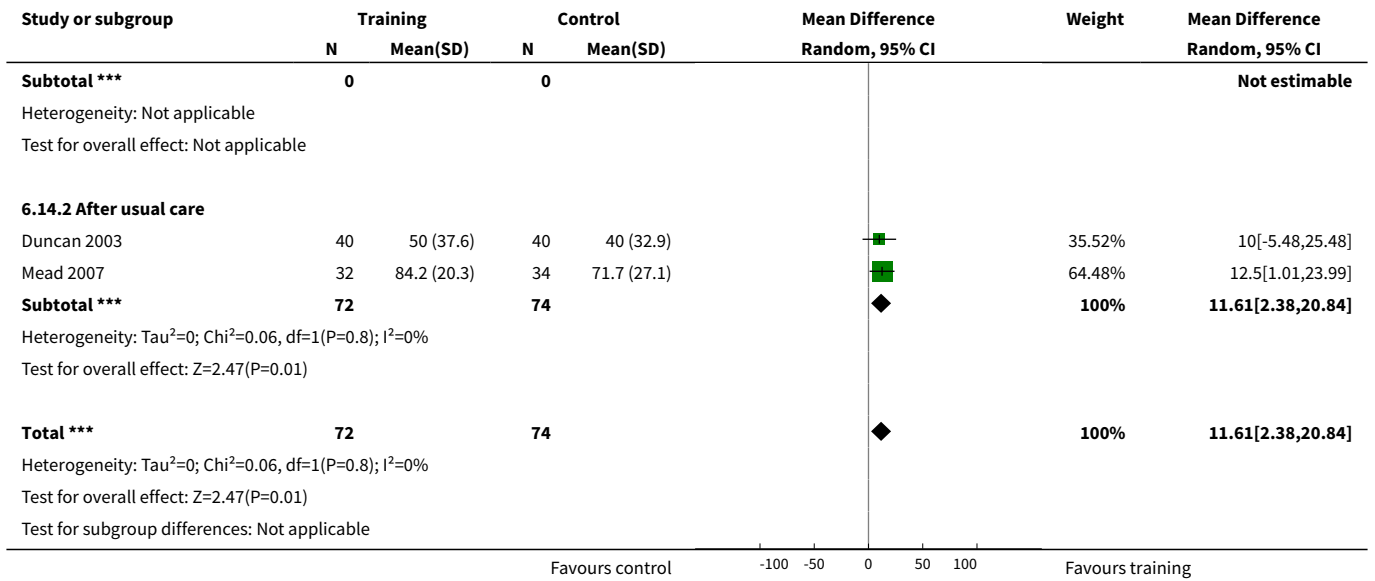


Analysis 6.13. Comparison 6 Mixed training versus control - end of retention follow-up, Outcome 13 Health-related QoL - SF-36 physical functioning.

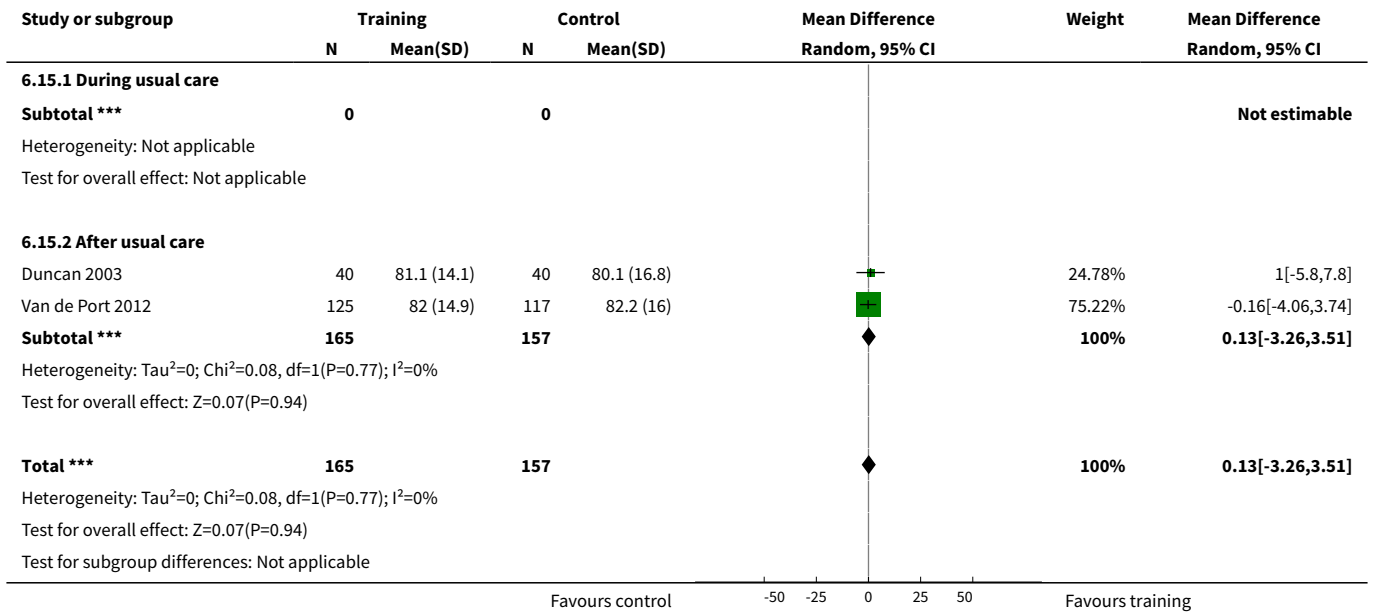


Analysis 6.14. Comparison 6 Mixed training versus control - end of retention follow-up, Outcome 14 Health-related QoL - SF-36 physical role functioning.

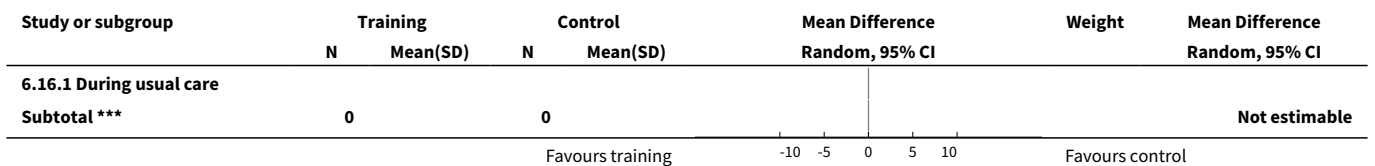


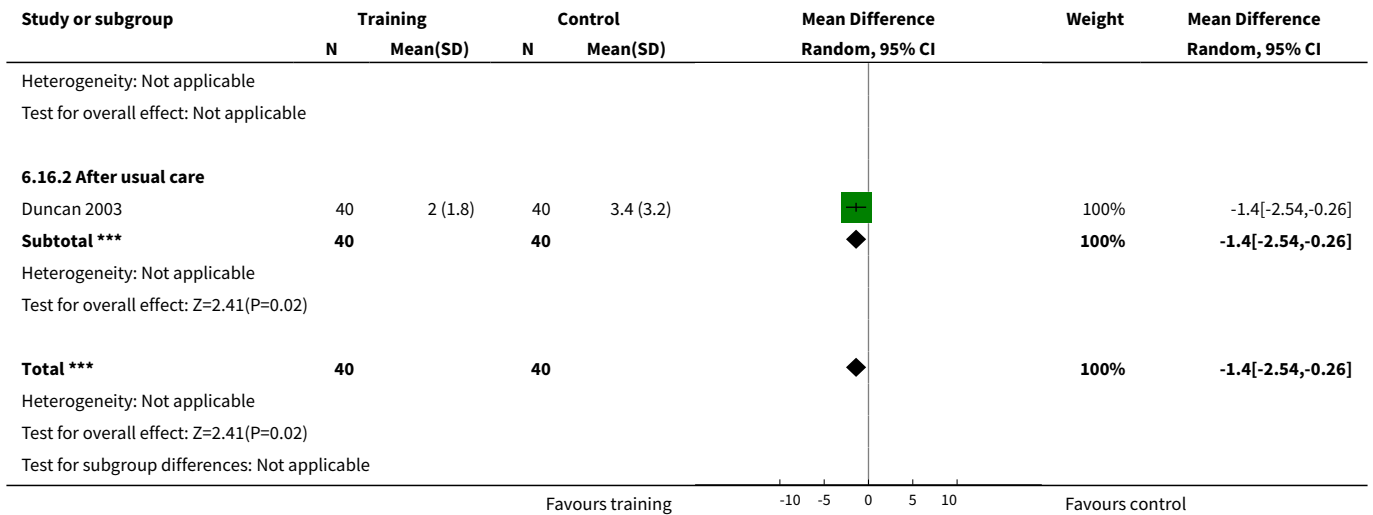


Analysis 6.15. Comparison 6 Mixed training versus control - end of retention follow-up, Outcome 15 Mood - Stroke Impact Scale emotion score.

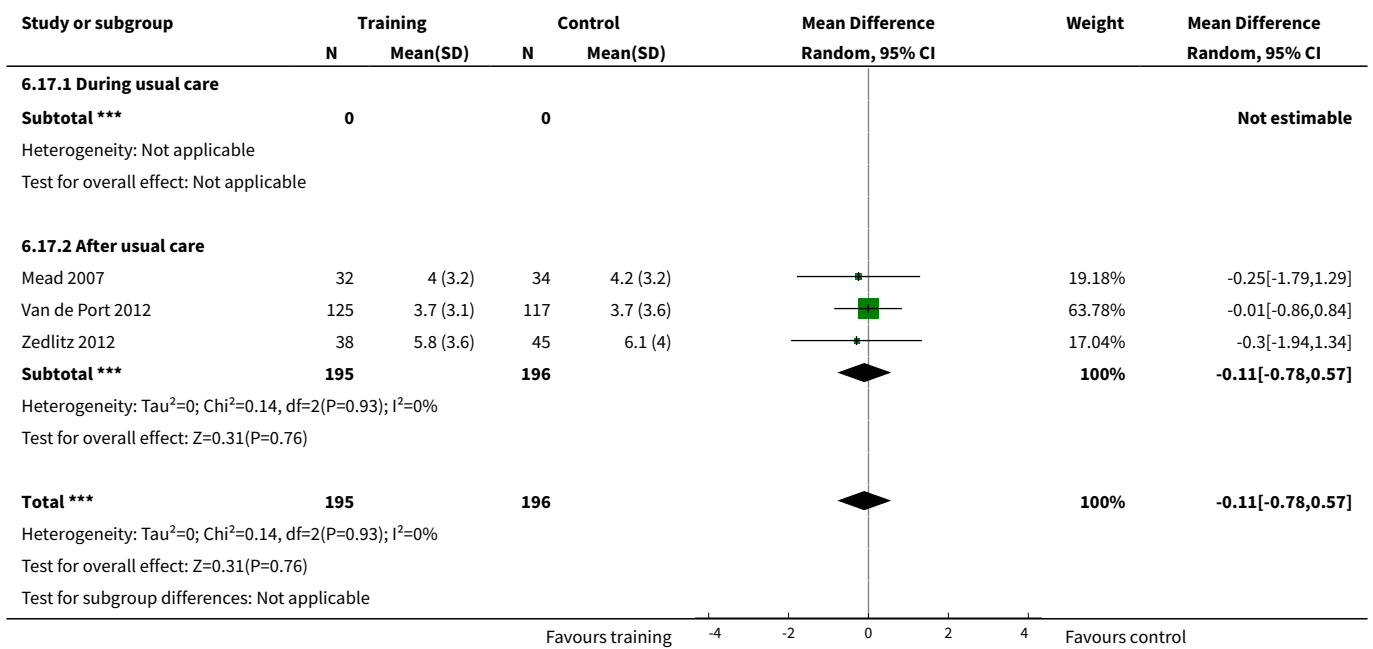


Analysis 6.16. Comparison 6 Mixed training versus control - end of retention follow-up, Outcome 16 Mood - Geriatric Depression Scale.

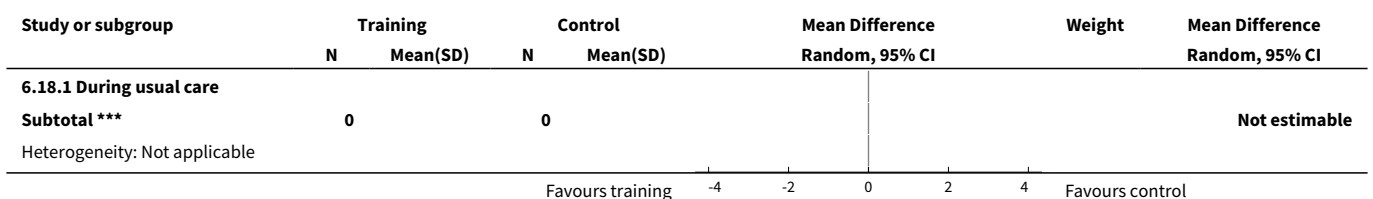


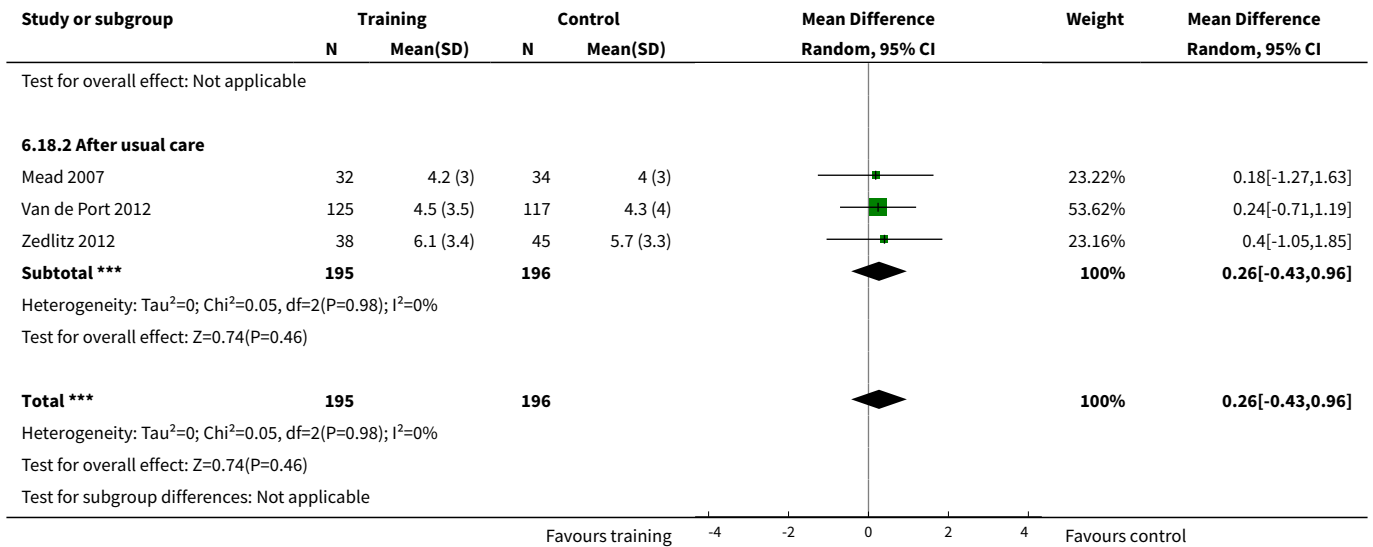


Analysis 6.17. Comparison 6 Mixed training versus control - end of retention follow-up, Outcome 17 Mood - Hospital Anxiety and Depression Scale (HADS) - anxiety score.

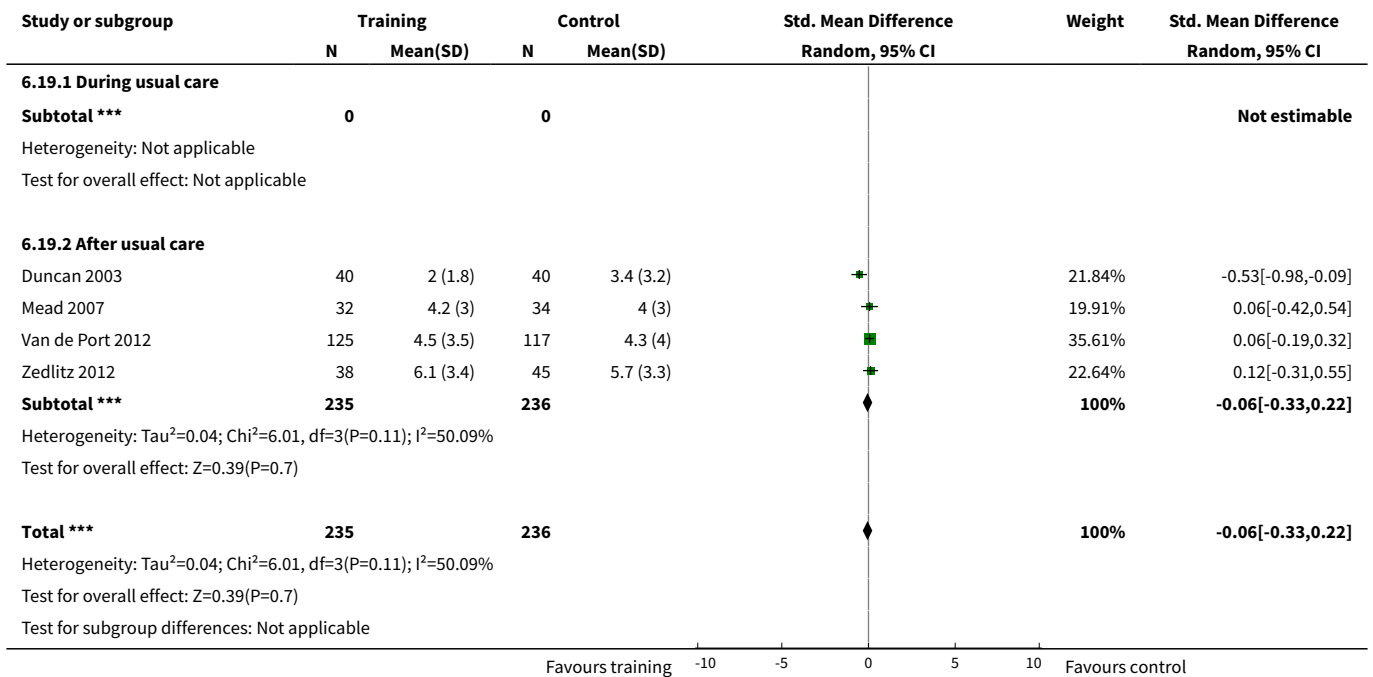


Analysis 6.18. Comparison 6 Mixed training versus control - end of retention follow-up, Outcome 18 Mood - Hospital Anxiety and Depression Scale (HADS) - depression score.

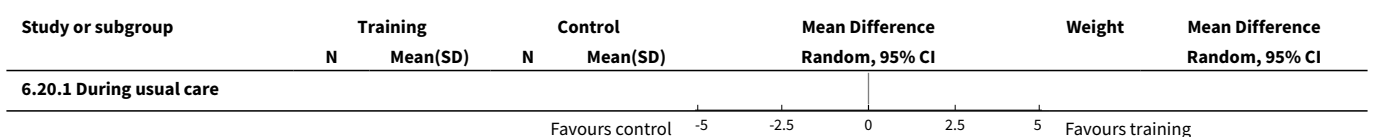


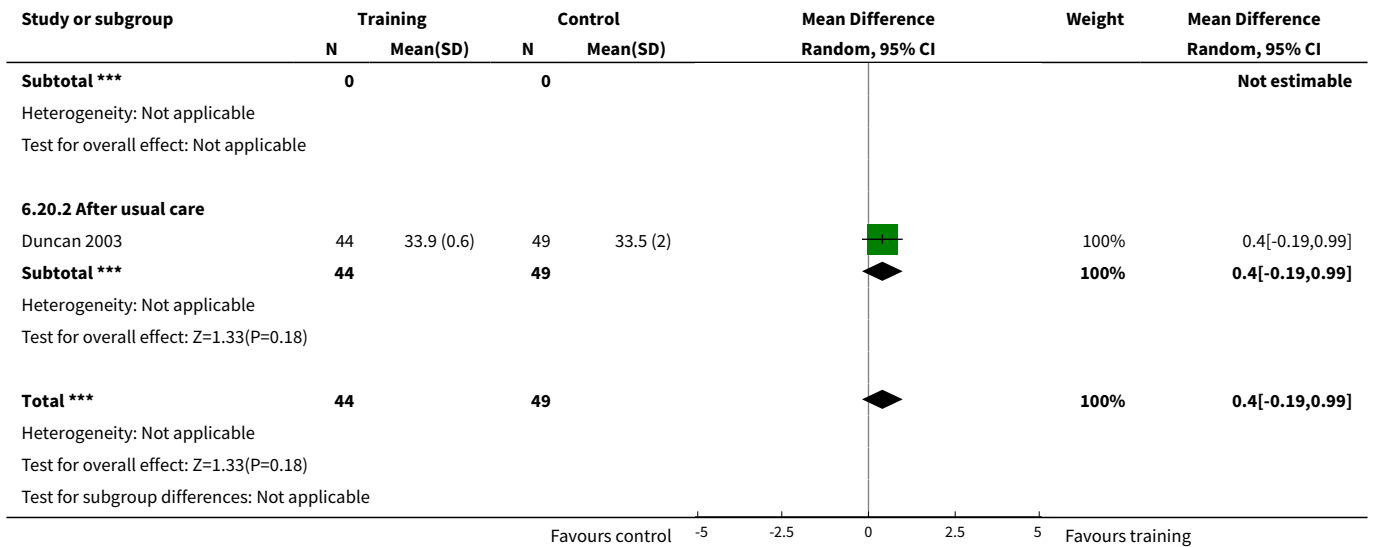


Analysis 6.19. Comparison 6 Mixed training versus control - end of retention follow-up, Outcome 19 Mood - combined depression scales.

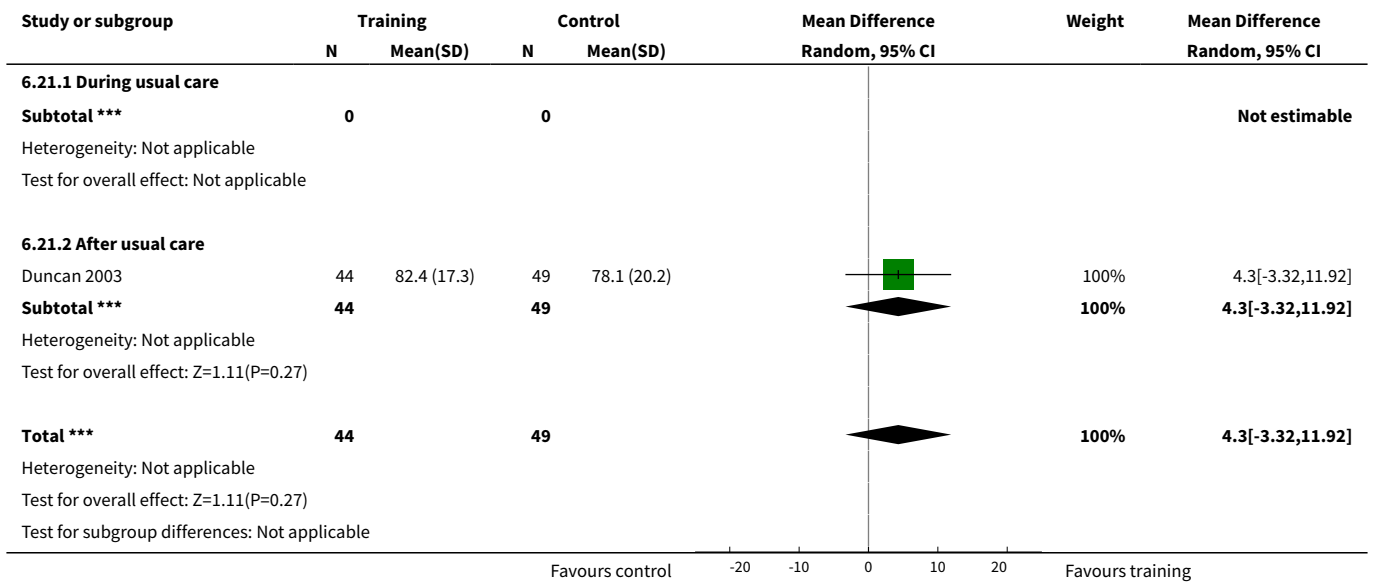


Analysis 6.20. Comparison 6 Mixed training versus control - end of retention follow-up, Outcome 20 Cognitive function - FIM cognitive score.

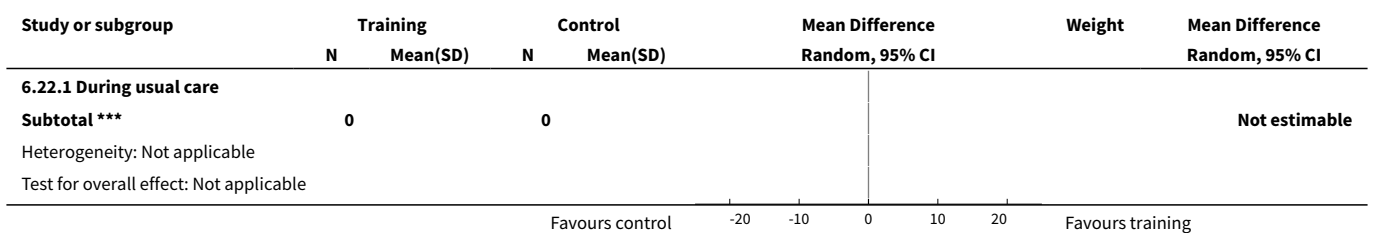


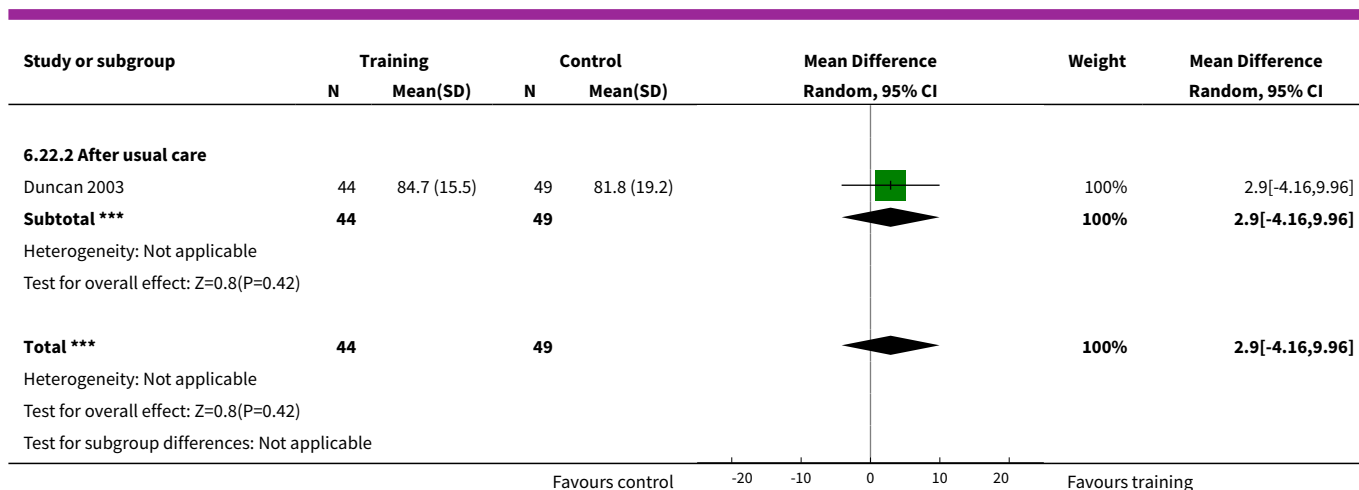


Analysis 6.21. Comparison 6 Mixed training versus control - end of retention follow-up, Outcome 21 Cognitive function - SIS memory and thinking.



Analysis 6.22. Comparison 6 Mixed training versus control - end of retention follow-up, Outcome 22 Cognitive function - SIS communication.










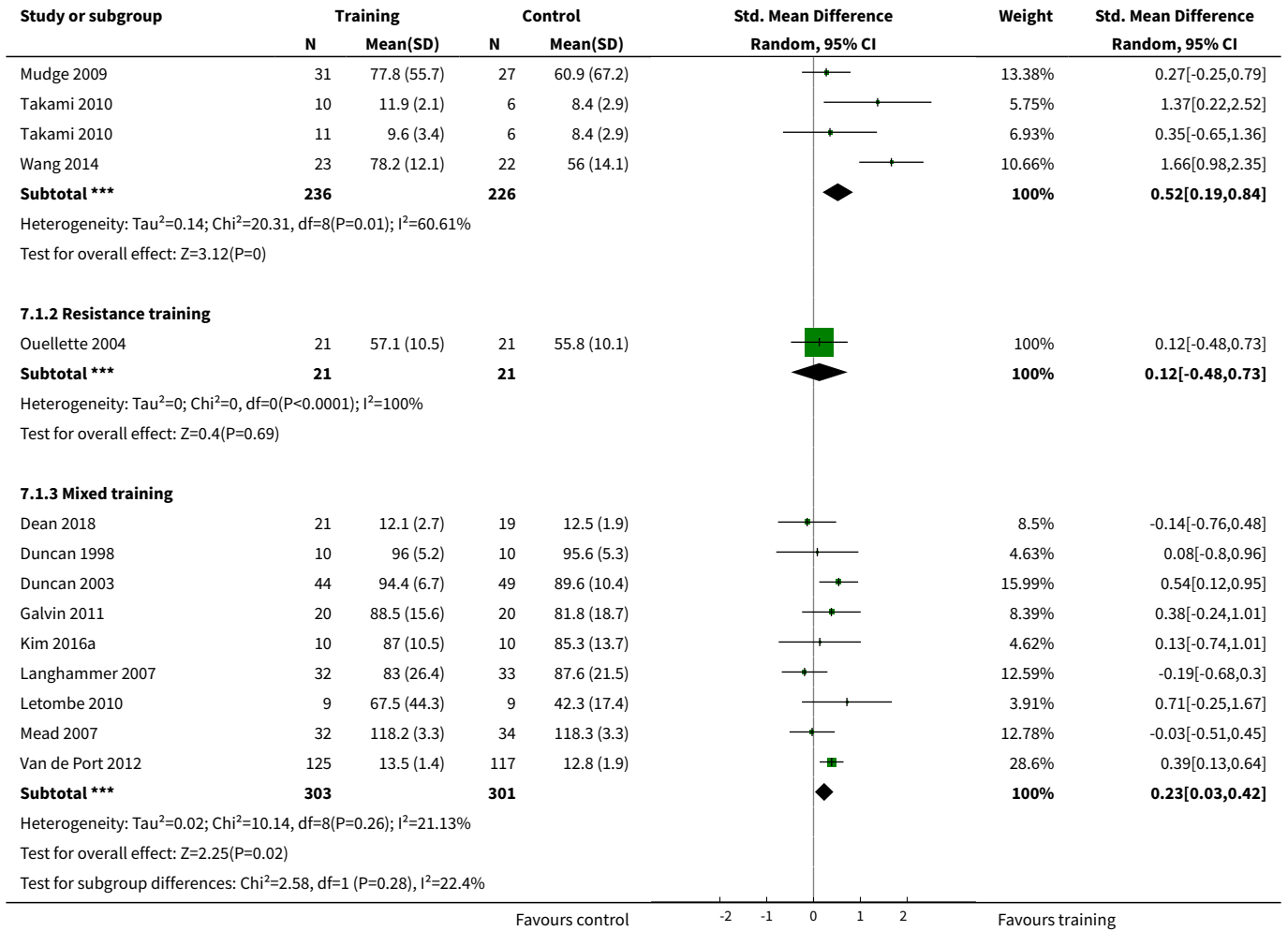
Comparison 7. Cardiorespiratory versus resistance versus mixed training

Outcome or subgroup title	No. of studies	No. of participants	Statistical method	Effect size
1 Disability - combined disability scales	18		Std. Mean Difference (IV, Random, 95% CI)	Subtotals only
1.1 Cardiorespiratory training	8	462	Std. Mean Difference (IV, Random, 95% CI)	0.52 [0.19, 0.84]
1.2 Resistance training	1	42	Std. Mean Difference (IV, Random, 95% CI)	0.12 [-0.48, 0.73]
1.3 Mixed training	9	604	Std. Mean Difference (IV, Random, 95% CI)	0.23 [0.03, 0.42]
2 Mobility - walking maximal speed	26	1176	Mean Difference (IV, Random, 95% CI)	5.60 [3.11, 8.08]
2.1 Cardiorespiratory training	17	782	Mean Difference (IV, Random, 95% CI)	7.66 [3.65, 11.68]
2.2 Resistance training	7	250	Mean Difference (IV, Random, 95% CI)	2.75 [-0.61, 6.12]
2.3 Mixed training	3	144	Mean Difference (IV, Random, 95% CI)	8.92 [1.74, 16.10]
3 Mobility - walking preferred speed	26	1481	Mean Difference (IV, Random, 95% CI)	3.98 [1.96, 6.01]
3.1 Cardiorespiratory training	12	588	Mean Difference (IV, Random, 95% CI)	4.47 [2.07, 6.87]
3.2 Resistance training	5	179	Mean Difference (IV, Random, 95% CI)	1.97 [-3.76, 7.71]

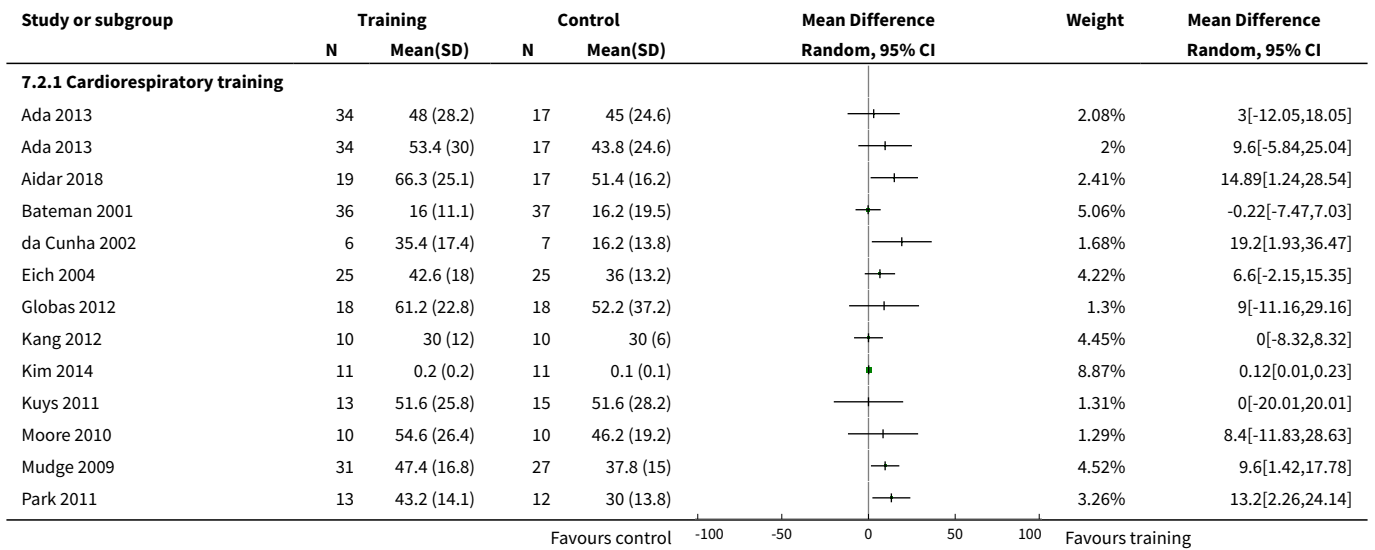
Outcome or subgroup title	No. of studies	No. of participants	Statistical method	Effect size
3.3 Mixed training	10	714	Mean Difference (IV, Random, 95% CI)	4.68 [1.26, 8.09]
4 Mobility - walking capacity (6-MWT distance)	30	1792	Mean Difference (IV, Random, 95% CI)	30.14 [21.27, 39.00]
4.1 Cardiorespiratory training	16	882	Mean Difference (IV, Random, 95% CI)	33.41 [19.04, 47.78]
4.2 Resistance training	5	214	Mean Difference (IV, Random, 95% CI)	24.83 [11.68, 37.97]
4.3 Mixed training	10	696	Mean Difference (IV, Random, 95% CI)	35.30 [15.88, 54.71]
5 Physical Function - Balance - Berg Balance Scale	21	1062	Mean Difference (IV, Random, 95% CI)	2.29 [1.42, 3.17]
5.1 Cardiorespiratory training	8	471	Mean Difference (IV, Random, 95% CI)	1.92 [0.16, 3.68]
5.2 Resistance training	5	196	Mean Difference (IV, Random, 95% CI)	3.24 [2.11, 4.38]
5.3 Mixed training	9	395	Mean Difference (IV, Random, 95% CI)	2.10 [0.73, 3.48]
6 Physical function - Timed up and go	16	1033	Mean Difference (IV, Random, 95% CI)	-3.04 [-4.62, -1.45]
6.1 Cardiorespiratory training	5	223	Mean Difference (IV, Random, 95% CI)	-3.42 [-4.78, -2.05]
6.2 Resistance training	5	224	Mean Difference (IV, Random, 95% CI)	-3.46 [-6.94, 0.02]
6.3 Mixed training	7	586	Mean Difference (IV, Random, 95% CI)	-2.21 [-4.43, 0.02]

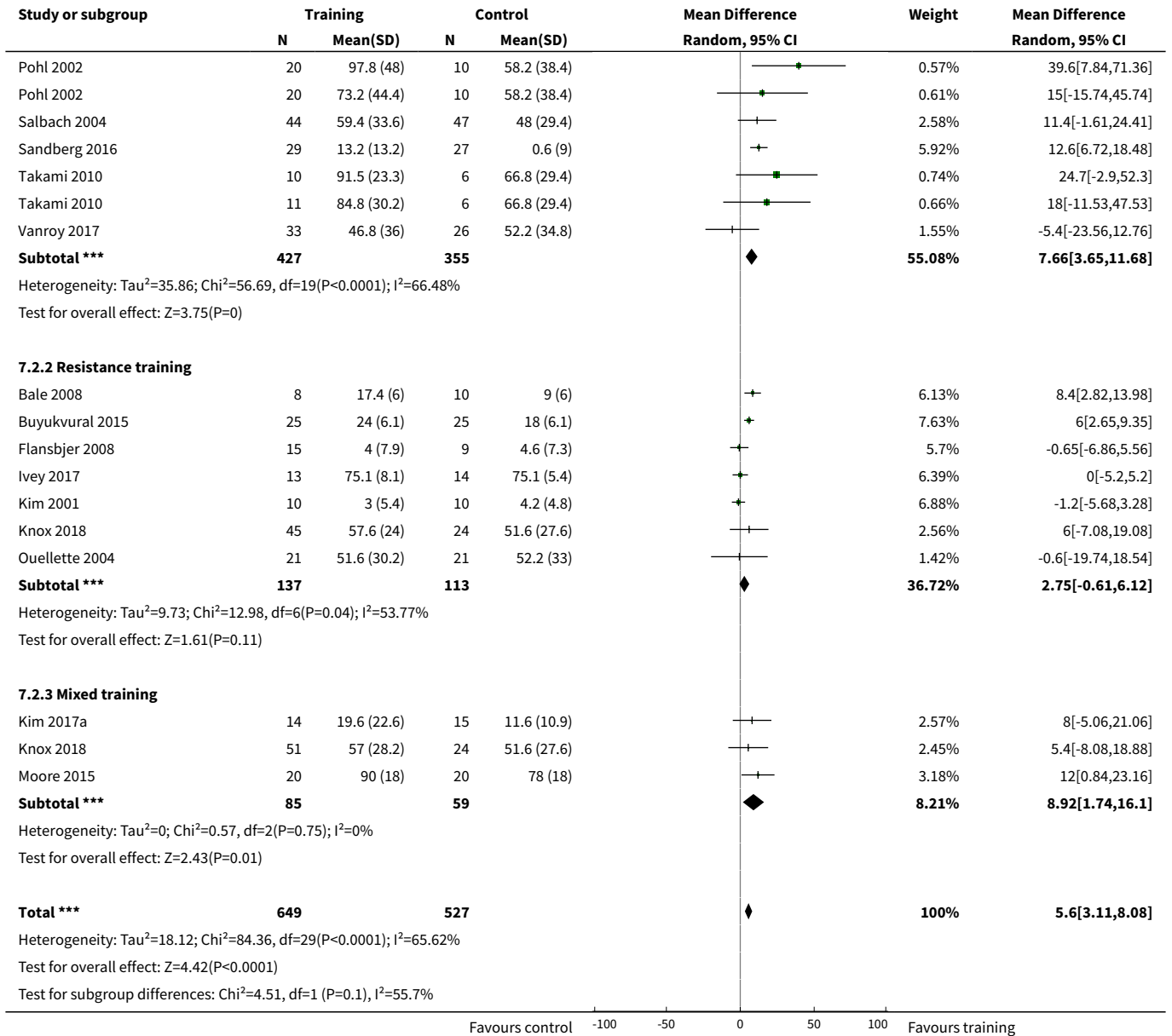
Analysis 7.1. Comparison 7 Cardiorespiratory versus resistance versus mixed training, Outcome 1 Disability - combined disability scales.

Study or subgroup	Training		Control		Std. Mean Difference Random, 95% CI	Weight	Std. Mean Difference Random, 95% CI
	N	Mean(SD)	N	Mean(SD)			
7.1.1 Cardiorespiratory training							
Bateman 2001	23	104.7 (17.7)	29	100.4 (18.9)		12.84%	0.23[-0.32,0.78]
Cuviello-Palmer 1988	10	44.8 (8.8)	10	47.2 (9.9)		8.16%	-0.25[-1.13,0.64]
Globas 2012	18	13.3 (1.7)	18	11.3 (2.7)		10.65%	0.87[0.18,1.55]
Gordon 2013	64	95.9 (6.3)	64	93.3 (9.3)		16.42%	0.33[-0.02,0.67]
Katz-Leurer 2003	46	105.8 (12.5)	44	101.4 (16)		15.21%	0.3[-0.11,0.72]
					-2 -1 0 1 2		
					Favours control		Favours training

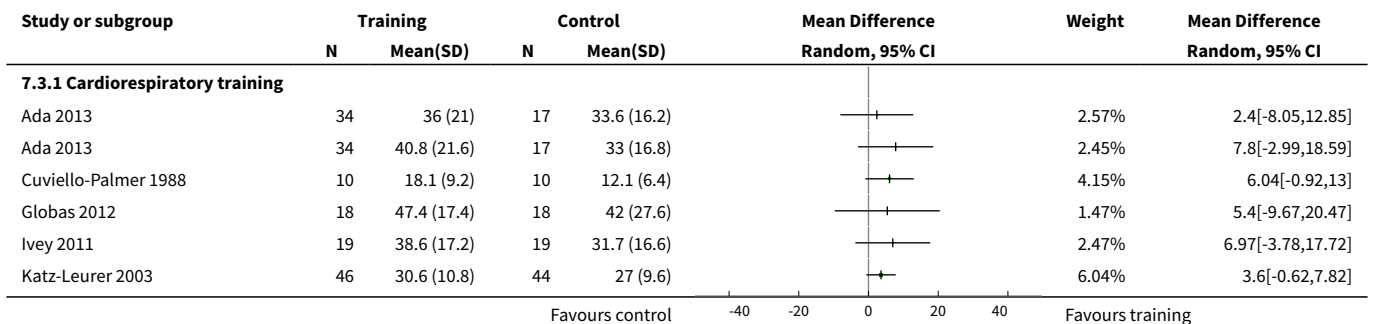


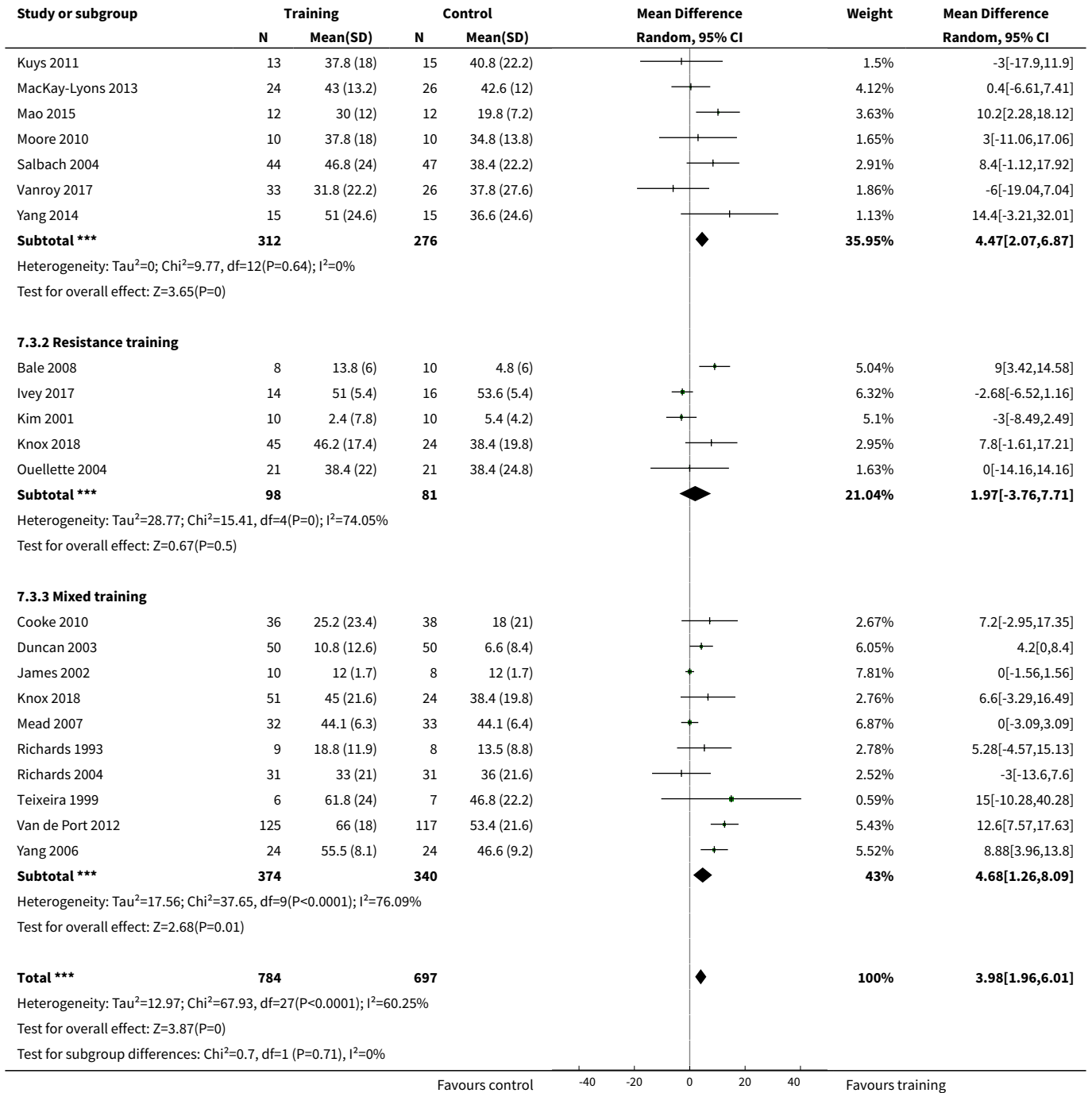
Analysis 7.2. Comparison 7 Cardiorespiratory versus resistance versus mixed training, Outcome 2 Mobility - walking maximal speed.



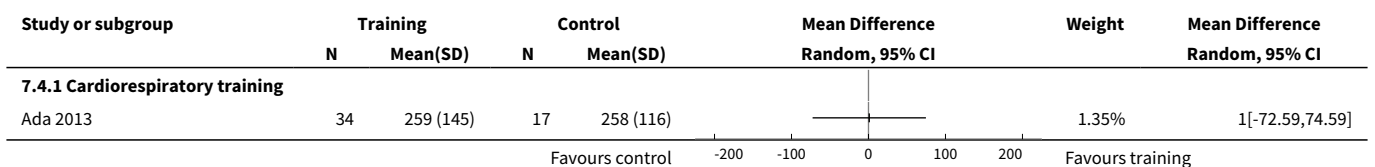


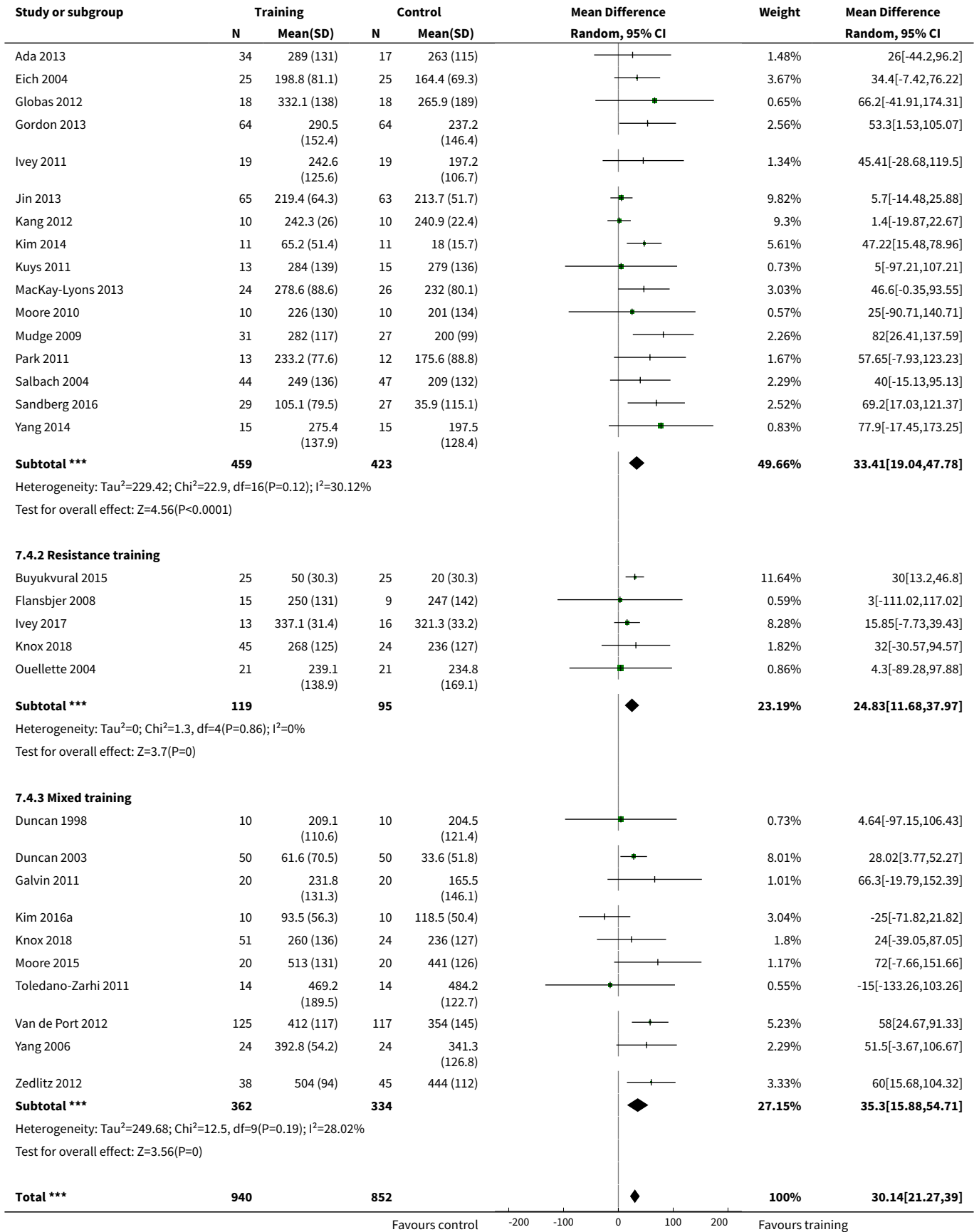
Analysis 7.3. Comparison 7 Cardiorespiratory versus resistance versus mixed training, Outcome 3 Mobility - walking preferred speed.

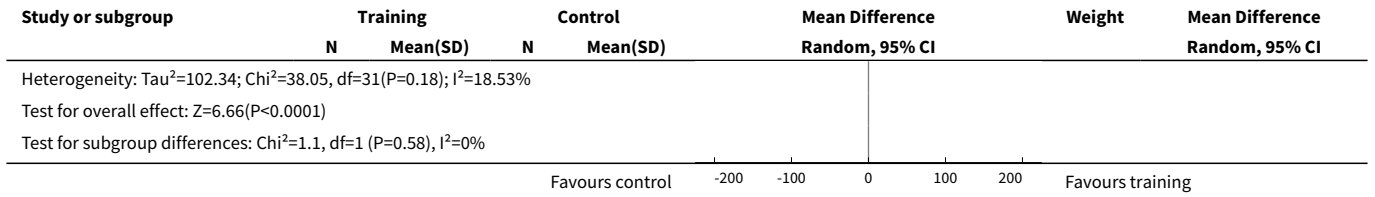




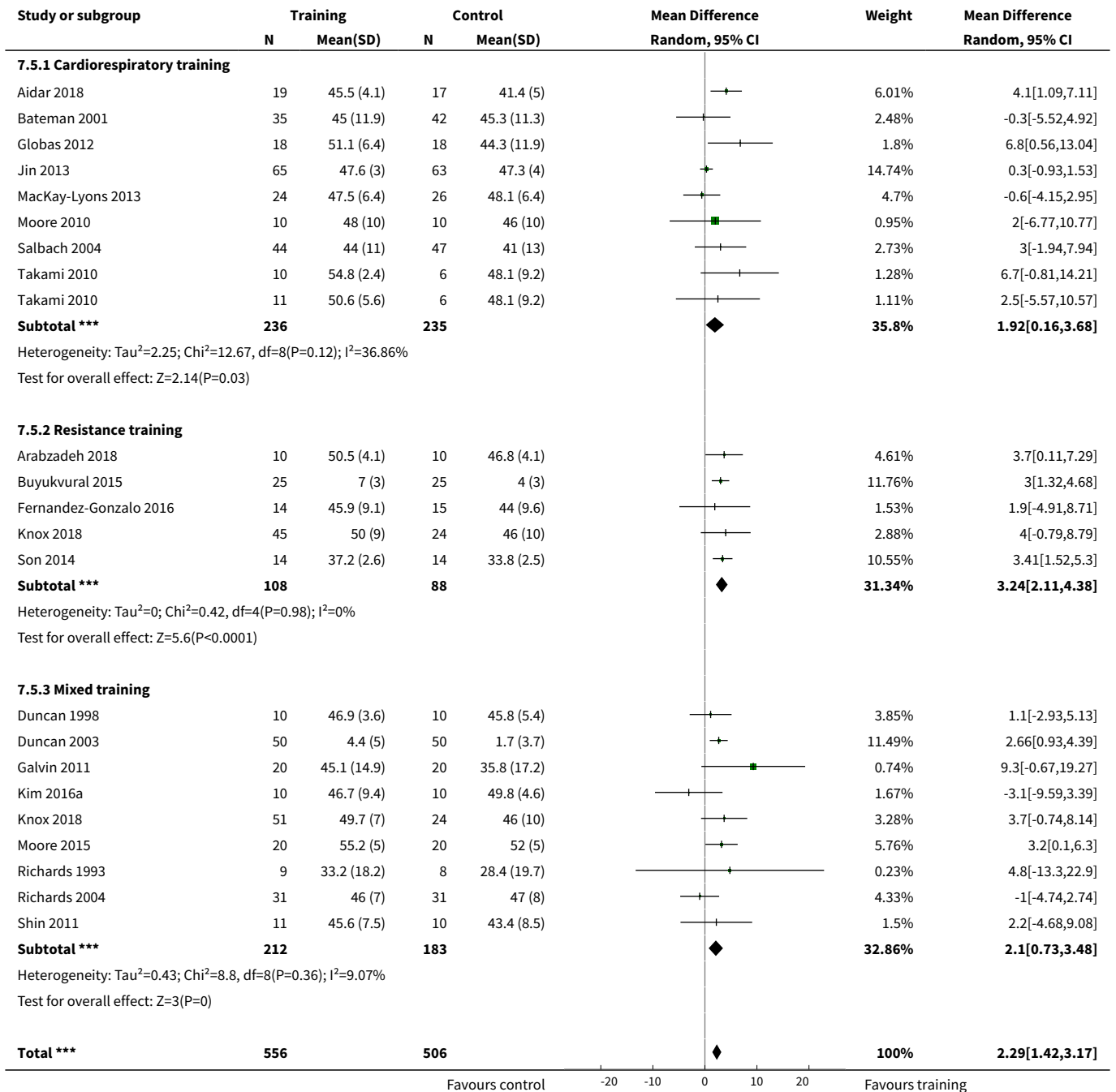
Analysis 7.4. Comparison 7 Cardiorespiratory versus resistance versus mixed training, Outcome 4 Mobility - walking capacity (6-MWT distance).

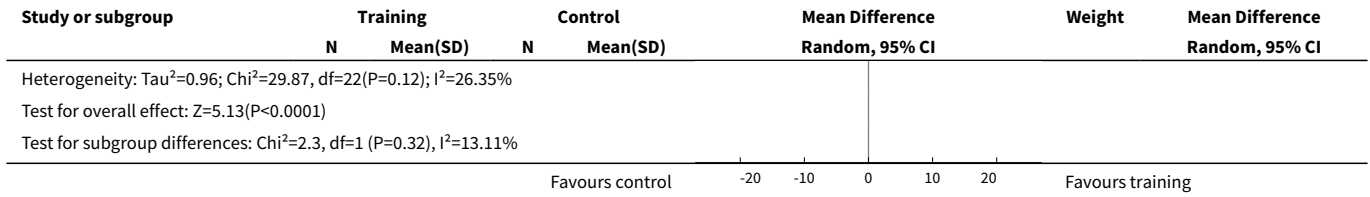




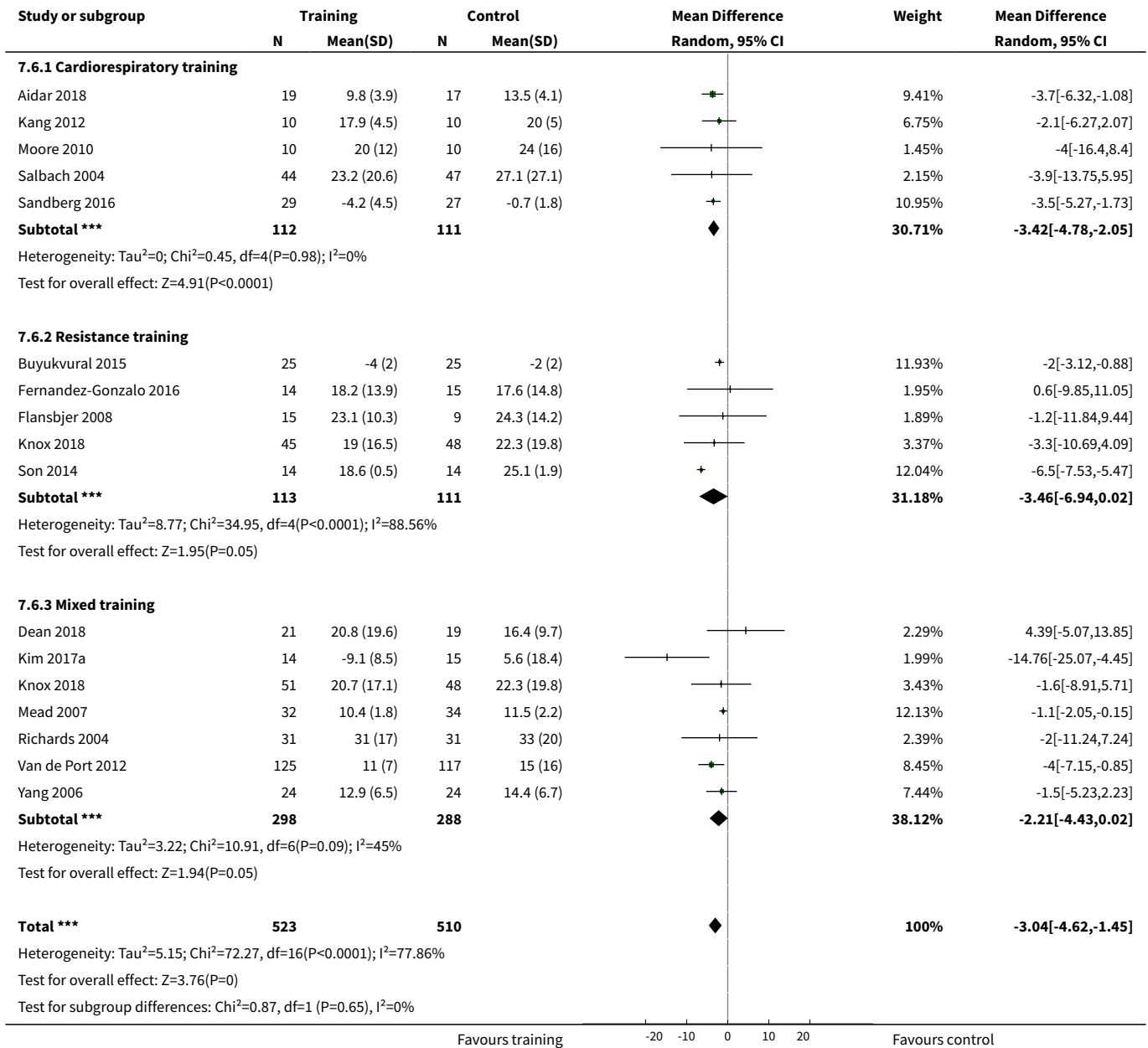


Analysis 7.5. Comparison 7 Cardiorespiratory versus resistance versus mixed training, Outcome 5 Physical Function - Balance - Berg Balance Scale.





Analysis 7.6. Comparison 7 Cardiorespiratory versus resistance versus mixed training, Outcome 6 Physical function - Timed up and go.



ADDITIONAL TABLES

Table 1. Outline of the studies that 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)
Ada 2013	Treadmill + overground walking	After	Lower body	Yes	Unknown	30 min	3	Group 1 = 16 Group 2 = 8
Aidar 2018	Water training	After	Both	Yes	Unknown	45-60	2	12
Bateman 2001	Cycle ergometer	During	Lower body	No	60%-80% age-related heart rate maximum	≤ 30	3	12
Cuvillo-Palmer 1988	Kinetron	During	Lower body	No	Heart rate < resting + 20 beats/min	7-17	5	3
da Cunha 2002	Treadmill gait training with body weight support	During	Lower body	Yes	Unknown	20	5	2-3
Eich 2004	Treadmill gait training	During	Lower body	Yes	60% heart rate reserve	30	5	6
Glasser 1986	Kinetron	During	Lower body	No	Unknown	20-60	5	3
Globas 2012	Treadmill	After	Lower body	Yes	40%-50% progressing to 60%-80% heart rate reserve	10-20 min increasing to 30-50 min	3	12
Gordon 2013	Overground community-based walking	After	Lower body	Yes	Target heart rate was 60%-85% of age-predicted maximum heart rate (220-age).	15min progressing by +5 min per week	3	12
Ivey 2010	Treadmill	After	Lower body	Yes	40%-50% progressing to 60%-70% heart rate reserve	10-20 min increasing to 40 min	3	24 (6 months)

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

Ivey 2011	Treadmill	After	Lower body	Yes	40%-50% progressing to 60%-70% heart rate reserve	10-20 min increasing to 40 min	3	24 (6 months)
Jin 2013	Cycle ergometry	During	Lower	No	Commencing at 40%-50% heart rate reserve progressing 5% heart rate reserve every 2 weeks up to 70% heart rate reserve	40	5	12
Kang 2012	Treadmill	After	Lower body	Yes	Unknown	30	3	4
Katz-Leurer 2003	Cycle ergometer	After	Lower body	No	≤ 60% heart rate reserve	20 then 30	5 then 3	2 then 6 (total 8)
Kim 2014	Community walking programme	During	Lower	Yes	Unclear The walking environment was made more challenging with increased exposure to uneven ground, gradients and stairs	60	5	4
Kuys 2011	Treadmill	After	Lower body	Yes	40% progressing to 60% heart rate reserve	30	3	6
Lennon 2008	Cycle ergometer (cardiac rehabilitation programme)	After	Both	No	50%-60% maximum heart rate	30	2	10
Mackay-Lyons 2013	Body weight supported treadmill training	During	Both	Yes	Target heart rates corresponding to 60%-75% of baseline VO ₂ peak Initially treadmill speed 80%-90% of self-paced overground speed with 20%-30% body weight supported for ambulatory independent participants and 70%-80% of overground speed with 40% body weight supported for ambulatory dependent participants	60	5/week for 6 weeks then 3/week for 6 weeks	12
Mao 2015	Body weight supported treadmill training	During	Lower	Yes	Treadmill walking with 30%-40% body weight support. Body support was decreased and treadmill speed increased. No further detail for per-	20 up to 40	5	3

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

					centage assisted body support was provided. Speed initially 0.5 miles/h (0.8 km/h) for 20 min progressing to 2.5 miles/h (4.0 km/h) for 40 min			
Moore 2010	Treadmill gait training with over-head harness	After	Lower body	Yes	80%-85% age-predicted maximum heart rate	Unknown	2-5	4
Mudge 2009	Circuit training	After	Lower body	Yes	Unknown	30	3	4
Park 2011	Overground community-based walking	During	Lower	Yes	Unknown	60	3	4
Pohl 2002	Treadmill gait training Group 1: structured speed-dependent treadmill training Group 2: limited progressive treadmill training	During	Lower body	Yes	Unknown	30	3	4
Potempa 1995	Cycle ergometer	After	Lower body	No	30%-50% maximum effort	30	3	10
Salbach 2004	Circuit training	After	Lower body	Yes	Unknown	55	3	6
Sandberg 2016	Cycling (main exercise element)	After	Lower	No	Class included 2 x 8-min periods of high-intensity exercise (14-15 RPE; 75% maximum oxygen consumption; 80% maximum heart rate)	60	2	12
Smith 2008	Treadmill gait training	After	Lower body	Yes	RPE ≤ 13	20	3	4
Takami 2010	Treadmill gait training with body weight support Group 1: backward walking group Group 2: forward walking group	During	Lower body	Yes	Unknown	10	6	3



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

Topcuoglu 2015	Arm-cranking ergometer	During	Upper	No	Intensity 10 watts/minute	30	5	4
Vanroy 2017	MOTOmed seated cycling ergometer	Com-menced during (some dis-charged home)	Lower	No	Intensity progressed from 60%-75% heart rate reserve	30 (Total ses-sion 51 min reduc-ing to 40 min)	3	12 (3 months)
Wang 2014	Wheelchair-seated pedaling er-gometry	During	Lower	Yes	Cycling training consisted of 30-min sessions including: 5-min warm-up; 30-min active pedaling at an intensi-ty based on an incremental graded exercise test (2.5 W ramp every 3 min maintaining 50 rpm until exhaus-tion); followed by 5-min cool down. Target heart rate was calculated as ((peak heart rate in graded exercise test – resting heart rate) x 50%-70%) + resting heart rate	30	3	6
Yang 2014	Cycle ergometer	During	Lower	Yes	Cycling training consisted of 15-min sessions each of forward and back-ward cycling including: 150-s passive warm-up; 10-min active pedaling at 50-70 rpm at an intensity of stage 13 of the Borg scale; 150 s of passive cool-down	30	5	4

mph: miles per hour; **RPE:** rate of perceived exertion; **RPM:** revolutions per minute

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

Study ID	Mode of training	During/af-ter usual care	Upper or lower body	Specific training	Intensity	Duration (minutes)	Frequen-cy (days)	Pro-gramme length (weeks)
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Table 2. Outline of the studies that focused on resistance training interventions (Continued)

Aidar 2016	Resistance training; machine weights	After	Both	No	OMNI Resistance Exercise Scale	45-60	3	12
Arabzadeh 2018	Task-oriented circuit with added weights and some balance activities	During	Lower	Yes	Unknown; tailored to individual capacity	50	3	4
Bale 2008	Resistance training; weights	During	Lower body	No	10-15 repetitions to achieve moderate fatigue	50	3	4
Buyukvural 2015	Isokinetic dynamometer training	During	Lower	No	Unclear	Unclear	5	3
Coroian 2018	Isokinetic dynamometer training	During	Upper	No	6 sets of 8 repetitions increasing from 40%-70% of maximal baseline torque	45	3	5
Fernandez-Gonzalo 2016	Unilateral explosive resistance training of the more affected leg	After	Lower	No	Maximal effort	Unclear	2	12
Flansbjerg 2008	Dynamic and isokinetic resistance training (leg extension/curl rehab exercise machine)	After	Lower body	Yes	6-10 repetitions equivalent to 80% of maximum load	90	Unknown	10
Inaba 1973	Resistance training	During	Lower body	No	50% and 100% maximum weight	Unknown	'Daily'	4-8
Ivey 2017	Pneumatic resistance machines	After	Lower	No	10-15, decreasing to 20 repetition maximum across sets	Unclear	3	12
Kim 2001	Resistance training; isokinetic dynamometer	After	Lower body	No	Maximal effort 3 x 10 repetitions	30	3	6
Knox 2018	Gravity, free weights, elastic bands and balls	After	Lower	No	3 set of 10 repetitions; progressed individually	60	6 sessions	12

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

							(average 0.5 per week)		
Lee 2013a	Closed chain and open chain progressive resistance training	After	Lower	No	3 sets of 8-10 repetitions 70% of 1 repetition maximum	Unclear (duration based on repetitions)	5	6	
Lee 2013b	Closed-chain and open-chain progressive resistance training	After	Lower	No	3 sets of 8-10 repetitions 70% of 1 repetition maximum	Unclear (duration based on repetitions)	5	6	
Ouellette 2004	Resistance training; weights and pneumatic resistance machines	After	Lower body	No	70% 1 repetition maximum: 3 x 8-10 repetitions	Not applicable	3	12	
Sims 2009	Resistance training; machine weights	After	Both	Yes	3 x 8/10 repetitions at 80% 1 repetition maximum	Unknown	2	10	
Son 2014	Pneumatic leg press machine	Probably after	Lower	No	3 sets of 8-10 repetitions 70% of 1 repetition maximum	30	5	6	
Taylor-Pilliaie 2014	Silversneakers national programme (strength and range of movement)	After	Unclear	Unclear	Unclear	40	3	12	
Verheyden 2009	Functional strength	During	Upper (trunk)	Yes	Functional trunk flexion and extension strength in supine and sitting. Exercises gradually introduced and number of repetitions determined by physiotherapists on a participant's performance basis.	30	4	5	

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

						No further details reported			
Winstein 2004	Resistance training; weights; TheraBand and grip devices	During	Upper body	No	Unknown	60	3 high 2 slow	4-6 (target of 20 sessions)	
Zou 2015	Resistance training machines	After	Lower	No	3 sets of 15 repetitions; initial intensity causing failure 10-12 repetitions, then reduce to allow completion of 15	40	3	8	

Table 3. Outline of the studies that 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)
Cooke 2010	Resistance training + treadmill training	During	Lower body	Yes	Unknown	60	4	6
Dean 2018	Group circuit training (0-3 months) + home training (0-6 months)	After	Both	Yes	Unclear	Unclear	2 classes (+ home exercise)	6 (0-3 months group exercise; 0-6 months home exercise)
Donaldson 2009	Paretic upper limb exercises and hand grip activities	During	Upper body	Yes	Unknown	60	4	6
Duncan 1998	Walking or cycle ergometry; elastic-resisted contractions	After	Both	Yes	Unknown	90	3	12

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

Duncan 2003	Circuit training	After	Lower body	Yes	50%-60% heart rate reserve	90-120	3	4
Furnari 2014	Aquatic exercise	During	Upper or lower body	Yes	Unclear; difficulty progressed weekly	60	3	8
Galvin 2011	Family-mediated gait and strength training	During	Lower	Yes	Unknown	35	7	8
James 2002	Circuit training	After	Both	Yes	Unknown	90	3	12-14 (total of 36 sessions)
Kim 2016a	Circuit training	During	Both	Yes	Treadmill speed/gradient TheraBand repetitions/load	90	5	4
Kim 2017a	Handgrip resistance training + treadmill walking with some added load to unaffected leg	During	Both	Yes	Resistance increase Treadmill speed increase	30	3	6
Knox 2018	Task-oriented circuit training (+ home-based walking)	After	Lower (+upper?)	Yes (walking)	Reduced support and increased complexity and more demanding home-based walking	60	6 sessions (average 0.5 per week)	12
Langhammer 2007	Walking, stationary bicycling, stair walking, treadmill, and resistance training	After	Both	Yes	70%-80% maximum pulse (cardiorespiratory component); 50%-60% one repetition maximum (strength component)	45	2/3	Unclear. Minimum 20 hours every third month in the first year after stroke
Letombe 2010	Cycle ergometry, treadmill walking, and isokinetic resistance training	During	Both including trunk	Yes (walking)	Cardiorespiratory training: 70%-80% maximal cycling power Strength training; 6 x 10 repetitions at 50%-60% maximum	40-60	4	4

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

Mead 2007	Circuit including walking, stepping, cycle ergometry; resistance training body mass, weights, and elastic	After	Both	Yes	Rating of perceived exertion: 13-16	40-75	3	12-14 (total of 36 sessions)
Moore 2015	Community-based group classes including warm-up, stretching, functional strengthening, balance, agility and cardiorespiratory training	After	Both	Yes	Increasing load and repetitions 40%-50% maximum heart rate increasing to 70%-80%	40-60	3	19
Richards 1993	Treadmill + Kinetron + tilt table	During	Lower body	Yes	Unknown	104	5	5
Richards 2004	Treadmill + Kinetron + limb load monitor	During	Lower body	Yes	Unknown	60	5	8
Shin 2011	Functional strength training (bridging and stepping) + treadmill and cycle ergometry	During	Lower	Yes (walking and stepping)	Cardiorespiratory progressive but < 40% heart rate reserve Strength training described only as 'medium intensity' of 5-15 repetitions	60	5	4
Teixeira 1999	Walking and stepping or cycle ergometry; resistance training body mass, weights and elastic	After	Lower body	Yes	50%-70% maximum work rate (cardiorespiratory component) 50%-80% 1 repetition maximum, 3 x 10 repetitions (strength component)	60-90	3	10
Toledano-Zarhi 2011	Treadmill, hand bike, cycle ergometer + group exercise for strength, balance and co-ordination exercise	During	Both	Yes (treadmill)	Cardiorespiratory 50%-70% of maximal heart rate	Cardiorespiratory 90 min Group 45-55 min	Cardiorespiratory 2/week Group 1/week	6
Van de Port 2012	Task-orientated circuit training. 8 workstations targeting balance, stair walking, turning, transfers and speed walking	After	Lower	Yes (task-orientated)	Unknown	90	2	12
Yang 2006	Functional stepping and chair rising	After	Lower body	Yes	Unknown	30	3	4

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

Zedlitz 2012	Treadmill walking, strength training, and home exercise assignments	After	Both	Yes (walking)	Cardiorespiratory and strength progressed from 40%-70%	120	2	12
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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	Studies (number of participants)	MD (95% CI)	Significance level	Studies (number of participants)	MD (95% CI)	Significance level
Cardiorespiratory training	Maximal gait speed	17 (782)	7.66 m/min (3.65 to 11.68)	P = 0.0002	5 (312)	6.71 m/min (2.40 to 11.02)	P = 0.002
	Preferred gait speed	12 (588)	4.47 m/min (2.07 to 6.87)	P = 0.0003	3 (176)	1.67 m/min (-3.27 to 6.62)	NS
	6-Minute Walk Test	16 (882)	33.41 m (19.04 to 47.78)	P = 0.00001	5 (283)	38.29 m (7.19 to 69.39)	P = 0.02
Resistance training	Maximal gait speed	6 (274)	2.83 m/min (-0.49 to 6.14)	NS	2 (117)	7.80 m/min (-3.32 to 18.91)	NS
	Preferred gait speed	5 (203)	2.15 m/min (-3.57 to 7.87)	NS	-	-	-
	6-Minute Walk Test	5 (238)	24.98 m (11.98 to 37.98)	P value 0.0002	2 (117)	22.41 m (-27.87 to 72.69)	NS
Mixed training	Maximal gait speed	3 (168)	8.48 m/min (1.76 to 15.20)	P = 0.01	-	-	-
	Preferred gait speed	10 (738)	4.71 m/min (1.32 to 8.10)	P = 0.006	5 (542)	2.54 m/min (-3.65 to 8.72)	NS
	6-Minute Walk Test	10 (720)	35.00 m (15.91 to 54.09)	P value < 0.0003	4 (464)	47.48 m (23.72 to 71.23)	P = 0.0001

CI: confidence interval; **MD:** mean difference; **NS:** no statistically significant difference

APPENDICES

Appendix 1. CENTRAL search strategy (the Cochrane Library)

#1[mh ^"cerebrovascular disorders"] or [mh "basal ganglia cerebrovascular disease"] or [mh "brain ischemia"] or [mh "carotid artery diseases"] or [mh "intracranial arterial diseases"] or [mh "intracranial arteriovenous malformations"] or [mh "intracranial embolism and thrombosis"] or [mh "intracranial hemorrhages"] or [mh ^stroke] or [mh "brain infarction"] or [mh ^"stroke, lacunar"] or [mh ^"vasospasm, intracranial"] or [mh ^"vertebral artery dissection"] or [mh ^"brain injuries"] or [mh ^"brain injury, chronic"] 15776

#2(stroke or poststroke or post-stroke or cerebrovasc* or brain next vasc* or cerebral next vasc* or cva* or apoplex* or SAH):ti,ab,kw (Word variations have been searched)48705

#3((brain* or cerebr* or cerebell* or intracran* or intracerebral) near/5 (isch*emi* or infarct* or thrombo* or emboli* or occlus*)):ti,ab,kw (Word variations have been searched)11213

#4((brain* or cerebr* or cerebell* or intracerebral or intracranial or subarachnoid) near/5 (haemorrhage* or hemorrhage* or haematoma* or hematoma* or bleed*)):ti,ab,kw (Word variations have been searched)7971

#5[mh ^hemiplegia] or [mh paresis] 1338

#6(hempar* or hemipleg* or brain next injur*):ti,ab,kw (Word variations have been searched)6443

#7[mh ^"Gait Disorders, Neurologic"] 555

#8#1 or #2 or #3 or #4 or #5 or #6 or #7 62227

#9[mh exercise] 21418

#10[mh "exercise therapy"] 11971

#11[mh sports] 14247

#12[mh ^"muscle strength"] or [mh "physical endurance"] or [mh ^"physical exertion"] or [mh ^"physical fitness"] 13586

#13exercis*:ti,ab,kw (Word variations have been searched)70858

#14train*:ti,ab,kw (Word variations have been searched)67624

#15conditioning:ti,ab,kw (Word variations have been searched)84620

#16strengthen*:ti,ab,kw (Word variations have been searched)4564

#17{or#9-#16} 189900

#18#8 and #17 10540

Appendix 2. MEDLINE (Ovid) search strategy

SAUNDERSv5_MEDLINE_2018

Physical fitness training for stroke patients_July2018_Final

1. cerebrovascular disorders/ or exp basal ganglia cerebrovascular disease/ or exp brain ischemia/ or exp carotid artery diseases/ or exp intracranial arterial diseases/ or exp intracranial arteriovenous malformations/ or exp "intracranial embolism and thrombosis"/ or exp intracranial hemorrhages/ or stroke/ or exp brain infarction/ or stroke, lacunar/ or vasospasm, intracranial/ or vertebral artery dissection/ or brain injuries/ or brain injury, chronic/
2. (stroke or poststroke or post-stroke or cerebrovasc\$ or brain vasc\$ or cerebral vasc\$ or cva\$ or apoplex\$ or SAH).tw.
3. ((brain\$ or cerebr\$ or cerebell\$ or intracran\$ or intracerebral) adj5 (isch?emi\$ or infarct\$ or thrombo\$ or emboli\$ or occlus\$)).tw.
4. ((brain\$ or cerebr\$ or cerebell\$ or intracerebral or intracranial or subarachnoid) adj5 (haemorrhage\$ or hemorrhage\$ or haematoma\$ or hematoma\$ or bleed\$)).tw.
5. hemiplegia/ or exp paresis/
6. (hempar\$ or hemipleg\$ or brain injur\$).tw.
7. Gait Disorders, Neurologic/
8. or/1-7
9. exp exercise/ or exp exercise therapy/
10. exp sports/
11. muscle strength/ or exp physical endurance/ or physical exertion/ or physical fitness/
12. exercis\$.tw.
13. train\$.tw.
14. conditioning.tw.
15. strengthen\$.tw.
16. or/9-15
17. randomized controlled trial.pt.
18. controlled clinical trial.pt.
19. randomized.ab.
20. placebo.ab.
21. randomly.ab.
22. trial.ab.
23. groups.ab.
24. or/17-23
25. exp animals/ not humans.sh.

26. 8 and 16 and 24
 27. 26 not 25
 28. limit 27 to yr="2015 -Current"

Appendix 3. Embase (Ovid) search strategy

SAUNDERSv5_Embase_2018

Physical fitness training for stroke patients_March2018_Saunders suggestions

1. cerebrovascular disease/ or exp basal ganglion hemorrhage/ or exp brain hematoma/ or exp brain hemorrhage/ or exp brain infarction/ or exp brain ischemia/ or exp carotid artery disease/ or cerebral artery disease/ or exp cerebrovascular accident/ or exp intracranial aneurysm/ or exp occlusive cerebrovascular disease/
2. stroke patient/ or stroke unit/
3. (stroke or poststroke or post-stroke or cerebrovasc\$ or brain vas\$ or cerebral vas\$ or cva\$ or apoplex\$ or SAH).tw.
4. ((brain\$ or cerebr\$ or cerebell\$ or intracran\$ or intracerebral) adj5 (isch?emi\$ or infarct\$ or thrombo\$ or emboli\$ or occlus\$)).tw.
5. ((brain\$ or cerebr\$ or cerebell\$ or intracerebral or intracranial or subarachnoid) adj5 (haemorrhage\$ or hemorrhage\$ or haematoma\$ or hematoma\$ or bleed\$)).tw.
6. brain injury/ or acquired brain injury/
7. hemiparesis/ or hemiplegia/ or paresis/ or neurologic gait disorder/ or hemiplegic gait/
8. (hempar\$ or hemipleg\$ or brain injur\$).tw.
9. or/1-8
10. exp exercise/
11. exp kinesiotherapy/
12. exp sport/
13. muscle strength/
14. endurance/
15. fitness/
16. exercis\$.tw.
17. train\$.tw.
18. conditioning.tw.
19. strengthen\$.tw.
20. or/10-19
21. Randomized Controlled Trial/ or "randomized controlled trial (topic)"/
22. Randomization/
23. Controlled clinical trial/ or "controlled clinical trial (topic)"/
24. control group/ or controlled study/
25. clinical trial/ or "clinical trial (topic)"/ or phase 1 clinical trial/ or phase 2 clinical trial/ or phase 3 clinical trial/ or phase 4 clinical trial/
26. Crossover Procedure/
27. Double Blind Procedure/
28. Single Blind Procedure/ or triple blind procedure/
29. placebo/ or placebo effect/
30. (random\$ or RCT or RCTs).tw.
31. (controlled adj5 (trial\$ or stud\$)).tw.
32. (clinical\$ adj5 trial\$).tw.
33. ((control or treatment or experiment\$ or intervention) adj5 (group\$ or subject\$ or patient\$)).tw.
34. (quasi-random\$ or quasi random\$ or pseudo-random\$ or pseudo random\$).tw.
35. ((control or experiment\$ or conservative) adj5 (treatment or therapy or procedure or manage\$)).tw.
36. ((singl\$ or doubl\$ or tripl\$ or trebl\$) adj5 (blind\$ or mask\$)).tw.
37. (cross-over or cross over or crossover).tw.
38. (placebo\$ or sham).tw.
39. trial.ti.
40. (assign\$ or allocat\$).tw.
41. controls.tw.
42. or/21-41
43. 9 and 20 and 42
44. (exp animals/ or exp invertebrate/ or animal experiment/ or animal model/ or animal tissue/ or animal cell/ or nonhuman/) not (human/ or normal human/ or human cell/)
45. 43 not 44
46. limit 45 to yr="2015 -Current"

Appendix 4. CINAHL (EBSCO) search strategy

S1(MH "Cerebrovascular Disorders+") or (MH "stroke patients") or (MH "stroke units")

S2TI (stroke or poststroke or post-stroke or cerebrovasc* or brain vas* or cerebral vasc or cva or apoplex or SAH) or AB (stroke or poststroke or post-stroke or cerebrovasc* or brain vas* or cerebral vasc or cva or apoplex or SAH)
 S3TI (brain* or cerebr* or cerebell* or intracran* or intracerebral) or AB (brain* or cerebr* or cerebell* or intracran* or intracerebral)
 S4TI (ischemi* or ischaemi* or infarct* or thrombo* or emboli* or occlus*) or AB (ischemi* or ischaemi* or infarct* or thrombo* or emboli* or occlus*)
 S5S3 and S4
 S6TI (brain* or cerebr* or cerebell* or intracerebral or intracranial or subarachnoid) or AB (brain* or cerebr* or cerebell* or intracerebral or intracranial or subarachnoid)
 S7TI (haemorrhage* or hemorrhage* or haematoma* or hematoma* or bleed*) or AB (haemorrhage* or hemorrhage* or haematoma* or hematoma* or bleed*)
 S8S6 and S7
 S9(MH "Hemiplegia")
 S10TI (hemipleg* or hemipar* or paresis or paretic) or AB (hemipleg* or hemipar* or paresis or paretic)
 S11(MH "Gait Disorders, Neurologic+")
 S12S1 or S2 or S5 or S8 or S9 or S10 or S11
 S13(MH "Exercise+")
 S14(MH "Therapeutic Exercise+")
 S15(MH "Sports+")
 S16(MH "Physical Endurance+") OR (MH "Exertion+") OR (MH "Muscle Strengthening+")
 S17TI exercis* OR AB exercis*
 S18TI train* OR AB train*
 S19TI conditioning OR AB conditioning
 S20TI strengthen* OR AB strengthen*
 S21S13 OR S14 OR S15 OR S16 OR S17 OR S18 OR S19 OR S20
 S22MH Random Assignment or MH Single-blind Studies or MH Double-blind Studies or MH Triple-blind Studies or MH Crossover design or MH Factorial Design
 S23TI ("multicentre study" or "multicenter study" or "multi-centre study" or "multi-center study") or AB ("multicentre study" or "multicenter study" or "multi-centre study" or "multi-center study") or SU ("multicentre study" or "multicenter study" or "multi-centre study" or "multi-center study")
 S24TI random* or AB random*
 S25AB "latin square" or TI "latin square"
 S26TI (crossover or cross-over) or AB (crossover or cross-over) or SU (crossover or cross-over)
 S27MH Placebos
 S28TI (((singl* or doubl* or trebl* or tripl*) N3 (blind* or mask*))) OR AB (((singl* or doubl* or trebl* or tripl*) N3 (blind* or mask*)))
 S29TI Placebo* or AB Placebo* or SU Placebo*
 S30MH Clinical Trials
 S31TI (Clinical AND Trial) or AB (Clinical AND Trial) or SU (Clinical AND Trial)
 S32S22 OR S23 OR S24 OR S25 OR S26 OR S27 OR S28 OR S29 OR S30 OR S31

Appendix 5. SPORTDiscus (EBSCO) search strategy

S1. DE "CEREBROVASCULAR disease" or DE "BRAIN Hemorrhage" or DE "CEREBRAL embolism & thrombosis"
 S2. TI (stroke or poststroke or post-stroke or cerebrovasc* or brain vas* or cerebral vasc or cva or apoplex or SAH) or AB (stroke or poststroke or post-stroke or cerebrovasc* or brain vas* or cerebral vasc or cva or apoplex or SAH)
 S3. (TI (brain* or cerebr* or cerebell* or intracran* or intracerebral) or AB (brain* or cerebr* or cerebell* or intracran* or intracerebral)) and (TI (ischemi* or ischaemi* or infarct* or thrombo* or emboli* or occlus*) or AB (ischemi* or ischaemi* or infarct* or thrombo* or emboli* or occlus*))
 S4. (TI (brain* or cerebr* or cerebell* or intracerebral or intracranial or subarachnoid) or AB (brain* or cerebr* or cerebell* or intracerebral or intracranial or subarachnoid)) and (TI (haemorrhage* or hemorrhage* or haematoma* or hematoma* or bleed*) or AB (haemorrhage* or hemorrhage* or haematoma* or hematoma* or bleed*))
 S5. DE "HEMIPLEGIA"
 S6. TI (hemipleg* or hemipar* or paresis or paretic) or AB (hemipleg* or hemipar* or paresis or paretic)
 S7. S1 or S2 or S3 or S4 or S5 or S6
 S8. TI random* or AB random*
 S9. (TI (singl* or doubl* or tripl* or trebl*) or AB (singl* or doubl* or tripl* or trebl*)) and (TI (blind* or mask*) or AB (blind* or mask*))
 S10. TI (crossover or cross-over or placebo* or control* or factorial or sham) or AB (crossover or cross-over or placebo* or control* or factorial or sham)
 S11. (TI (clin* or intervention* or compar* or experiment* or preventive or therapeutic) or AB (clin* or intervention* or compar* or experiment* or preventive or therapeutic)) and (TI trial* or AB trial*)
 S12. TI (counterbalance* or multiple baseline* or ABAB design) or AB (counterbalance* or multiple baseline* or ABAB design)
 S13. TI (meta analysis* or metaanalysis or meta-anlysis or systematic review*) or AB (meta analysis* or metaanalysis or meta-anlysis or systematic review*)

S14. SU (random* or trial or crossover or cross-over or placebo* or control* or factorial or sham or counterbalance* or multiple baseline* or ABAB design or meta analysis* or metaanalysis or meta-anlysis or systematic review*) or KW (random* or trial or crossover or cross-over or placebo* or control* or factorial or sham or counterbalance* or multiple baseline* or ABAB design or meta analysis* or metaanalysis or meta-anlysis or systematic review*)

S15. S8 or S9 or S10 or S11 or S12 or S13 or S14

S16. (S7 and S15)

Appendix 6. PsycINFO (Ovid) search strategy

1. cerebrovascular disorders/ or cerebral hemorrhage/ or exp cerebral ischemia/ or cerebrovascular accidents/ or subarachnoid hemorrhage/
2. (stroke\$ or post stroke or poststroke or post-stroke or apoplex\$ or cerebral vasc\$ or cerebrovasc\$ or cva or SAH).tw.
3. ((brain\$ or cerebr\$ or cerebell\$ or vertebrobasil\$ or hemispher\$ or intracran\$ or intracerebral or infratentorial or supratentorial or middle cerebral artery or MCA\$ or anterior circulation or posterior circulation or basilar artery or vertebral artery or space-occupying) adj3 (isch?emi\$ or infarct\$ or thrombo\$ or emboli\$ or occlus\$ or hypoxi\$)).tw.
4. ((brain\$ or cerebr\$ or cerebell\$ or intracerebral or intracran\$ or parenchymal or intraparenchymal or intraventricular or infratentorial or supratentorial or basal gangli\$ or putaminal or putamen or posterior fossa or hemispher\$ or subarachnoid) adj3 (h?emorrhag\$ or h?ematoma\$ or bleed\$)).tw.
5. hemiparesis/ or hemiplegia/
6. (hemipleg\$ or hemipar\$ or paresis or paretic).tw.
7. or/1-6
8. exp exercise/
9. exp sports/
10. physical strength/ or physical endurance/ or physical fitness/
11. exercis\$.tw.
12. train\$.tw.
13. conditioning.tw.
14. strengthen\$.tw.
15. or/8-14
16. clinical trials/ or treatment effectiveness evaluation/ or placebo/
17. (random\$ or RCT or RCTs).tw.
18. (controlled adj5 (trial\$ or stud\$)).tw.
19. (clinical\$ adj5 trial\$).tw.
20. ((control or treatment or experiment\$ or intervention) adj5 (group\$ or subject\$ or patient\$)).tw.
21. (quasi-random\$ or quasi random\$ or pseudo-random\$ or pseudo random\$).tw.
22. ((control or experiment\$ or conservative) adj5 (treatment or therapy or procedure or manage\$)).tw.
23. ((singl\$ or doubl\$ or tripl\$ or trebl\$) adj5 (blind\$ or mask\$)).tw.
24. (cross-over or cross over or crossover).tw.
25. (placebo\$ or sham).tw.
26. trial.ti.
27. (assign\$ or allocat\$).tw.
28. controls.tw.
29. or/16-28
30. 7 and 15 and 29

Appendix 7. Conference Proceedings (WoS)

20#19 AND #10 AND #5

Indexes=SCI-EXPANDED, CPCI-S Timespan=2015-2018

19#18 OR #17 OR #16 OR #15 OR #14 OR #13 OR #12 OR #11

Indexes=SCI-EXPANDED, CPCI-S Timespan=2015-2018

18TS=(placebo* or sham)

Indexes=SCI-EXPANDED, CPCI-S Timespan=2015-2018

17TS=(cross-over or cross over or crossover)

Indexes=SCI-EXPANDED, CPCI-S Timespan=2015-2018

16TS=((singl* or doubl* or tripl* or trebl*) NEAR/5 (blind* or mask*))

Indexes=SCI-EXPANDED, CPCI-S Timespan=2015-2018

15TS=((control or experiment* or conservative) NEAR/5 (treatment or therapy or procedure or manage*))

Indexes=SCI-EXPANDED, CPCI-S Timespan=2015-2018

14TS=((control or treatment or experiment* or intervention) NEAR/5 (group* or subject* or patient*))

Indexes=SCI-EXPANDED, CPCI-S Timespan=2015-2018

13TS=(clinical* NEAR/5 trial*)

Indexes=SCI-EXPANDED, CPCI-S Timespan=2015-2018

Physical fitness training for stroke patients (Review)

12TS=(controlled NEAR/5 (trial* or stud*))
Indexes=SCI-EXPANDED, CPCI-S Timespan=2015-2018
11TS=random*
Indexes=SCI-EXPANDED, CPCI-S Timespan=2015-2018
10#9 OR #8 OR #7 OR #6
Indexes=SCI-EXPANDED, CPCI-S Timespan=2015-2018
9TS=strengthen*
Indexes=SCI-EXPANDED, CPCI-S Timespan=2015-2018
8TS=conditioning
Indexes=SCI-EXPANDED, CPCI-S Timespan=2015-2018
7TS=train*
Indexes=SCI-EXPANDED, CPCI-S Timespan=2015-2018
6TS=exercis*
Indexes=SCI-EXPANDED, CPCI-S Timespan=2015-2018
5#4 OR #3 OR #2 OR #1
Indexes=SCI-EXPANDED, CPCI-S Timespan=2015-2018
4TS=((hemipleg* or hemipar* or bain injur*))
Indexes=SCI-EXPANDED, CPCI-S Timespan=2015-2018
3TS=((brain* or cerebr* or cerebell* or intracerebral or intracranial or subarachnoid) NEAR/5 (haemorrhage* or hemorrhage* or haematoma* or hematoma* or bleed*))
Indexes=SCI-EXPANDED, CPCI-S Timespan=2015-2018
2TS=((brain* or cerebr* or cerebell* or intracran* or intracerebral) NEAR/5 (isch\$emi* or infarct* or thrombo* or emboli* or occlus*))
Indexes=SCI-EXPANDED, CPCI-S Timespan=2015-2018
1TS=(stroke or poststroke or post-stroke or cerebrovasc* or brain vasc* or cerebral vasc* or cva* or apoplex* or SAH)
Indexes=SCI-EXPANDED, CPCI-S Timespan=2015-2018

Appendix 8. PEDro search strategy

Two separate searches were performed using the PEDRO advanced search

Search #1

1. Title and Abstract = "Stroke"
 2. Therapy = "**FITNESS TRAINING**"
 3. Problem = [No appropriate value in this field]
 4. Body Part = [No appropriate value in this field]
 5. Sub Discipline = [No appropriate value in this field]
 6. Topic = [No appropriate value in this field]
 7. Method = "Clinical Trial"
 8. New Records Added Since = 01/01/2015
- Match all search terms (AND)

Search #2

1. Title and Abstract = "Stroke"
 2. Therapy = "**STRENGTH TRAINING**"
 3. Problem = [No appropriate value in this field]
 4. Body Part = [No appropriate value in this field]
 5. Sub Discipline = [No appropriate value in this field]
 6. Topic = [No appropriate value in this field]
 7. Method = "Clinical Trial"
 8. New Records Added Since = 01/01/2015
- Match all search terms (AND)

Appendix 9. Searching other resources

The additional resources were searched using the following simple search approach

STROKE AND (FITNESS OR EXERCISE OR TRAINING)

WHAT'S NEW

Date	Event	Description
7 July 2019	New citation required and conclusions have changed	<p>In this update there are now more studies containing resistance training either as a standalone intervention or as part of mixed training (resistance plus cardiorespiratory). This has clarified that resistance training content within programmes of training can benefit balance after stroke.</p> <p>There are new co-authors with experience of exercise and activity after stroke.</p>
7 July 2019	New search has been performed	<p>We have updated all main electronic search strategies to July 2018; we have rewritten the syntax of all the search strategies including the addition of new resources (PsycINFO). Layout of the methods now mirrors that in a related review (Interventions to reduce sedentary behaviour after stroke).</p> <p>We have included 17 additional randomised controlled trials, bringing the total number of included studies to 75, involving 3617 participants.</p>

HISTORY

Protocol first published: Issue 4, 2001

Review first published: Issue 1, 2004

Date	Event	Description
12 November 2015	New citation required and conclusions have changed	<p>New trials have changed where significant benefits emerge. Improvements in global indices of disability are apparent now for mixed training as well as cardiorespiratory training. Improvements in balance are now only apparent among trials of mixed training. We have added a new patient-important outcome (cognitive function) but there is a lack of evidence and this highlights an important knowledge gap.</p>
29 October 2015	New search has been performed	<p>We have updated all main electronic search strategies to February 2015. We have included 13 additional randomised controlled trials, bringing the total number of included trials to 58, involving 2797 participants. We have added a cognitive function outcome to the review because this has been identified as a research priority. Secondly an application to carry out a Cochrane review of exercise interventions for cognition after stroke was judged to overlap and to be more efficiently combined with this review of fitness training interventions after stroke. We checked all previously included trials for cognitive outcomes as well as those in the updated searches. We have added two new co-authors.</p>
5 July 2013	New citation required and conclusions have changed	<p>Additional co-author. We have revised the main text and conclusions of the review according to the findings of the new included trials.</p>
28 January 2013	New search has been performed	<p>We have updated all main electronic search strategies to January 2013. We have included 13 additional randomised clinical trials, bringing the total number of included trials to 45, involving 2188 participants. We have incorporated 'Risk of bias' tables.</p>

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 7 ongoing trials. We have better 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.
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

DH Saunders developed and ran searches, selected studies, extracted and interpreted data, performed the analyses, and wrote the review. MF Sanderson, S Hayes, L Johnson, S Kramer, D Carter, and H Jarvis selected studies, extracted and interpreted data, and contributed to writing the review.

M Brazzelli advised on the methodology, interpreted data, and contributed to writing the review.

GE Mead helped select studies and provided comments on a draft version of the review.

DECLARATIONS OF INTEREST

DH Saunders was a co-author of one included study ([Mead 2007](#)).

M Sanderson has no declarations of interest.

S Hayes has no declarations of interest.

L Johnson has no declarations of interest.

S Kramer has no declarations of interest.

D Carter has no declarations of interest.

H Jarvis has no declarations of interest.

M Brazzelli has no declarations of interest.

GE Mead receives royalties (about GBP 100 a year) for a book about fitness training after stroke (Exercise and Fitness Training after stroke) a handbook for evidence-based practice. Ed Gillian Mead and Frederike van Wijck. These royalties are used to support further research. She has led a study of exercise after stroke that is included in the review (Mead 2007).

SOURCES OF SUPPORT

Internal sources

- No sources of support supplied

External sources

- National Institute for Health Research (NIHR), UK.

Cochrane Review Incentive Scheme 2012

DIFFERENCES BETWEEN PROTOCOL AND REVIEW

Subgroup analyses were, on the whole, not possible as there were too few studies within the meta-analyses, too many other influential factors, and the scope and breadth of the review makes these unmanageable.

The subgroups in the previous version have been removed:

- type of control interventions (no intervention versus non-exercise intervention versus other intervention); no intervention is explored in depth anyway (studies confounded for exposure time);
- duration of training (less than 12 weeks versus 12 weeks or more); duration is still discussed in the current results;
- severity of stroke (mild symptoms versus severe symptoms); most participants recruited in exercise studies are high-functioning.

INDEX TERMS

Medical Subject Headings (MeSH)

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

MeSH check words

Humans