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Exercise training for adults undergoing maintenance dialysis (Review)

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[Intervention Review]

Exercise training for adults undergoing maintenance dialysis

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ABSTRACT

Background

Dialysis treatments weigh heavily on patients' physical and psychosocial health. Multiple studies have assessed the potential for exercise training to improve outcomes in adults undergoing dialysis. However, uncertainties exist in its relevance and sustainable benefits for patient-important outcomes. This is an update of a review first published in 2011.

Objectives

To assess the benefits and safety of regular structured exercise training in adults undergoing dialysis on patient-important outcomes including death, cardiovascular events, fatigue, functional capacity, pain, and depression. We also aimed to define the optimal prescription of exercise in adults undergoing dialysis.

Search methods

In this update, we conducted a systematic search of the Cochrane Kidney and Transplant Register of Studies up to 23 December 2020. The Register includes studies identified from CENTRAL, MEDLINE, EMBASE, the International Clinical Trials Register (ICTRP) Search Portal and ClinicalTrials.gov as well as kidney-related journals and the proceedings of major kidney conferences.

Selection criteria

Randomised controlled trials (RCTs) and quasi-RCTs of any structured exercise programs of eight weeks or more in adults undergoing maintenance dialysis compared to no exercise or sham exercise.

Data collection and analysis

Two authors independently assessed the search results for eligibility, extracted the data and assessed the risk of bias using the Cochrane risk of bias tool. Whenever appropriate, we performed random-effects meta-analyses of the mean difference in outcomes. The primary outcomes were death (any cause), cardiovascular events and fatigue. Secondary outcomes were health-related quality of life (HRQoL), depression, pain, functional capacity, blood pressure, adherence to the exercise program, and intervention-related adverse events.

Main results

We identified 89 studies involving 4291 randomised participants, of which 77 studies (3846 participants) contributed to the meta-analyses. Seven studies included adults undergoing peritoneal dialysis. Fifty-six studies reported aerobic exercise interventions, 21 resistance exercise interventions and 19 combined aerobic and resistance training within the same study arm. The interventions lasted from eight weeks to two years and most often took place thrice weekly during dialysis treatments. A single study reported death and no study reported long-term cardiovascular events. Five studies directly assessed fatigue, 46 reported HRQoL and 16 reported fatigue or pain through their assessment of HRQoL. Thirty-five studies assessed functional capacity, and 21 reported resting peripheral blood pressure. Twelve studies reported adherence to exercise sessions, and nine reported exercise-related adverse events. Overall, the quality of the included studies was low and blinding of the participants was generally not feasible due to the nature of the intervention.

Exercise had uncertain effects on death, cardiovascular events, and the mental component of HRQoL due to the very low certainty of evidence. Compared with sham or no exercise, exercise training for two to 12 months may improve fatigue in adults undergoing dialysis, however, a meta-analysis could not be conducted. Any exercise training for two to 12 months may improve the physical component of HRQoL (17 studies, 656 participants: MD 4.12, 95% CI 1.88 to 6.37 points on 100 points-scale; I^2 = 49%; low certainty evidence). Any exercise training for two to 12 months probably improves depressive symptoms (10 studies, 441 participants: SMD -0.65, 95% CI -1.07 to -0.22; I^2 = 77%; moderate certainty evidence) and the magnitude of the effect may be greater when maintaining the exercise beyond four months (6 studies, 311 participants: SMD -0.30, 95% CI 0.14 to -0.74; I^2 = 71%). Any exercise training for three to 12 months may improve pain (15 studies, 872 participants: MD 5.28 95% CI -0.12 to 10.69 points on 100 points-scale; I^2 = 63%: low certainty evidence) however, the 95% CI indicates that exercise training may make little or no difference in the level of pain. Any exercise training for two to six months probably improves functional capacity as it increased the distance reached during six minutes of walking (19 studies, 827 participants: MD 49.91 metres, 95% CI 37.22 to 62.59; I^2 = 34%; moderate certainty evidence) and the number of sit-to-stand cycles performed in 30 seconds (MD 2.33 cycles, 95% CI 1.71 to 2.96; moderate certainty evidence). There was insufficient evidence to assess the safety of exercise training for adults undergoing maintenance dialysis. The results were similar for aerobic exercise, resistance exercise, and a combination of both aerobic and resistance exercise.

Authors' conclusions

It is uncertain whether exercise training improves death, cardiovascular events, or the mental component of HRQoL in adults undergoing maintenance dialysis. Exercise training probably improves depressive symptoms, particularly when the intervention is maintained beyond four months. Exercise training is also likely to improve functional capacity. Low certainty evidence suggested that exercise training may improve fatigue, the physical component of quality of life, and pain. The safety of exercise training for adults undergoing dialysis remains uncertain.

PLAIN LANGUAGE SUMMARY

Exercise training for adults receiving dialysis treatments

What is the issue?

People undergoing dialysis treatments are at higher risk of cardiovascular disease and depression, have a lower quality of life and limited survival than the general population. Furthermore, many people undergoing dialysis have difficulty performing daily activities because they lack the physical capacity and strength to do so. Multiple trials have assessed the potential for exercise training to improve the condition of adults undergoing dialysis, but no consensus has been reached.

What did we do?

We searched the medical literature for all randomised trials that assessed structured exercise programs in people undergoing dialysis. We then assessed the quality of those studies and combined their results to draw conclusions regarding the effect of exercise training to improve aspects of physical and mental health that are important to patients undergoing dialysis.

What did we find?

We found 89 studies involving 4291 participants. The exercise training programs lasted from eight weeks to two years and most often took place three times a week during the dialysis treatment. We could not determine the impact of exercise training on death, cardiovascular events (such as a heart attack) or mental well-being. Moderate certainty evidence suggested that exercise training of any type is likely to improve depressive symptoms in adults undergoing dialysis, particularly when the exercise was maintained for longer than four months. Moderate quality evidence also suggested that exercise training may improve people's capacity to perform activities and tasks through the improvement of their capacity to walk and the strength and endurance of their legs. Exercise training may also improve fatigue and the physical aspects of quality of life, but the quality of the evidence was low. We could not conclude on the effect of exercise training on a person's mental well-being.

Conclusions

Exercise training for people undergoing maintenance dialysis is likely to improve depression and their capacity to perform activities and tasks. Exercise training may also improve fatigue and pain sightly. Exercise training may improve the physical aspects of quality of life,

but it is unclear whether it improves a person's mental well-being. It is unclear whether exercise training reduces the number of deaths or cardiovascular events.

SUMMARY OF FINDINGS

Summary of findings 1. Any exercise versus no exercise or placebo exercise for adults undergoing maintenance dialysis

Any exercise versus no exercise or placebo exercise for adults undergoing maintenance dialysis

Patient or population: adults undergoing maintenance dialysis
Setting: all settings (e.g. during dialysis, pre- and post-dialysis; home exercise)
Intervention: any exercise
Comparison: no exercise or placebo exercise

Outcomes	Anticipated absolute effects* (95% CI)		Relative effect (95% CI)	No. of participants (studies)	Certainty of the evidence (GRADE)	Comments
	Risk with no exercise or placebo exercise	Risk with any exercise				
Death (any cause Follow up: 3 years	159 per 1,000	151 per 1,000 (89 to 257)	RR 0.95 (0.56 to 1.62)	296 (1)	⊕⊖⊖⊖ VERY LOW [1 2 3]	-
Cardiovascular events	Not reported	Not reported	-	-	-	-
Fatigue Follow up: range 2 to 12 months	See comment	See comment	-	326 (6)	⊕⊕⊖⊖ LOW [4 7]	A pooled estimate of the effect was not calculated because the included studies assessed different dimensions of fatigue. Based on the direction of the effect in the included studies, any exercise may reduce fatigue
HRQoL: Physical component score Assessed: SF-36 Scale: 0 to 100 Follow up: range 2 to 12 months	The mean physical component score ranged from 34 to 74 points	The mean physical component score was 4.1 points higher with exercise (1.9 to 6.4 higher)	-	656 (17)	⊕⊕⊖⊖ LOW [4 5]	Any exercise may improve the physical component score of HRQoL
HRQoL: Mental component score Assessed: SF-36 Scale: 0 to 100 Follow up: range 2 to 12 months	The mean mental component score ranged from 38 to 76 points	The mean mental component score was 2.5 points higher with exercise (0.4 lower to 5.5 higher)	-	656 (17)	⊕⊖⊖⊖ VERY LOW [4 5 6]	-

Pain Assessed: SF-36 Scale: 0 to 100 Follow up: range 3 to 12 months	The mean pain score ranged from 47 to 87 points	The mean pain score was 5.3 points higher with exercise (0.1 lower to 10.7 higher)	-	872 (15)	⊕⊕⊖⊖ LOW [4 5]	Any exercise may reduce pain however, the 95% CI indicates that exercise training might make little or no difference in the level of pain
Depression Assessed: multiple severity of depressive symptoms scales Follow up: range 2 to 12 months	-	The SMD for depression was 0.62 SD lower with exercise (1.00 to 0.24 lower)	-	490 (11)	⊕⊕⊕⊖ MODERATE[5]	A SD of 0.2 represents a small difference between groups^ Any exercise probably improves depression. The magnitude of the effect was greater after four months of exercise training (SMD -1.26, 95% CI -1.80 to -0.72)
Functional capacity Assessed: 6MWT Follow up: range 2 to 6 months	The mean 6MWT ranged from 290 to 495 metres	The mean 6MWT was 49.9 metres further with exercise (37.2 to 62.6 further)	-	827 (19)	⊕⊕⊕⊖ MODERATE [5]	Any exercise probably improves functional capacity

*__The risk in the intervention group__ (and its 95% CI) is based on the assumed risk in the comparison group and the __relative effect__ of the intervention (and its 95% CI).

^ Cohen's interpretation of effect size

CI: Confidence interval; **RR:** Risk ratio; **6MWT:** 6-minute walking test; **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

[1] High risk of bias: significantly greater proportion of participants lost to follow-up in the exercise group compared to the control group
[2] Imprecision: based on a single study that was not powered for this outcome
[3] Indirectness: the outcome was assessed 2.5 years after the completion of the intervention
[4] Indirectness: short interventions and short-term follow-up
[5] High risk of bias in the included studies
[6] Inconsistency: significant unexplained heterogeneity
[7] Imprecision: outcome reported in few participants

Summary of findings 2. Aerobic exercise versus no exercise or placebo exercise for adults undergoing maintenance dialysis

Aerobic exercise versus no exercise or placebo exercise for adults undergoing maintenance dialysis

Patient or population: adults undergoing maintenance dialysis
Setting: all settings (e.g. during dialysis, pre- and post-dialysis; home exercise)
Intervention: aerobic exercise
Comparison: no exercise or placebo exercise

Outcomes	Anticipated absolute effects* (95% CI)		Relative effect (95% CI)	No. of participants (studies)	Certainty of the evidence (GRADE)	Comments
	Risk with no exercise or placebo exercise	Risk with Aerobic exercise				
Death (any cause) Follow up: 3 years	159 per 1,000	151 per 1,000 (89 to 257)	RR 0.95 (0.56 to 1.62)	296 (1)	⊕⊖⊖⊖ VERY LOW [1 2 3]	-
Cardiovascular events	Not reported	Not reported	-	-	-	-
Fatigue Follow up: range 2 to 12 months	See comment	See comment	-	221 (4)	⊕⊖⊖⊖ VERY LOW [1 4 5]	A pooled estimate of the effect was not calculated because the included studies assessed different dimensions of fatigue
HRQoL: Physical component score Assessed: SF-36 Scale: 0 to 100 Follow up: range 2 to 12 months	The mean physical component score ranged from 34 to 71 points	The mean physical component score was 6.0 points higher with aerobic exercise (1.3 lower to 10.7 higher)	-	306 (9)	⊕⊖⊖⊖ VERY LOW [4 5 6]	-
HRQoL: Mental component score Assessed: SF-36 Scale: 0 to 100 Follow up: range 2 to 12 months	The mean mental component score ranged from 39 to 65 points	The mean mental component score was 3.3 points higher with aerobic exercise (0.9 lower to 7.6 higher)	-	306 (9)	⊕⊖⊖⊖ VERY LOW [4 5 6 7]	-

Pain Assessed: SF-36 Scale: 0 to 100 Follow up: range 3 to 12 months	The mean pain score ranged from 47 to 87 points	The mean pain score was 2.3 points higher with aerobic exercise (1.6 lower to 6.1 higher)	-	570 (8)	⊕⊕⊖⊖ LOW [4 6]	Aerobic exercise may result in little to no difference in pain
Depression Assessed: multiple severity of depressive symptoms scales Follow up: range 2 to 12 months	-	The SMD for depression was 0.19 SD lower with aerobic exercise (0.89 lower to 0.52 higher)	-	127 (4)	⊕⊖⊖⊖ VERY LOW [5 6 7]	A SD of 0.2 represents a small difference between groups^
Functional capacity Assessed: 6MWT Follow up: range 2 to 6 months	The mean 6MWT ranged from 290 to 454 metres	The mean 6MWT was 53.0 metres further with aerobic exercise (33.8 to 72.2 further)	-	515 (10)	⊕⊕⊕⊖ MODERATE [6]	Aerobic exercise probably improves functional capacity.

*__The risk in the intervention group__ (and its 95% CI) is based on the assumed risk in the comparison group and the __relative effect__ of the intervention (and its 95% CI).

^ Cohen's interpretation of effect size

CI: Confidence interval; **RR:** Risk ratio; **6MWT:** 6-minute walking test; **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

[1] High risk of bias: significantly greater proportion of participants lost to follow-up in the exercise group compared to the control group
[2] Imprecision: based on a single study that was not powered for this outcome
[3] Indirectness: the outcome was assessed 2.5 years after the completion of the intervention
[4] Indirectness: short interventions and short follow-up
[5] Imprecision: outcome reported in few participants
[6] High risk of bias in the included studies
[7] Inconsistency: significant unexplained heterogeneity

Summary of findings 3. Resistance exercise versus no exercise or placebo exercise for adults undergoing maintenance dialysis

Resistance exercise versus no exercise or placebo exercise for adults undergoing maintenance dialysis

Patient or population: adults undergoing maintenance dialysis

Setting: all settings (e.g. during dialysis, pre- and post-dialysis; home exercise)
Intervention: resistance exercise
Comparison: no exercise or placebo exercise

Outcomes	Anticipated absolute effects* (95% CI)		Relative effect (95% CI)	No. of participants (studies)	Certainty of the evidence (GRADE)	Comments
	Risk with no exercise or placebo exercise	Risk with resistance exercise				
Death (any cause)	Not reported	Not reported	-	-	-	-
Cardiovascular events	Not reported	Not reported	-	-	-	-
Fatigue Assessed: Profile of Mood States score Follow up: 12 weeks	The mean fatigue score was 8.95 points	The mean fatigue score was 1.88 points lower with resistance exercise (4.14 lower to 0.38 higher)	-	68 (1)	⊕⊖⊖⊖ VERY LOW [1 2]	-
HRQoL: Physical component score Assessed: SF-36 Scale: 0 to 100 Follow up: range 2 to 12 months	The mean physical component score ranged from 46 to 74 points	The mean physical component score was 2.5 points higher with resistance exercise (1.3 lower to 6.3 higher)	-	176 (5)	⊕⊖⊖⊖ VERY LOW [2 3 4]	-
HRQoL: Mental component score Assessed: SF-36 Scale: 0 to 100 Follow up: range 2 to 12 months	The mean mental component score ranged from 38 to 76 points	the mean mental component score was 0.7 points lower with resistance exercise (5.9 lower to 4.6 higher)	-	176 (5)	⊕⊖⊖⊖ VERY LOW [2 3 4 5]	-
Pain Assessed: SF-36 Scale: 0 to 100 Follow up: range 3 to 12 months	The mean pain score ranged from 60 to 82 points	The mean pain score was 10.7 points higher with resistance exercise (6.5 lower to 28.0 higher)	-	154 (5)	⊕⊖⊖⊖ VERY LOW [2 3 4]	-
Depression Assessed: multiple severity of depressive symptoms scales Follow up: range 2 to 12 months	-	The SMD for depression was 0.52 SD lower with resistance exercise (0.92 to 0.12 lower)	-	99 (2)	⊕⊖⊖⊖ VERY LOW [2 3 4]	A SD of 0.2 represents a small difference between groups^

						The evidence is very uncertain about the effect of resistance exercise on depression
Functional capacity Assessed: 6MWT Follow up: range 2 to 6 months	The mean 6MWT ranged from 407 to 495 metres	The mean 6MWT was 44.7 metres further with resistance exercise (27.0 to 62.4 further)	-	216 (7)	⊕⊕⊕⊖ MODERATE [2]	Resistance exercise probably improves functional capacity

*__The risk in the intervention group__ (and its 95% CI) is based on the assumed risk in the comparison group and the __relative effect__ of the intervention (and its 95% CI).

^ Cohen's interpretation of effect size

CI: Confidence interval; **RR:** Risk ratio; **6MWT:** 6-minute walking test; **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

[1] Imprecision: based on a single study that was not powered for this outcome
[2] High risk of bias in the included studies
[3] Indirectness: short interventions and short follow-up
[4] Imprecision: outcome reported in few participants
[5] Inconsistency: significant heterogeneity

Summary of findings 4. Combined aerobic and resistance exercise versus no exercise or placebo exercise for adults undergoing maintenance dialysis

Combined aerobic and resistance exercise versus no exercise or placebo exercise for adults undergoing maintenance dialysis

Patient or population: adults undergoing maintenance dialysis
Setting: all settings (e.g. during dialysis, pre- and post-dialysis; home exercise)
Intervention: combined aerobic and resistance exercise
Comparison: no exercise or placebo exercise

Outcomes	Anticipated absolute effects* (95% CI)	Relative effect (95% CI)	No. of participants (studies)	Certainty of the evidence (GRADE)	Comments

	Risk with no exercise or placebo exercise)	Risk with combined aerobic and resistance exercise				
Death (any cause)	Not reported	Not reported	-	-	-	-
Cardiovascular events	Not reported	Not reported	-	-	-	-
Fatigue	Not reported	Not reported	-	-	-	-
HRQoL: Physical component score Assessed: SF-36 Scale: 0 to 100 Follow up: range 2 to 12 months	The mean physical component score ranged from 38 to 51	The mean physical component score was 4.4 points higher with combined exercise (1.9 higher to 6.8 higher)	-	228 (6)	⊕⊖⊖⊖ VERY LOW [1 2 3]	The evidence is very uncertain about the effect of combined aerobic and resistance exercise on the physical component of HRQoL
HRQoL: Mental component score Assessed: SF-36 Scale: 0 to 100 Follow up: range 2 to 12 months	The mean mental component score ranged from 40 to 43	The mean mental component score was 2.6 points higher with combined exercise (1.7 lower to 6.9 higher)	-	228 (6)	⊕⊖⊖⊖ VERY LOW [1 2 3]	-
Pain Assessed: SF-36 Scale: 0 to 100 Follow up: range 3 to 12 months	The mean pain score ranged from 68 to 83 points	The mean pain score was 4.0 points higher with combined exercise (2.5 lower to 10.5 higher)	-	161 (3)	⊕⊖⊖⊖ VERY LOW [1 2 3]	-
Depression Assessed: multiple severity of depressive symptoms scales Follow up: range 2 to 12 months	-	The SMD for depression was 1.0 SD lower with combined exercise (1.7 lower to 0.3 lower)	-	214 (4)	⊕⊖⊖⊖ VERY LOW [2 3]	A SD of 0.2 represents a small difference between groups^ The evidence is very uncertain about the effect of combined aerobic and resistance exercise on depression
Functional capacity Assessed: 6MWT Follow up: range 2 to 6 months	The mean 6MWT ranged from 399 to 430 metres	The mean 6MWT was 53.6 metres further (39.4 to 67.9 further)	-	138 (6)	⊕⊕⊕⊖ MODERATE [1 2]	Combined aerobic and resistance exercise probably improves functional capacity.

*__The risk in the intervention group__ (and its 95% CI) is based on the assumed risk in the comparison group and the __relative effect__ of the intervention (and its 95% CI).

^ Cohen's interpretation of effect size

CI: Confidence interval; **RR:** Risk ratio; **6MWT:** 6-metre walking test; **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

[1] Indirectness: short interventions and short follow-up
[2] High risk of bias in the included studies
[3] Imprecision: outcome reported in few participants

BACKGROUND

Description of the condition

Kidney failure on dialysis is a debilitating condition weighing heavily on patients' physical and psychosocial health. Death is high, particularly in older age groups, with less than 50% surviving five years after initiation (ERA-EDTA 2017; USRDS 2017; ANZDATA 2019). In addition to the time and commitment for the treatment itself, dialysis is often accompanied by debilitating symptoms such as fatigue, pain, pruritus, cramping, sleep disturbances and sexual dysfunction. As a result, quality of life (QoL) for individuals undergoing dialysis is among the lowest of any chronic diseases (Wyld 2012).

Neuromuscular complications of chronic kidney disease (CKD) have long been described (Serratrice 1967; Tyler 1975). Multiple uraemic, hormonal, immunologic, mechanical and myocellular changes are likely to contribute to skeletal muscle wasting in dialysis patients (Fahal 2014). Furthermore, the transfer of oxygen to the muscle cells is impaired despite the correction of anaemia (Stray-Gundersen 2016). In consequence, people suffering from kidney failure have a severely impaired capacity to exercise, averaging 50% to 60% of the age-expected norm (Kaysen 2011; Painter 2017) and low self-reported physical functioning even amongst younger patients (DeOreo 1997; Painter 2005). Correspondingly, people with kidney failure have extremely low levels of physical activity and rank under the fifth percentile of healthy age-matched individuals (Cupisti 2017; Johansen 2010). Of note, low exercise capacity, low physical functioning and low levels of physical activity have all been associated with a higher risk of death in this population (DeOreo 1997; Johansen 2013; Knight 2003; Sietsema 2004).

Description of the intervention

Physical activity varies in its nature, intensity, frequency, and duration. Aerobic or cardiovascular exercise implies an increase in heart and respiratory rate such as running, cycling, walking, or swimming. Resistance exercise relates to activities leading to increased muscle strength, tone and bulk, such as repeated movements of the upper and lower limbs against gravity with weights or against elastic bands. The World Health Organization recommends that adults aged 18 to 64 years old perform a minimum of 150 minutes of moderate-intensity aerobic physical activity or 75 minutes of vigorous-intensity aerobic physical activity throughout the week to improve cardiorespiratory and muscular fitness (WHO 2010). Based on evidence in the general population, the 2005 KDOQI Clinical Practice Guidelines for Cardiovascular Disease in Dialysis Patients recommend working towards 30 minutes of moderate exercise most days for adults on dialysis (KDOQI 2005).

How the intervention might work

Exercise training has the potential to improve many outcomes that are important to patients receiving dialysis treatments. In the general population, physical activity may reduce the risk of death (any cause), coronary heart disease, high blood pressure, stroke, type 2 diabetes, metabolic syndrome, and colon and breast cancer (WHO 2010). Fatigue, a debilitating symptom affecting 55% to 97% of people receiving dialysis (Chang 2001; Jacobson 2019; Jhamb 2008; Yngman-Uhlin 2010), was improved after exercise training in people with cancer (Cramp 2012) and chronic fatigue syndrome (Larun 2019). Exercise can also improve depression (Cooney 2013), which affects 23% to 39% of adults undergoing dialysis (Palmer 2013). Finally, the previous version of this review demonstrated exercise training is likely to improve physical fitness, physical functioning and health-related QoL (HRQoL) in adults with CKD (Heiwe 2011). Through better cardiorespiratory capacity and strength, exercise training may improve patients' capacity to perform their daily activities and ease the burden of dialysis treatments.

Why it is important to do this review

Patients, caregivers, and health professionals alike believe lifestyle interventions, including exercise, should be a top priority for research in CKD (Manns 2014; Tong 2015). However, most randomised controlled trials (RCTs) do not address patients' priorities or patient-important outcomes (Tong 2018). The previous version of this review found exercise training improved physical fitness, HRQoL, and some cardiovascular and nutritional parameters. However, the certainty of the evidence was low, and many important outcomes such as death, cardiovascular events, and fatigue could not be assessed. Numerous studies have since been published, but no consensus has emerged concerning the effects and safety of exercise training for adults undergoing maintenance dialysis.

Differences with the previous Cochrane review

In its previous form, the Cochrane review for exercise training in adults with CKD included studies performed in individuals at all stages of CKD, including kidney transplantation and earlier stages of CKD (Heiwe 2011). As the exercise interventions in adults undergoing dialysis differed significantly from those in adults not receiving dialysis, and because these populations differ in their needs, risk factors and coexisting diseases, an editorial decision was taken to divide the previously published review into three separate reviews. The current review will focus on RCTs of exercise interventions in adults undergoing maintenance haemodialysis (HD) or peritoneal dialysis (PD), and separate reviews to be published at a later time will focus on adults with CKD not undergoing dialysis and kidney transplant recipients.

OBJECTIVES

To assess the benefits and safety of regular structured exercise training in adults undergoing dialysis on patient-important outcomes including death, cardiovascular events, fatigue, functional capacity, pain, and depression. We also aimed to define the optimal prescription of exercise in adults undergoing dialysis.

METHODS

Criteria for considering studies for this review

Types of studies

We included all RCTs and quasi-RCTs (RCTs in which allocation to treatment was obtained by alternation, use of alternate medical records, date of birth or other predictable methods) evaluating a structured program of regular physical exercise training in adults undergoing dialysis.

Types of participants

Inclusion criteria

We included studies involving adults receiving maintenance HD or PD treatments.

Exclusion criteria

We excluded studies involving children, kidney transplant recipients or adults with CKD not undergoing dialysis.

Types of interventions

We included interventions consisting of a structured program of regular physical exercise lasting a minimum of eight weeks to ensure the intervention consisted of regular ongoing exercise training. Interventions consisting solely of the recommendation or promotion of physical activity were excluded. Interventions targeting a single muscle group for purposes other than improvement of the general fitness, such as respiratory muscle training or hand-forearm exercises for arteriovenous fistula maturation, were also excluded.

Eligible studies had to include a control group that did not partake in any significant exercise training. Sham exercises such as light stretching exercises were allowed. Co-interventions with exercise training were allowed if the co-interventions were also administered to the control group.

Types of outcome measures

While all outcomes were collected, this review focused on patient-important outcomes, which we identified using the SONG core-outcome set for adults undergoing HD (SONG-HD 2017). When the outcomes were measured at multiple time points within the same study, we included the results corresponding to the end of the intervention period in the meta-analyses. For long-term outcomes such as death and cardiovascular events, we also recorded outcome results that were measured after the completion of the intervention.

Primary outcomes

- Death (any cause)
- Cardiovascular events
- Fatigue

Secondary outcomes

- HRQoL
- Pain
- Depression
- Functional capacity
- Resting blood pressure: systolic blood pressure (SBP) and diastolic blood pressure (DBP)
- Adherence to the exercise program
- Adverse events related to the exercise program

Other outcomes

We also assessed exploratory outcomes that were either reported in the previous version of this review (Heiwe 2011) or were commonly reported across the included studies.

- Haemoglobin
- Dialysis adequacy
- Potassium
- Physical fitness (aerobic capacity, muscular strength)
- Measures from cardiac ultrasound (left ventricular ejection fraction, left ventricular mass index)
- Body mass indices (body mass index, muscle mass, fat mass)
- Nutritional measures (albumin, energy intake, protein intake)
- Blood lipids (total cholesterol, low-density lipoproteins (LDL), high-density lipoproteins (HDL), triglycerides)
- Bone health (calcium, phosphorus, parathyroid hormone)
- Markers of inflammation (C-reactive protein)

Search methods for identification of studies

Electronic searches

We searched the Cochrane Kidney and Transplant Register of Studies to 23 December 2020 through contact with the Information Specialist using search terms relevant to this review. The Cochrane Kidney and Transplant Specialised Register contains studies identified from the following sources.

1. Monthly searches of the Cochrane Central Register of Controlled Trials (CENTRAL)
2. Weekly searches of MEDLINE OVID SP
3. Searches of kidney and transplant journals, and the proceedings and abstracts from major kidney and transplant conferences
4. Searching of the current year of EMBASE OVID SP
5. Weekly current awareness alerts for selected kidney and transplant journals
6. Searches of the International Clinical Trials Register (ICTRP) Search Portal and ClinicalTrials.gov.

Studies contained in the Register are identified through searches of CENTRAL, MEDLINE, and EMBASE based on the scope of Cochrane Kidney and Transplant. Details of search strategies, as well as a list of handsearched journals, conference proceedings and current awareness alerts, are available on the Cochrane Kidney and Transplant website under CKT Register of Studies.

See Appendix 1 for search terms used in strategies for this review.

Searching other resources

1. Reference lists of review articles, relevant studies and clinical practice guidelines.
2. Contacting relevant individuals/organisations seeking information about unpublished or incomplete studies.

Data collection and analysis

Selection of studies

Two authors independently screened the titles and abstracts from the electronic search and retained potentially eligible studies. Two authors then independently assessed the abstracts and, when necessary, the full published text and identified the studies to be included in the review.

Data extraction and management

Two authors independently extracted the data from each study using standardised data extraction forms. Studies in a non-English

language were translated into English. Results from multiple publications of the same study were grouped, and the primary study publication was used as the reference for the methods. One author performed the final data entry, and a second verified each entry using the independently collected extraction sheet. Disagreements were resolved by returning to the full published text, and a third author was available for persisting disagreements.

Assessment of risk of bias in included studies

The following items were assessed independently by two authors using the risk of bias assessment tool (Higgins 2011) (see Appendix 2).

- Was there adequate sequence generation (selection bias)?
- Was allocation adequately concealed (selection bias)?
- Was knowledge of the allocated interventions adequately prevented during the study?
- Participants and personnel (performance bias)
- Outcome assessors (detection bias)
- Were incomplete outcome data adequately addressed (attrition bias)?
- Are reports of the study free of suggestion of selective outcome reporting (reporting bias)?
- Was the study apparently free of other problems that could put it at risk of bias?

Due to the nature of the intervention, we assumed that the studies that did not report whether the participants were blinded did not attempt to blind the participants.

Measures of treatment effect

We used the mean difference (MD) with 95% confidence intervals (CI) to measure the effect of exercise training on continuous outcomes. Where the included studies used different measuring scales, we used the standardised mean difference (SMD). For dichotomous outcomes, we used risk ratios (RR) with 95% CI to measure the effect of the intervention.

To assess whether the observed effect is clinically meaningful, we considered the following for each outcome measure.

- Anchor-based estimates of the minimal clinically important differences
- Distribution methods such as the standardised mean difference
- Definitions of a clinically meaningful effect that have been used in previous RCTs and systematic reviews of adults undergoing dialysis.

When an estimate of the minimal clinically important difference was not available for the kidney failure population, we used estimates established in populations with other debilitating chronic diseases.

Unit of analysis issues

This review included studies with non-standard designs such as cross-over RCTs, cluster RCTs, cluster step-wedge RCTs, factorial RCTs and studies with two or more intervention arms.

Cross-over RCTs

Cross-over RCTs were eligible for inclusion in the review. However, the exercise intervention administered in the first study period was likely to have carry-over effects into the subsequent study periods from long-lasting effects and behaviour changes arising from the intervention. Therefore, we planned to only include outcome data following the first treatment period, where the intervention was randomly allocated analogous to a two-arms parallel RCT. There was one cross-over RCT eligible for inclusion in the review.

Cluster RCTs

Cluster RCTs were eligible for inclusion in the review. To correct for the correlation between the individuals within a cluster, we divided the effective sample size by the design effect defined as 1+ICC(M-1), where M is the average cluster size and ICC the intra-cluster correlation coefficient. Two cluster RCTs were eligible for inclusion in the review and their published article provided the ICC used for sample size calculation.

Step-wedge RCTs

Step-wedge RCTs were eligible for inclusion in the review. We collected and analysed the results at the latest time point before the last group initiated the intervention. The last group which had not yet initiated the intervention was used as the control group, analogous to a parallel RCT.

Factorial RCTs

Factorial RCTs were eligible for inclusion in the review. We pooled the results from the arm receiving exercise and the alternative intervention together with the results of the arm receiving exercise only under the exercise group and pooled the results from the arm receiving only the alternative intervention together with the results of the arm receiving no intervention under the control arm.

Multi-arms RCTs

RCTs with more than two arms were eligible for inclusion in the review. One of the arms had to be a control group not undertaking any significant exercise training for the study to be included. We extracted the results from all arms meeting the inclusion criteria for the intervention. When two or more arms from the same study were relevant to a meta-analysis (e.g. an aerobic exercise arm and a resistance exercise arm both eligible for a meta-analysis of any exercise), we combined the results of each arm as if they were the same treatment arm. For subgroup analyses of continuous outcomes, if two or more arms from the same study were included in distinct subgroups but shared the same control group, we divided the sample size of the control group by the number of arms. At all times, we took special care not to include the same participants twice in either the treatment or the control group for all meta-analyses.

Dealing with missing data

We contacted the study authors by written correspondence whenever data was missing from the publication. We also contacted the authors of abstracts for which we could not identify a full-text publication. Whenever we suspected a report to be a secondary publication of another included study, we also contacted the authors for clarification.

When results were only provided in the form of graphs, we extracted, to the best of our abilities, the results from the graph and included them in meta-analyses. For continuous outcomes, when only the median and the range or only the median and the interquartile range were reported, we estimated the mean and the standard deviation (SD) using the method described by Wan 2014. For continuous outcomes, when the SD was not reported, we imputed the missing SD using the highest SD from the other studies included in the meta-analysis.

Assessment of heterogeneity

We first assessed the heterogeneity by visual inspection of the forest plot. We then quantified statistical heterogeneity using the I^2 statistic, which describes the percentage of total variation across studies that is due to heterogeneity rather than sampling error (Higgins 2003). A guide to the interpretation of I^2 values was as follows.

- 0% to 40%: might not be important
- 30% to 60%: may represent moderate heterogeneity
- 50% to 90%: may represent substantial heterogeneity
- 75% to 100%: considerable heterogeneity.

The importance of the observed value of I^2 depends on the magnitude and direction of treatment effects and the strength of evidence for heterogeneity (e.g. P-value from the Chi^2 test, or a confidence interval for I^2) (Higgins 2011).

Assessment of reporting biases

In meta-analyses of 10 studies or more and in the absence of statistical heterogeneity, we used funnel plots whenever possible to assess for the potential small study bias (Higgins 2011).

Data synthesis

In the meta-analyses, we pooled the estimated effects of exercise training using the DerSimonian and Laird method for random effects (DerSimonian 1986).

Subgroup analysis and investigation of heterogeneity

We performed subgroup analyses to investigate the reasons behind heterogeneity. We performed the following subgroup analyse whenever there was evidence of significant heterogeneity in the effect of the intervention:

- Type of exercise (aerobic versus resistance versus combined aerobic and resistance)
- Duration of intervention (4 months or less versus longer)
- Intensity of the exercise intervention (light to moderate versus moderate versus moderate to vigorous versus unclear)
- Risk of bias (studies that blinded participants to treatment allocation versus those that didn't).

Sensitivity analysis

For each of the primary and secondary outcomes, we performed sensitivity analyses based on the risk of bias (study at higher risk of bias versus those at lower risk of bias).

Summary of findings and assessment of the certainty of the evidence

We have presented the main results of the review in 'Summary of findings' tables. These tables present key information concerning the quality of the evidence, the magnitude of the effects of the interventions examined, and the sum of the available data for the main outcomes (Schunemann 2011a). The 'Summary of findings' table also includes an overall grading of the evidence related to each of the main outcomes using the GRADE (Grades of Recommendation, Assessment, Development and Evaluation) approach (GRADE 2008; GRADE 2011). The GRADE approach defines the quality of a body of evidence as to the extent to which one can be confident that an estimate of effect or association is close to the true quantity of specific interest. The quality of a body of evidence involves consideration of the within-trial risk of bias (methodological quality), directness of evidence, heterogeneity, the precision of effect estimates and risk of publication bias (Schunemann 2011b). We have presented the following outcomes.

- Death (any cause)
- Cardiovascular events
- Fatigue
- HRQoL - physical component score
- HRQoL - mental component score
- Pain
- Depression
- Functional capacity - 6MWT

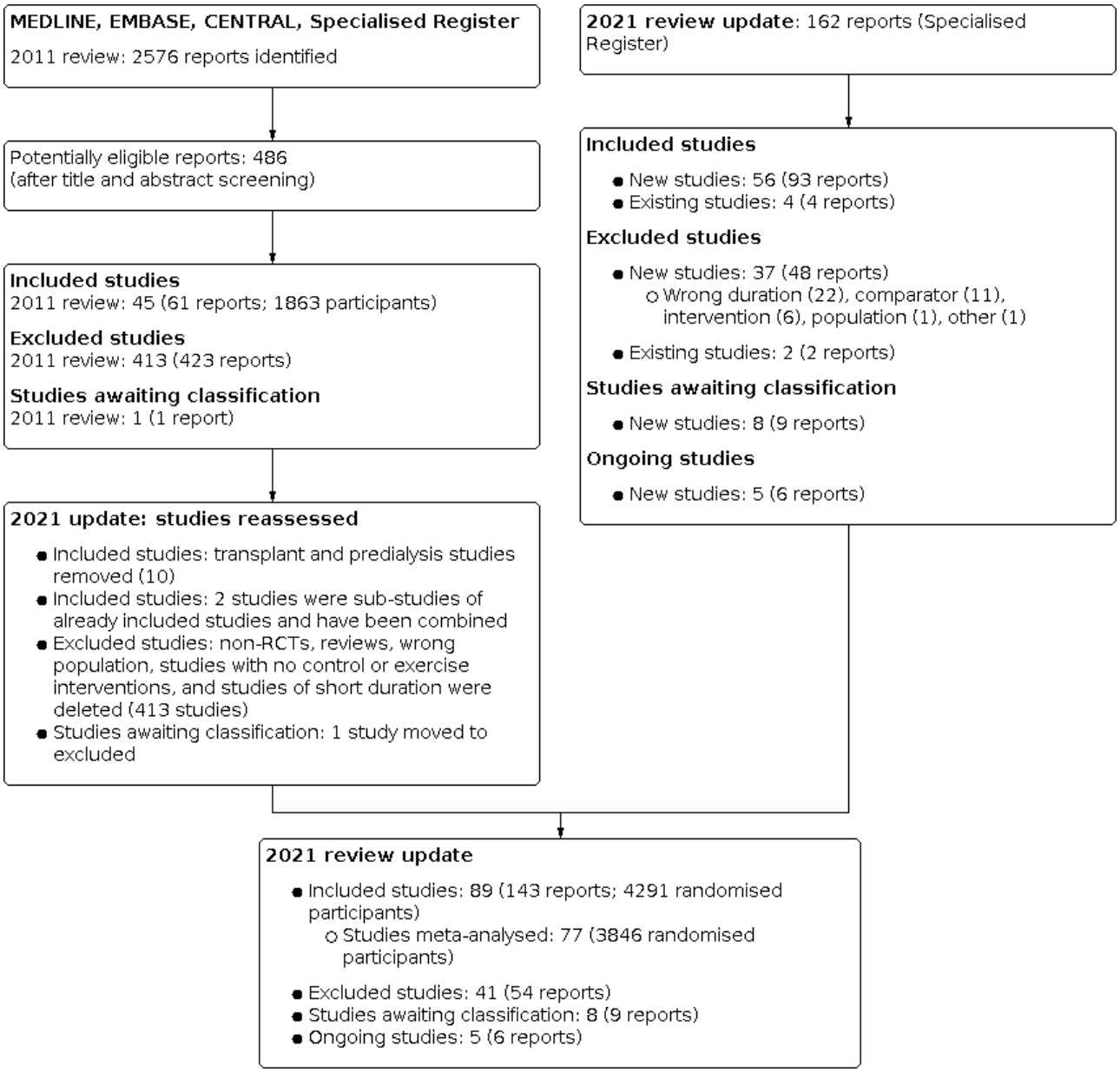
RESULTS

Description of studies

Results of the search

Figure 1 shows the number of studies screened and included in the 2011 review and in this current review.

Figure 1. Flow diagram showing study identification and selection



2011 review

The original literature search for the 2011 review identified 2576 reports. Sixty-one reports from 45 studies were included (Heiwe 2011). Studies were mainly excluded because they were not RCTs, did not involve an exercise intervention or did not involve a control group.

2021 update

The 2011 review has been divided into three independent reviews, one for adults undergoing dialysis, one for adults with CKD not undergoing dialysis and one for kidney transplant recipients. Of the 45 studies included in 2011, only studies involving participants undergoing dialysis were retained for this review update. We have confirmed with the authors that two studies were secondary publications of other already included studies, and have been combined for this update (Harter 1985; Kouidi 1997). There are 33 studies remaining from the 2011 review (Akiba 1995; Carmack 1995; Chen 2010; Deligiannis 1999; Deligiannis 1999a, DePaul 2002; Frey 1999; Goldberg 1983; Harter 1985; Johansen 2006; Koh 2009; Konstantinidou 2002; Kopple 2007; Koufaki 2002; Koufaki 2003; Kouidi 1997; Kouidi 2003; Kouidi 2004a; Kouidi 2005; Kouidi 2008; Kouidi 2010; Lee 2001; Matsumoto 2007; Molsted 2004; Ouzouni 2009; Painter 2002a; Parsons 2004; PEAK 2006; Segura-Orti 2009; Toussaint 2008; Tsuyuki 2003; van Vilsteren 2005; Yurtkuran 2007).

We searched the Cochrane Kidney and Transplantation up to December 2020 and identified 162 new potentially eligible reports. After reviewing abstracts and full-text publications, we identified: 56 new included studies (93 reports); four reports of four previously included studies; 37 new excluded studies (48 reports); two reports of two previously excluded studies; and five ongoing studies (6

reports). Eight studies have been completed but are yet to publish results.

In total, for this 2021 update, we included 89 studies (143 reports) and excluded 41 studies (54 reports). There are five ongoing studies and eight studies awaiting classification which will be assessed in a future update of this review.

We contacted via email the authors of 25 studies (Abreu 2017; Abundis Mora 2017; Afshar 2010; Afshar 2011; Bennett 2013; Burrows 2018; Goldberg 1983, Harter 1985, IHOPE 2019; Kouidi 1997; Kouidi 2003; Kouidi 2004a; Kouidi 2005; Kouidi 2008; Kouidi 2010; Ma 2018; Marinho 2016; Mitsiou 2015; Miura 2015; Paluchamy 2018; Reboredo 2010; Rouchon 2016; Sheshadri 2020; Wilund 2010; Zhao 2017) and received unpublished data from two (Paluchamy 2018; Rouchon 2016).

Included studies

Details of each included study are provided in Characteristics of included studies and Appendix 3.

We included 89 studies (143 reports; 4291 randomised participants). There was one cross-over RCT (Toussaint 2008), one cluster RCT (CYCLE-HD 2016), one step-wedge cluster RCT (Bennett 2013), and three factorial RCTs (Johansen 2006; Mitsiou 2015; Painter 2002a). The remaining 83 studies were parallel-group RCTs. Sixteen studies had three arms (Afshar 2010; Amini 2016; AVANTE-HEMO 2020; Bennett 2013; Deligiannis 1999a; de Lima 2013; Dobsak 2012; Giannaki 2013a; IHOPE 2019; Koh 2009; McAdams-DeMarco 2018; McGregor 2018; Miura 2015; Pellizzaro 2013; Suhardjono 2019; Zhao 2017) and seven had four arms (Cho 2018; DIALY-SIZE 2016; Johansen 2006; Konstantinidou 2002; Kopple 2007, Mitsiou 2015; Painter 2002a). The remaining studies had two arms.

Nine studies were only published as abstracts (Abundis Mora 2017; Burrows 2018; CYCLE-HD 2016; Koufaki 2003; Jong 2004; Ma 2018; Mitsiou 2015; Miura 2015; Rouchon 2016). Twelve studies could not contribute to the meta-analyses (Abundis Mora 2017; Burrows 2018; Dashtidehkordi 2019; Harter 1985; Koufaki 2003; Kouidi 2003; Kouidi 2005; Ma 2018; McAdams-DeMarco 2018; Mitsiou 2015; Miura 2015; Mortazavi 2013) because they either did not report the number of participants in which the outcome was measured or did not report outcomes that were relevant to this review. Therefore, 77 studies (3846 randomised participants) contributed to the meta-analyses.

Twenty-six studies were conducted in Europe/UK (ACTINUT 2013; CYCLE-HD 2016; Deligiannis 1999; Deligiannis 1999a; Dobsak 2012; EXCITE 2014; Giannaki 2013a; Groussard 2015; Konstantinidou 2002; Koufaki 2002; Koufaki 2003; Kouidi 1997; Kouidi 2003; Kouidi 2004a; Kouidi 2005; Kouidi 2008; Kouidi 2010; Marinho 2016; McGregor 2018; Mitsiou 2015; Molsted 2004; Ouzouni 2009; Rouchon 2016; Samara 2016; Segura-Orti 2009; van Vilsteren 2005), 22 in North America (Abundis Mora 2017; AVANTE-HEMO 2020; Burrows 2018; Carmack 1995; Chen 2010; Cooke 2018; DePaul 2002; DIALY-SIZE 2016; Dong 2011; Frey 1999; Goldberg 1983; Harter 1985; IHOPE 2019; Johansen 2006; Kopple 2007; Martin-Alemany 2016; McAdams-DeMarco 2018; Olvera-Soto 2016; Parsons 2004; Painter 2002a; Sheshadri 2020; Wilund 2010), 17 in Asia (Akiba 1995; CHAIR 2015; Chang 2010; Cho 2018; Jong 2004; Lee 2001; Liao 2016; Ma 2018; Matsumoto 2007; Miura 2015; Paluchamy 2018; Song 2012a; Suhardjono 2019; Tsuyuki 2003; Uchiyama 2019; Wu 2014d; Zhao 2017), 10 in the Middle East (Afshar 2010; Afshar 2011; Amini 2016; Dashtidehkordi 2019; Makhlough 2012; Momeni 2014; Mortazavi 2013; Rahimimoghadam 2017; Rezaei 2015; Yurtkuran 2007), eight in South America (Abreu 2017; de Lima 2013; Fernandes 2019; Marchesan 2016; Martins do Valle 2020; Pellizzaro 2013; Reboredo 2010; Rosa 2018), four in Oceania (Bennett 2013; Koh 2009; PEAK 2006; Toussaint 2008), and two in Africa (Frih 2017a; Soliman 2015).

Participants

Three studies exclusively included participants on PD (Jong 2004; Rouchon 2016; Uchiyama 2019), and four others included participants either on maintenance HD or PD (EXCITE 2014; Koufaki 2002; Koufaki 2003; Sheshadri 2020) for a total of 151 included participants receiving PD. The remaining studies included participants on HD only. Exclusion criteria were diverse but often included any medical condition or physical incapacities precluding the participant from undertaking the exercise intervention, cognitive limitations, medical instability, and significant cardiac events in the months leading to the trial. Many studies relied on a convenience sample of prevalent HD patients with only 15 studies reporting a power and sample size calculation (AVANTE-HEMO 2020; Bennett 2013; Chang 2010; CYCLE-HD 2016; Dong 2011; EXCITE 2014; Giannaki 2013a; IHOPE 2019; Koh 2009; Rahimimoghadam 2017; Rezaei 2015; Sheshadri 2020; Song 2012a; Suhardjono 2019; Uchiyama 2019).

The number of participants randomised ranged from 11 and 296 participants (median = 38) and 30 (34%) studies randomised less than 30 participants (Abundis Mora 2017; ACTINUT 2013; Afshar 2010; Afshar 2011; Akiba 1995; Burrows 2018; CHAIR 2015; Cooke 2018; Dobsak 2012; Frey 1999; Giannaki 2013a; Goldberg 1983; Groussard 2015; Harter 1985; Koufaki 2003; Kouidi 2004a; Marchesan 2016; Marinho 2016; Martins do Valle 2020; McAdams-DeMarco 2018; Mortazavi 2013; Paluchamy 2018; Parsons 2004; Reboredo 2010; Rouchon 2016; Samara 2016; Segura-Orti 2009; Toussaint 2008; Tsuyuki 2003; Wilund 2010). The rate of attrition ranged from 0 to 49% (median 13%).

The participants mean age ranged from 30 to 72 years. In 15 studies, the participants' mean age was lower than 40 years old (Akiba 1995; AVANTE-HEMO 2020; CHAIR 2015; DIALY-SIZE 2016; Goldberg 1983; Harter 1985; Marinho 2016; Martin-Alemany 2016; Mortazavi 2013; Olvera-Soto 2016; Rahimimoghadam 2017; Tsuyuki 2003; Wu 2014d; Yurtkuran 2007; Zhao 2017) and older than 60 years in 12 (ACTINUT 2013; Bennett 2013; Chen 2010; EXCITE 2014; Frih 2017a; Groussard 2015; Liao 2016; Marchesan 2016; Miura 2015; PEAK 2006; Rouchon 2016; Uchiyama 2019).

The included studies involved predominantly males (62% of all the included participants). Three studies included only men (Afshar 2010; Afshar 2011, Frih 2017a) and six included more than 75% men (DIALY-SIZE 2016; EXCITE 2014; Rahimimoghadam 2017; Samara 2016; Sheshadri 2020; Wu 2014d). The average duration of dialysis across studies ranged from 1.8 to 6.0 years, and the average BMI across studies ranged from 20.1 to 31.2 kg/m^2. Eighteen studies had a mean participant's BMI above 25 (Chen 2010; Cooke 2018; de Lima 2013; Dobsak 2012; Dong 2011; EXCITE 2014; Giannaki 2013a; IHOPE 2019; Johansen 2006; Koh 2009; Koufaki 2002; Kouidi 1997; McAdams-DeMarco 2018; McGregor 2018; PEAK 2006; Rouchon 2016; Soliman 2015; Toussaint 2008).

Study comparisons

Within the 89 published studies, there were 100 different eligible exercise interventions. The characteristics of the included exercise interventions are detailed in Table 1 and in Characteristics of included studies. The interventions lasted between eight weeks and two years. In 49 studies (55%), the intervention lasted three months or less (Abreu 2017; Afshar 2010; Afshar 2011; Akiba 1995; Amini 2016; AVANTE-HEMO 2020; Bennett 2013; CHAIR 2015; Chang 2010; Cho 2018; Dashtidehkordi 2019; de Lima 2013; DePaul 2002; DIALY-SIZE 2016; Fernandes 2019; Frey 1999; Johansen 2006; Jong 2004; Koufaki 2002; Koufaki 2003; Lee 2001; Liao 2016; Makhlough 2012; Marinho 2016; Martin-Alemany 2016; Martins do Valle 2020; McAdams-DeMarco 2018; McGregor 2018; Miura 2015; Momeni 2014; Olvera-Soto 2016; Paluchamy 2018; Parsons 2004; PEAK 2006; Pellizzaro 2013; Rahimimoghadam 2017; Rezaei 2015; Reboredo 2010; Rosa 2018; Rouchon 2016; Sheshadri 2020; Soliman 2015; Song 2012a; Suhardjono 2019; Toussaint 2008; Uchiyama 2019; van Vilsteren 2005; Wu 2014d; Yurtkuran 2007) whilst only 10 interventions lasted more than six months (Abundis Mora 2017; Goldberg 1983; Harter 1985; IHOPE 2019; Kouidi 2003 ; Kouidi 2005; Kouidi 2010; Ma 2018; Matsumoto 2007; Ouzouni 2009).

Aerobic exercise

Aerobic training was assessed in 56 (63%) studies (Abundis Mora 2017; ACTINUT 2013; Afshar 2010 Afshar 2011; Akiba 1995; Amini 2016; AVANTE-HEMO 2020; Carmack 1995; CHAIR 2015; Chang 2010; Cho 2018; Cooke 2018; CYCLE-HD 2016; Dashtidehkordi 2019; Deligiannis 1999a; de Lima 2013; DIALY-SIZE 2016; Dobsak 2012; EXCITE 2014; Fernandes 2019; Frey 1999; Giannaki 2013a; Goldberg 1983; Harter 1985; Groussard 2015; IHOPE 2019; Jong 2004; Koh 2009; Kopple 2007; Koufaki 2002; Koufaki 2003; Kouidi 1997; Kouidi 2003; Kouidi 2004a; Kouidi 2005; Lee 2001; Liao 2016; Makhlough 2012; Matsumoto 2007; McAdams-DeMarco 2018; McGregor 2018; Miura 2015; Momeni 2014; Mortazavi 2013; Painter 2002a; Paluchamy 2018; Parsons 2004; Reboredo 2010; Samara 2016; Sheshadri 2020; Suhardjono 2019; Toussaint 2008; Tsuyuki 2003; Wilund 2010; Wu 2014d; Zhao 2017).

The most common intervention consisted of stationary cycling on an ergometer in 46 studies (Abundis Mora 2017; ACTINUT 2013; Afshar 2010; Afshar 2011; Akiba 1995; AVANTE-HEMO 2020; Carmack 1995; Chang 2010; Cho 2018; Cooke 2018; CYCLE-HD 2016; Dashtidehkordi 2019; Deligiannis 1999a; de Lima 2013; DIALY-SIZE 2016; Dobsak 2012; Fernandes 2019; Frey 1999; Giannaki 2013a; Goldberg 1983; Harter 1985; Groussard 2015; IHOPE 2019; Koh 2009; Kopple 2007; Koufaki 2003; Kouidi 1997; Kouidi 2003; Kouidi 2004a; Kouidi 2005; Lee 2001; Liao 2016; Matsumoto 2007; McAdams-DeMarco 2018; McGregor 2018; Miura 2015; Momeni 2014; Mortazavi 2013; Painter 2002a; Paluchamy 2018; Parsons 2004; Reboredo 2010; Suhardjono 2019; Toussaint 2008; Wilund 2010; Wu 2014d), but also included chair-stand exercises (CHAIR 2015), walking (EXCITE 2014; Goldberg 1983; Harter 1985; Jong 2004; Koh 2009; Kouidi 1997; Lee 2001; Sheshadri 2020; Tsuyuki 2003), road cycling (Zhao 2017), and swimming (Samara 2016).

Duration of the aerobic training sessions varied between 10 and 90 minutes, with most intervention being between 20 and 40 minutes/sessions (ACTINUT 2013; Afshar 2010; Afshar 2011; Akiba 1995; AVANTE-HEMO 2020; Carmack 1995; Chang 2010; Cho 2018; CYCLE-HD 2016; Dashtidehkordi 2019; Deligiannis 1999a; Lee 2001; de Lima 2013; DIALY-SIZE 2016; Dobsak 2012; Fernandes 2019; Frey 1999; Goldberg 1983; Groussard 2015; IHOPE 2019; Koh 2009; Koufaki 2003; Lee 2001; Liao 2016; Matsumoto 2007; Momeni 2014; Mortazavi 2013; Painter 2002a; Parsons 2004; Reboredo 2010; Samara 2016; Suhardjono 2019; Toussaint 2008; Tsuyuki 2003; Wilund 2010).

There was considerable heterogeneity on the method to assess the intensity of the exercise training: 19 studies used a version of the Borg scale of perceived exertion (ACTINUT 2013; Afshar 2011; Akiba 1995; AVANTE-HEMO 2020; Chang 2010; Cooke 2018; CYCLE-HD 2016; de Lima 2013; DIALY-SIZE 2016; IHOPE 2019; Koh 2009; Lee 2001; Liao 2016; Miura 2015; Mortazavi 2013; Reboredo 2010; Samara 2016; Wilund 2010; Wu 2014d); six used a percentage of the maximum heart rate (Deligiannis 1999a; Fernandes 2019; Frey 1999; Matsumoto 2007; Suhardjono 2019; Tsuyuki 2003); four used a percentage of the maximum load (Dobsak 2012; Giannaki 2013a; Groussard 2015; Parsons 2004); four using a percentage of the maximum oxygen consumption (Goldberg 1983; Harter 1985; Kopple 2007; Koufaki 2003); three using a combination of methods (Kouidi 1997; McGregor 2018; Painter 2002a); and the remaining studies did not report the method they used. Using the interpretation of each scale we classified five studies as light to moderate intensity (perceived as light to somewhat hard) (de Lima 2013; Dobsak 2012; Miura 2015; Mortazavi 2013; Parsons 2004), 23 studies as moderate (perceived as somewhat hard) (Abundis Mora 2017; ACTINUT 2013; Akiba 1995; AVANTE-HEMO 2020; Chang 2010; Deligiannis 1999; DIALY-SIZE 2016; Fernandes 2019; Giannaki 2013a; Goldberg 1983; Harter 1985; Groussard 2015; IHOPE 2019; Koh 2009; Kopple 2007; Kouidi 1997; Lee 2001; Matsumoto 2007; McGregor 2018; Reboredo 2010; Samara 2016; Suhardjono 2019; Tsuyuki 2003; Wilund 2010), and nine studies as moderate to vigorous (perceived as somewhat hard to hard) (Afshar 2010; Afshar 2011; Cooke 2018; CYCLE-HD 2016; Frey 1999; Koufaki 2002; Liao 2016; Painter 2002a; Wu 2014d).

Resistance exercise

Twenty-one (24%) studies assessed resistance training (Abreu 2017; Afshar 2010; AVANTE-HEMO 2020; Bennett 2013; Chen 2010; Cho 2018; de Lima 2013; DIALY-SIZE 2016; Dong 2011; Johansen 2006; Kopple 2007; Marinho 2016; Martin-Alemany 2016; Martins do Valle 2020; Olvera-Soto 2016; PEAK 2006; Pellizzaro 2013; Rahimimoghadam 2017; Rosa 2018; Segura-Orti 2009; Song 2012a).

Twelve exercise programs focused solely on the lower body (Abreu 2017; Afshar 2010; Bennett 2013; Chen 2010; de Lima 2013; DIALY-SIZE 2016; Dong 2011; Johansen 2006; Kopple 2007; Marinho 2016; Pellizzaro 2013; Segura-Orti 2009) and eight exercised both the upper and lower limbs (AVANTE-HEMO 2020; Cho 2018; Martin-Alemany 2016; Martins do Valle 2020; Olvera-Soto 2016; PEAK 2006; Rosa 2018; Song 2012a). Eight studies used weights (Abreu 2017; Afshar 2010; Chen 2010; DIALY-SIZE 2016; Johansen 2006; Martin-Alemany 2016; Martins do Valle 2020; Pellizzaro 2013), three studies used resistance bands (AVANTE-HEMO 2020; Bennett 2013; Cho 2018), six studies used both (DIALY-SIZE 2016; Marinho 2016; Martin-Alemany 2016; Olvera-Soto 2016; Rosa 2018; Song 2012a) and two studies used a leg press machine (Dong 2011; Kopple 2007).

Eight studies defined the duration of the exercise session in terms of the time required to complete the prescribed number of repetitions (AVANTE-HEMO 2020; Bennett 2013; DIALY-SIZE 2016; Dong 2011; Johansen 2006; Marinho 2016; Martins do Valle 2020; Pellizzaro 2013). In 10 studies (Abreu 2017; Afshar 2010; AVANTE-

HEMO 2020; Martin-Alemany 2016; Olvera-Soto 2016; PEAK 2006; Rahimimoghadam 2017; Rosa 2018; Segura-Orti 2009; Song 2012a), the duration of the training sessions varied between 10 and 50 minutes. and in four studies the duration was not reported or unclear (Chen 2010; Cho 2018; de Lima 2013; Kopple 2007).

Eight studies defined the target level of intensity on the Borg scale of perceived exertion (Afshar 2010; AVANTE-HEMO 2020; DIALY-SIZE 2016; Martin-Alemany 2016; Martins do Valle 2020; PEAK 2006; Segura-Orti 2009; Song 2012a), one on the Omni scale of perceived exertion (Chen 2010), six as a percentage of the one, three or five-repetition maximum load (Abreu 2017; Dong 2011; Johansen 2006; Kopple 2007; Marinho 2016; Pellizzaro 2013), and six did not report the level of intensity (Bennett 2013; Cho 2018; de Lima 2013; Olvera-Soto 2016; Rahimimoghadam 2017; Rosa 2018). Using the interpretation of each scale we classified 12 studies as moderate (perceived as somewhat hard) (Abreu 2017; AVANTE-HEMO 2020; Chen 2010; DIALY-SIZE 2016; Dong 2011; Johansen 2006; Kopple 2007; Marinho 2016; Martin-Alemany 2016; Pellizzaro 2013; Segura-Orti 2009; Song 2012a), and three studies as moderate to vigorous (perceived as somewhat hard to hard) (Afshar 2010; Martins do Valle 2020; PEAK 2006).

Combined aerobic and resistance exercise

Nineteen (22%) studies assessed interventions that combined aerobic and exercises within the same treatment arm (Burrows 2018; Cho 2018; Deligiannis 1999; Deligiannis 1999a; DePaul 2002; DIALY-SIZE 2016; Frih 2017a; Konstantinidou 2002; Kopple 2007; Kouidi 2008; Kouidi 2010; Ma 2018; Marchesan 2016; Molsted 2004; Ouzouni 2009; Rouchon 2016; Suhardjono 2019; Uchiyama 2019; van Vilsteren 2005). These interventions consisted of a combination of the previously mentioned aerobic and resistance exercises in varying proportions. Cycling remained the most common aerobic exercise (14 studies: Burrows 2018; Cho 2018; Deligiannis 1999; Deligiannis 1999a; DePaul 2002; Frih 2017a; Konstantinidou 2002; Kopple 2007; Kouidi 2008; Kouidi 2010; Marchesan 2016; Ouzouni 2009; Rouchon 2016; Suhardjono 2019). The duration of the training sessions varied between 20 and 90 minutes. Five studies did not report a target intensity level (Cho 2018; Kouidi 2010; Ma 2018; Ouzouni 2009; Rouchon 2016), and the remaining studies used a combination of the previously mentioned scales. We classified one study as light to moderate intensity (perceived as light to somewhat hard) (Suhardjono 2019), 11 studies as moderate intensity (perceived as somewhat hard) (Burrows 2018; Deligiannis 1999; Deligiannis 1999a; DePaul 2002; DIALY-SIZE 2016; Frih 2017a; Konstantinidou 2002; Kopple 2007; Marchesan 2016; Uchiyama 2019; van Vilsteren 2005), and three as moderate to vigorous (perceived as somewhat hard to hard) (Kouidi 2008; Konstantinidou 2002; Molsted 2004).

Other exercise training

One study assessed a yoga intervention (Yurtkuran 2007). The sessions lasted 30 minutes, two times/week and were progressive and supervised. Three studies assessed range of movement exercises (Makhlough 2012; Rezaei 2015; Soliman 2015) which consist of movements of the body articulations in their range of movement without resistance. The sessions lasted between 15 and 30 minutes, three times/week, and while the intensity was not specified, based on their description, we classified them as light exercises.

Timing of exercise training in relation to dialysis sessions

In the majority of studies (65 studies; 73%), exercise training took place during dialysis (Abreu 2017; Abundis Mora 2017; ACTINUT 2013; Afshar 2010; Afshar 2011; Akiba 1995; AVANTE-HEMO 2020; Bennett 2013; Burrows 2018; Carmack 1995; Chang 2010; Chen 2010; Cho 2018; Cooke 2018; CYCLE-HD 2016; Dashtidehkordi 2019; de Lima 2013; DePaul 2002; DIALY-SIZE 2016; Dobsak 2012; Fernandes 2019; Frey 1999; Giannaki 2013a; Groussard 2015; IHOPE 2019; Johansen 2006; Koh 2009; Konstantinidou 2002; Kopple 2007; Koufaki 2002; Koufaki 2003; Kouidi 2003; Kouidi 2004a; Kouidi 2005; Kouidi 2008; Kouidi 2010; Liao 2016; Ma 2018; Makhlough 2012; Marinho 2016; Martin-Alemany 2016; Martins do Valle 2020; Marchesan 2016; McAdams-DeMarco 2018; McGregor 2018; Mitsiou 2015; Miura 2015; Momeni 2014; Mortazavi 2013; Olvera-Soto 2016; Ouzouni 2009; Painter 2002a; Paluchamy 2018; Parsons 2004; PEAK 2006; Pellizzaro 2013; Rosa 2018; Reboredo 2010; Segura-Orti 2009; Soliman 2015; Suhardjono 2019; Toussaint 2008; van Vilsteren 2005; Wilund 2010; Wu 2014d).

Exercise training took place before or after the dialysis sessions in nine studies (CHAIR 2015; Dong 2011; Lee 2001; Matsumoto 2007; PEAK 2006; Rosa 2018; Song 2012a; van Vilsteren 2005; Zhao 2017), and on non-dialysis days in eleven studies (Deligiannis 1999; Deligiannis 1999a; EXCITE 2014; Frih 2017a; Goldberg 1983; Harter 1985; Konstantinidou 2002; Kouidi 1997; Rahimimoghadam 2017; Samara 2016; Tsuyuki 2003). The timing of the exercise sessions was unclear in the remaining studies.

Supervision of exercise sessions

The exercise sessions were directly supervised by a physicians in 15 studies (ACTINUT 2013; Afshar 2010; CHAIR 2015; Deligiannis 1999; Deligiannis 1999a; Harter 1985; IHOPE 2019; Konstantinidou 2002; Kouidi 1997; Kouidi 2008; Kouidi 2010; Liao 2016; Ouzouni 2009; Suhardjono 2019; Tsuyuki 2003), by a kinesiologist or an exercise physiologist in 10 studies (Bennett 2013; Deligiannis 1999; DePaul 2002; DIALY-SIZE 2016; Harter 1985; Kouidi 1997; McGregor 2018; Ouzouni 2009; PEAK 2006; Rosa 2018), by an investigator or research personnel in 10 studies (Amini 2016; Dong 2011; IHOPE 2019; Johansen 2006; Kopple 2007; Matsumoto 2007; McAdams-DeMarco 2018; Painter 2002a; Song 2012a; Wilund 2010), by a physical education teacher in four studies (Deligiannis 1999; Deligiannis 1999a; Konstantinidou 2002; Marinho 2016), by a physiotherapist in four studies (Abreu 2017; Frih 2017a; Molsted 2004; Segura-Orti 2009), by an exercise trainer in four studies (Kouidi 1997; Kouidi 2008; Kouidi 2010; Samara 2016), and by other professionals in two studies (EXCITE 2014; Groussard 2015). A further eight interventions were described as supervised without further information (Chen 2010; Koh 2009; Kouidi 2003; Kouidi 2004a; Kouidi 2005; Martins do Valle 2020; Olvera-Soto 2016; Reboredo 2010). The exercise sessions were unsupervised in six studies (Jong 2004; Koh 2009; Rezaei 2015; Sheshadri 2020; Toussaint 2008; Uchiyama 2019) and the remaining studies did not report whether the exercise intervention was supervised.

Tailoring

Twenty (22%) studies did not report tailoring of the intervention to the participant's physical capacity (Abreu 2017; Abundis Mora 2017; AVANTE-HEMO 2020; Amini 2016; Kouidi 2003; Kouidi 2004a; Kouidi 2005; Ma 2018; McAdams-DeMarco 2018; Mitsiou 2015; Miura 2015; Momeni 2014; Olvera-Soto 2016; Rahimimoghadam 2017; Rezaei 2015; Rouchon 2016; Segura-Orti 2009; Soliman 2015; Toussaint

2008; Zhao 2017). In the remaining studies, the intervention was tailored to the participant's physical capacity through adjustment of the intensity level or adjustment of the duration of the exercise session or both.

Progression

In 50 (56%) studies, the intervention were progressive through time in term of either intensity, duration or the number of repetitions or steps to achieve (ACTINUT 2013; Afshar 2010; Akiba 1995; AVANTE-HEMO 2020; Bennett 2013; Burrows 2018; Chang 2010; Chen 2010; Cho 2018; CYCLE-HD 2016; Deligiannis 1999; Deligiannis 1999a; de Lima 2013; DePaul 2002; DIALY-SIZE 2016; Dobsak 2012; Dong 2011; EXCITE 2014; Frey 1999; Frih 2017a; Giannaki 2013a; Goldberg 1983; Harter 1985; Groussard 2015; IHOPE 2019; Johansen 2006; Koh 2009; Konstantinidou 2002; Kopple 2007; Kouidi 1997; Kouidi 2008; Kouidi 2010; Lee 2001; Liao 2016; Marchesan 2016; Olvera-Soto 2016; Ouzouni 2009; Painter 2002a; Parsons 2004; Pellizzaro 2013; Rosa 2018; Samara 2016; Segura-Orti 2009; Sheshadri 2020; Song 2012a; Suhardjono 2019; Uchiyama 2019; Wilund 2010; Wu 2014d; Yurtkuran 2007). In the remaining studies, the intervention either remained unchanged throughout the study period or was not sufficiently described to assess progression.

Structured exercise intervention versus no exercise or placebo exercise were included in this review:

- Aerobic exercise versus placebo/no exercise: Abundis Mora 2017; ACTINUT 2013; Afshar 2011; Akiba 1995; Amini 2016; Carmack 1995; CHAIR 2015; Chang 2010; Cooke 2018; CYCLE-HD 2016; Dashtidehkordi 2019; Dobsak 2012; EXCITE 2014; Fernandes 2019; Frey 1999; Giannaki 2013a; Goldberg 1983; Harter 1985; Groussard 2015; IHOPE 2019; Jong 2004; Koufaki 2003; Kouidi 1997; Kouidi 2003; Kouidi 2004a; Kouidi 2005; Lee 2001; Liao 2016; Matsumoto 2007; McAdams-DeMarco 2018; McGregor 2018; Miura 2015; Momeni 2014; Mortazavi 2013; Painter 2002a; Paluchamy 2018; Parsons 2004; Reboredo 2010; Samara 2016; Sheshadri 2020; Toussaint 2008; Tsuyuki 2003; Wilund 2010; Wu 2014d; Zhao 2017
- Resistance exercise versus placebo/no exercise: Abreu 2017; Bennett 2013; Dong 2011; Johansen 2006; Marinho 2016; Martin-Alemany 2016; Martins do Valle 2020; Olvera-Soto 2016; PEAK 2006; Pellizzaro 2013; Rahimimoghadam 2017; Rosa 2018; Segura-Orti 2009; Song 2012a
- Combined aerobic and resistance exercise versus placebo/no exercise: Burrows 2018; Chen 2010; Deligiannis 1999; DePaul 2002; Frih 2017a;Kouidi 2008; Kouidi 2010; Ma 2018; Marchesan 2016; Molsted 2004; Ouzouni 2009; Rouchon 2016; Uchiyama 2019; van Vilsteren 2005
- Aerobic exercise versus resistance exercise versus placebo/no exercise: Afshar 2010; AVANTE-HEMO 2020; Deligiannis 1999a; de Lima 2013
- Aerobic exercise versus combined aerobic and resistance exercise versus placebo/no exercise: Suhardjono 2019
- Aerobic exercise versus resistance exercise versus combined aerobic and resistance exercise versus placebo/no exercise: Cho 2018; DIALY-SIZE 2016; Kopple 2007
- Intra-HD combined aerobic and resistance exercise versus home-based aerobic exercise versus placebo/no exercise: Deligiannis 1999a
- Intra-HD aerobic exercise versus home-based aerobic exercise versus placebo/no exercise: Koh 2009
- Intra-HD combined aerobic and resistance exercise versus inter-HD rehabilitation centre-based combined aerobic and resistance exercise versus home-based combined aerobic and resistance exercise versus placebo/no exercise: Konstantinidou 2002
- Yoga versus placebo/no exercise: Yurtkuran 2007
- Range of motion exercise versus placebo/no exercise: Makhlough 2012; Rezaei 2015; Soliman 2015
- Undefined exercise versus placebo/no exercise: Mitsiou 2015

Co-interventions reported were dietary counselling (ACTINUT 2013; AVANTE-HEMO 2020), oral nutritional supplement (AVANTE-HEMO 2020; Dong 2011; IHOPE 2019; Martin-Alemany 2016), antidepressant medication (Zhao 2017), volume control (Burrows 2018), and erythropoietin (Konstantinidou 2002; Koufaki 2003; Kouidi 2005).

Study outcomes

The reported outcomes were numerous and disparate, which illustrate the broad spectrum of benefits that are expected from exercise training.

Death

One study reported death at the completion of the intervention which consisted of six months of home-based walking sessions and at a post-study follow-up, three years after randomisation (EXCITE 2014). Death was a secondary endpoint for which the study was not powered.

Cardiovascular events

No study reported cardiovascular events.

Fatigue

Six studies directly measured fatigue, each using different instruments including the revised Piper Fatigue Scale and Rhoten Fatigue Scale (Amini 2016), the Hemodialysis Fatigue Scale (Chang 2010), the Profile of Mood States (Johansen 2006), the Iowa Fatigue Scale (Soliman 2015), and a poorly defined visual analogue scale (Yurtkuran 2007). One study reported the fatigue domain of the Dialysis Symptom Index (Sheshadri 2020). Because these scales assess different dimensions of fatigue, we did not conduct a meta-analysis.

A further 16 studies reported the vitality domain of either the Medical Outcomes Study 36-item Short-Form Health Survey (SF-36) or a version of the Kidney Disease Quality of Life (KDQOL) questionnaires (Abreu 2017; AVANTE-HEMO 2020; Dobsak 2012; EXCITE 2014; Koh 2009; Martin-Alemany 2016; Martins do Valle 2020; Matsumoto 2007; Paluchamy 2018; Parsons 2004; PEAK 2006; Pellizzaro 2013; Sheshadri 2020; van Vilsteren 2005; Wu 2014d; Zhao 2017). One study could not contribute to the meta-analysis because its results were not rescaled from 0 to 100 points (Paluchamy 2018) and another did not provide sufficient information to be included in the meta-analysis (Martins do Valle 2020).

Health-Related Quality of Life

Forty-six studies assessed HRQoL, 27 using the SF-36 questionnaire (Abreu 2017; ACTINUT 2013; CHAIR 2015; Chen 2010; DePaul 2002; Dobsak 2012; Frih 2017a; Giannaki 2013a; IHOPE 2019; Jong 2004; Johansen 2006; Koh 2009; Martins do Valle 2020; Matsumoto 2007;

Molsted 2004; Mortazavi 2013; Painter 2002a; Parsons 2004; PEAK 2006; Ouzouni 2009; Rosa 2018; Samara 2016; Segura-Orti 2009; Sheshadri 2020; Song 2012a; van Vilsteren 2005; Zhao 2017), three using the KDQOL questionnaire (Bennett 2013; Burrows 2018; Sheshadri 2020), nine using the KDQOL-Short Form (KDQOL-SF) which includes the SF-36 (AVANTE-HEMO 2020; de Lima 2013; EXCITE 2014; Martin-Alemany 2016; Paluchamy 2018; Pellizzaro 2013; Suhardjono 2019; Uchiyama 2019; Wu 2014d), one using the SF-12 (IHOPE 2019), one using the KDQOL-SF 36 which includes SF-12 (DIALY-SIZE 2016), two using the Spitzer Index (Kouidi 1997; Ouzouni 2009), one using the Scale of Life Satisfaction (Ouzouni 2009), one using questions from the Laupacis Kidney Disease Questionnaire (DePaul 2002) and one abstract that did not report the instrument (Kouidi 2005). Of the 39 that used either the SF-36, the SF-12 or a version of the KDQOL, 17 reported the summary physical and mental component scores (ACTINUT 2013; CHAIR 2015; Chen 2010; DIALY-SIZE 2016; Dobsak 2012; Frih 2017a; Giannaki 2013a; IHOPE 2019; Koh 2009; Molsted 2004; Ouzouni 2009; Rosa 2018; Samara 2016; Segura-Orti 2009; Song 2012a; Suhardjono 2019; Uchiyama 2019) and all could contribute to the meta-analysis.

Twenty studies reported the scores for at least one individual domain of the SF-36 questionnaire (Abreu 2017; AVANTE-HEMO 2020; CHAIR 2015; Dobsak 2012; EXCITE 2014; Johansen 2006; Jong 2004; Koh 2009; Martin-Alemany 2016; Martins do Valle 2020; Matsumoto 2007; Paluchamy 2018; Parsons 2004; PEAK 2006; Pellizzaro 2013; Sheshadri 2020; Uchiyama 2019; van Vilsteren 2005; Wu 2014d; Zhao 2017) and all but one (Paluchamy 2018), for which the results were not rescaled from 0 to 100 points, contributed to the meta-analysis.

Pain

One study reported pain on a 0 to 10 visual analogue scale (Yurtkuran 2007). Sixteen studies reported pain as a domain of the SF-36 questionnaire (Abreu 2017; AVANTE-HEMO 2020; Dobsak 2012; EXCITE 2014; Koh 2009; Martin-Alemany 2016; Martins do Valle 2020; Matsumoto 2007; Molsted 2004; Paluchamy 2018; Pellizzaro 2013; van Vilsteren 2005; Uchiyama 2019; Wu 2014d; Yurtkuran 2007; Zhao 2017)and all but one study (Paluchamy 2018), for which the results were not rescaled from 0 to 100 points, contributed to the meta-analysis.

Depression

Seventeen studies assessed depression (Carmack 1995; CYCLE-HD 2016; Frih 2017a; Giannaki 2013a; Goldberg 1983; Harter 1985; Johansen 2006; Kouidi 1997; Kouidi 2005; Kouidi 2010; Ma 2018; Ouzouni 2009; PEAK 2006; Rahimimoghadam 2017; Rezaei 2015;Sheshadri 2020; van Vilsteren 2005). Seven used the Beck Depression Index (Amini 2016; Goldberg 1983; Harter 1985; Kouidi 1997; Kouidi 2010; Ouzouni 2009; Rezaei 2015), three the Hospital Anxiety and Depression Scale (CYCLE-HD 2016; Frih 2017a; Kouidi 2010), two the Center for Epidemiologic Studies Depression Scale (CES-D) (Carmack 1995; Sheshadri 2020), two the Self-rating Depression Scale (Giannaki 2013a; van Vilsteren 2005), four used other instruments (Amini 2016; Johansen 2006; PEAK 2006; Rahimimoghadam 2017) and two did not report their instrument (Kouidi 2005; Ma 2018). Ten studies (Carmack 1995; Frih 2017a; Giannaki 2013a; Kouidi 1997; Kouidi 2010; Ouzouni 2009; Rahimimoghadam 2017; Rezaei 2015; Sheshadri 2020; van Vilsteren 2005) provided sufficient information to contribute to the meta-analysis using the standardised mean difference.

Functional capacity

Functional capacity was reported in 35 studies (ACTINUT 2013; AVANTE-HEMO 2020; Bennett 2013; CHAIR 2015; Cho 2018; Cooke 2018; de Lima 2013; DePaul 2002; DIALY-SIZE 2016; Dobsak 2012; EXCITE 2014; Fernandes 2019; Frih 2017a; Giannaki 2013a; Groussard 2015; IHOPE 2019; Johansen 2006; Koh 2009; Koufaki 2002; Liao 2016; Ma 2018; Martins do Valle 2020; Marchesan 2016; Mitsiou 2015; PEAK 2006; Pellizzaro 2013; Rosa 2018; Rouchon 2016; Samara 2016; Segura-Orti 2009; Song 2012a; Suhardjono 2019; Uchiyama 2019; Wilund 2010; Wu 2014d). We meta-analysed and reported the two most commonly reported tests.

Twenty-three studies reported result for the 6MWT which measures the distance in metres covered over six minutes and reflects aerobic capacity and endurance (ACTINUT 2013; AVANTE-HEMO 2020; CHAIR 2015; Cho 2018; DePaul 2002; DIALY-SIZE 2016; EXCITE 2014; Fernandes 2019; Frih 2017a; Groussard 2015; Koh 2009; Liao 2016; Ma 2018; Martins do Valle 2020; Marchesan 2016; Mitsiou 2015; PEAK 2006; Pellizzaro 2013; Rosa 2018; Rouchon 2016; Samara 2016; Segura-Orti 2009; Wu 2014d). Nineteen studies could be meta-analysed (ACTINUT 2013; CHAIR 2015; Cho 2018; DePaul 2002; DIALY-SIZE 2016; EXCITE 2014; Fernandes 2019; Frih 2017a; Koh 2009; Liao 2016; Martins do Valle 2020; Marchesan 2016; PEAK 2006; Pellizzaro 2013; Rosa 2018; Rouchon 2016; Samara 2016; Segura-Orti 2009; Wu 2014d).

Sixteen studies reported results for the sit-to-stand test which measures leg strength and endurance (AVANTE-HEMO 2020; Bennett 2013; Cho 2018; DIALY-SIZE 2016; EXCITE 2014; Frih 2017a; Giannaki 2013a; IHOPE 2019; Johansen 2006; Koufaki 2002; Marchesan 2016; Rosa 2018; Samara 2016; Segura-Orti 2009; Song 2012a; Wu 2014d). Eight reported the maximum number of sit-to-stand cycles executed within 30 seconds (Bennett 2013; Cho 2018; DIALY-SIZE 2016; Giannaki 2013a; IHOPE 2019; Marchesan 2016; Rosa 2018; Song 2012a), and five reported the number of sit-to-stand cycles executed within 60 seconds (Frih 2017a; Giannaki 2013a; Koufaki 2002; Segura-Orti 2009; Wu 2014d). To meta-analyse the results conjointly, we approximated the number of cycles executed within 30 seconds by dividing the results of the last five studies by two. Five studies reported the time in seconds required to execute five sit-to-stand cycles (AVANTE-HEMO 2020; EXCITE 2014; Giannaki 2013a; Johansen 2006; Koufaki 2002), and four studies reported the time in seconds required to execute 10 sit-to-stand cycles (Frih 2017a; Samara 2016; Segura-Orti 2009; Wu 2014d). To combine these results within the same meta-analysis, we approximated the time to execute five cycles by dividing the results of the later four studies by two. All but one study (AVANTE-HEMO 2020) reported their results in a manner that was amenable to meta-analysis.

Resting blood pressure

Twenty-one studies assessed resting peripheral SBP and DBP (Cooke 2018; CYCLE-HD 2016; Deligiannis 1999a; DePaul 2002; Fernandes 2019; Frih 2017a; Goldberg 1983; IHOPE 2019; Koh 2009; Kouidi 2008; Liao 2016; McGregor 2018; Miura 2015, Molsted 2004; Ouzouni 2009; Paluchamy 2018; Soliman 2015; Toussaint 2008; Tsuyuki 2003; van Vilsteren 2005; Wilund 2010) and all but one (Miura 2015) provided the results in a form amenable to meta-analysis.

Adherence to the exercise intervention

Twelve (14%) studies reported the percentage of training sessions attended by the participants allocated to the intervention group (ACTINUT 2013; Chen 2010; Cooke 2018; IHOPE 2019; Kouidi 2008; Martins do Valle 2020; Molsted 2004; PEAK 2006; Reboredo 2010; Rosa 2018; Toussaint 2008; Uchiyama 2019).

Adverse events

Thirteen (15%) studies reported adverse events (AVANTE-HEMO 2020; CHAIR 2015; Chen 2010; Cho 2018; DIALY-SIZE 2016; EXCITE 2014; IHOPE 2019; Marinho 2016; McAdams-DeMarco 2018; PEAK 2006; Sheshadri 2020; Uchiyama 2019; Wu 2014d) of which three reported severe adverse events separately (CHAIR 2015; DIALY-SIZE 2016; EXCITE 2014). Nine studies specifically reported adverse events related to the intervention (AVANTE-HEMO 2020; CHAIR 2015; Chen 2010; Cho 2018; DIALY-SIZE 2016; IHOPE 2019; Sheshadri 2020; Uchiyama 2019; Wu 2014d) and were meta-analysed.

Other outcomes

Outcomes that were frequently reported but not identified as important to patients included: aerobic capacity (VO_2 max or peak); maximum heart rate; muscular strength; body mass index; body composition (fat and lean mass); haemoglobin; serum albumin; blood lipids; serum potassium; serum calcium; serum phosphate; parathyroid hormone levels; C-reactive protein levels; left ventricular ejection fraction; and left ventricular mass index measured on cardiac ultrasonography. These outcomes were reported in Heiwe 2011 and have been retained for historical reference only.

Excluded studies

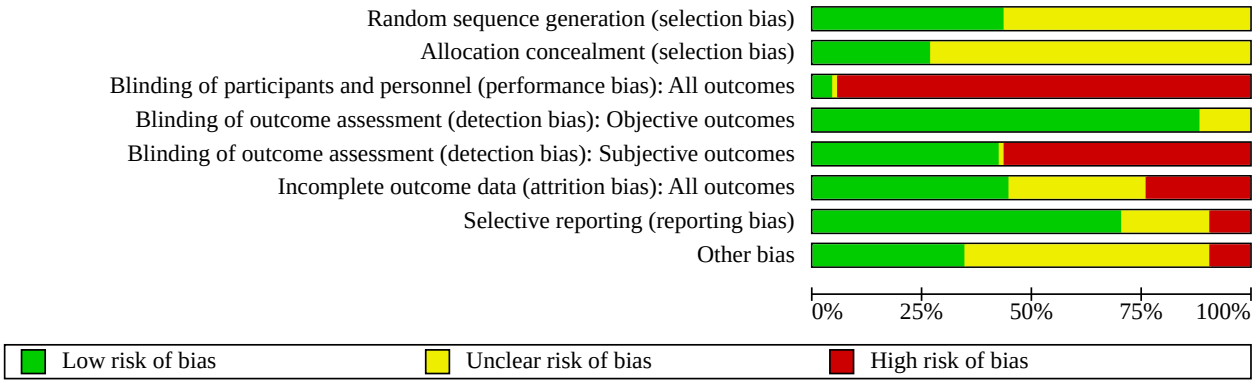
Forty-one studies were excluded. The reasons for exclusion were no control group or active control (11 studies); no intervention group (6 studies); duration < eight weeks (22 studies); wrong population (1 study); and co-interventions not the same in the control and intervention groups (1 study).

See Characteristics of excluded studies table.

Risk of bias in included studies

Figure 2 summarises the assessment of the risk of bias for the included studies, and Figure 3 provide the risk of bias assessment for individual studies.

Figure 2. Methodological quality graph: review authors' judgements about each methodological quality item presented as percentages across all included studies.



Allocation

Random sequence generation

The random sequence generation method was at low risk of bias in 39 studies (44%) (ACTINUT 2013; AVANTE-HEMO 2020; Bennett 2013; CHAIR 2015; Cho 2018; Cooke 2018; CYCLE-HD 2016; de Lima 2013; DePaul 2002; DIALY-SIZE 2016; Dong 2011; EXCITE 2014; Fernandes 2019; Frih 2017a; IHOPE 2019; Johansen 2006; Koh 2009; Kopple 2007; Koufaki 2002; Kouidi 2008; Makhlough 2012; Marinho 2016; Martin-Alemany 2016; Martins do Valle 2020; McGregor 2018; Olvera-Soto 2016; Painter 2002a; Parsons 2004; PEAK 2006; Rahimimoghadam 2017; Rosa 2018; Rouchon 2016; Samara 2016; Segura-Orti 2009; Sheshadri 2020; Suhardjono 2019; Uchiyama 2019; Wu 2014d; Yurtkuran 2007), and not reported in the remaining 50 studies.

Allocation concealment

The method to conceal the treatment allocation was at low risk of bias in 24 studies (27%) (ACTINUT 2013; Bennett 2013; CHAIR 2015; Cho 2018; CYCLE-HD 2016; Dashtidehkordi 2019; de Lima 2013; DIALY-SIZE 2016; EXCITE 2014; Fernandes 2019; IHOPE 2019; Johansen 2006; Koh 2009; Koufaki 2002; Martins do Valle 2020; McGregor 2018; Molsted 2004; Painter 2002a; PEAK 2006; Rosa 2018; Sheshadri 2020; Toussaint 2008; Uchiyama 2019; Yurtkuran 2007) and not reported in the remaining 65 studies.

Blinding

Blinding of participants and investigators

While complete blinding of the participants to the exercise intervention is unlikely, we deemed the four studies that used a placebo or sham exercise were at low risk of bias (Chen 2010; DePaul 2002; Rosa 2018; Segura-Orti 2009). One study was judged to be at unclear risk of bias (Dashtidehkordi 2019), and the remaining 84 studies were judged to be at high risk of bias.

Blinding of outcome assessment

Objective outcomes

We considered the 6MWT, the Sit-To-Stand test, the Time-Up and Go test, muscular strength, blood pressure, heart rate, Kt/V, laboratory results, dietary intake, and cardiac ultrasound measures as objective outcomes that were less likely to be significantly affected by the lack of blinding of the assessors. With the exception of 10 abstracts (Abundis Mora 2017; Burrows 2018; Jong 2004; Koufaki 2003; Kouidi 2003; Kouidi 2004a; Kouidi 2005; Ma 2018; Mitsiou 2015; Miura 2015) that we deemed at unclear risk; all studies were judged to be at low risk of bias.

Eight studies did not report any of the listed objective outcomes (Amini 2016; Chang 2010; Dashtidehkordi 2019; Matsumoto 2007; Mortazavi 2013; Rahimimoghadam 2017; Rezaei 2015; Wu 2014d).

Subjective outcomes

Fatigue, HRQoL, pain, and depression were considered subjective outcomes. Since the participants themselves assessed these outcomes, we deemed the four studies that used a placebo or sham exercise to be at low risk of bias for blinding of outcome assessment (Chen 2010; DePaul 2002; Rosa 2018; Segura-Orti 2009) as well as the 34 studies that did not report any subjective outcomes (Abundis Mora 2017; Afshar 2011; Akiba 1995; Cho 2018; Cooke 2018; Deligiannis 1999; Deligiannis 1999a; de Lima 2013; Dong 2011; Fernandes 2019; Groussard 2015; Harter 1985; Konstantinidou 2002; Kopple 2007; Koufaki 2003; Kouidi 2003; Kouidi 2004a; Kouidi 2008; Lee 2001; Liao 2016; Makhlough 2012; Marchesan 2016; Marinho 2016; McAdams-DeMarco 2018; McGregor 2018; Mitsiou 2015; Miura 2015; Momeni 2014; Olvera-Soto 2016; Reboredo 2010; Rouchon 2016; Toussaint 2008; Tsuyuki 2003; Wilund 2010). One abstract was judged as unclear (Burrows 2018), and the remaining 50 studies were judged to be at high risk of bias since the participants reported the outcomes and the participants were not blinded to treatment allocation.

Incomplete outcome data

We judged 40 (45%) studies to be at low risk of bias for incomplete outcome data (ACTINUT 2013; AVANTE-HEMO 2020; Chang 2010; Cho 2018; Dashtidehkordi 2019; de Lima 2013; DePaul 2002; DIALY-SIZE 2016; Fernandes 2019; Groussard 2015; Johansen 2006; Konstantinidou 2002; Koufaki 2002; Kouidi 1997; Kouidi 2008; Kouidi 2010; Liao 2016; Marchesan 2016; Marinho 2016; Martin-Alemany 2016; Martins do Valle 2020; Matsumoto 2007; Momeni 2014; Olvera-Soto 2016; Ouzouni 2009; Painter 2002a; Parsons 2004; Rahimimoghadam 2017; Rosa 2018; Samara 2016; Segura-Orti 2009; Sheshadri 2020; Song 2012a; Suhardjono 2019; Toussaint 2008; Uchiyama 2019; van Vilsteren 2005; Wilund 2010; Wu 2014d; Yurtkuran 2007) and 21 (23.5%) to be at high risk (Abreu 2017; Akiba 1995; Bennett 2013; Carmack 1995; CHAIR 2015; EXCITE 2014; Frey 1999; Frih 2017a; Harter 1985; IHOPE 2019; Koh 2009; Kopple 2007; Lee 2001; McAdams-DeMarco 2018; McGregor 2018; Molsted 2004; Pellizzaro 2013; Reboredo 2010; Rezaei 2015; Rouchon 2016; Soliman 2015). The remaining 28 studies provided insufficient information to permit judgement.

Selective reporting

Eight (9%) studies were at high risk of bias from selective reporting of outcomes (Lee 2001; Liao 2016; McAdams-DeMarco 2018; Olvera-Soto 2016; Painter 2002a; PEAK 2006; Pellizzaro 2013; Rezaei 2015).

Eighteen (20%) studies did not provide sufficient information to assess the risk of bias from selective reporting (Abundis Mora 2017; Afshar 2011; Akiba 1995; Burrows 2018; CYCLE-HD 2016; Harter 1985; Jong 2004; Koufaki 2003; Kouidi 2003; Kouidi 2004a; Kouidi 2005; Ma 2018; Mitsiou 2015; Miura 2015; Momeni 2014; Paluchamy 2018; Rouchon 2016; Zhao 2017). The remaining 63 studies were at low risk of bias from selective reporting.

Other potential sources of bias

We judge seven (8%) studies at high risk of bias because they received private funding without specifying whether the funders were involved in the conduction of the study (DePaul 2002; Groussard 2015; Johansen 2006; Koufaki 2002; Molsted 2004; Painter 2002a; PEAK 2006). A further study was judged at high risk of bias for discrepancies in the number of participants across the published article (Makhlough 2012). We judge 31 studies (34%) at low risk of other sources of bias because they reported either no funding or public funding (Abreu 2017; ACTINUT 2013; AVANTE-HEMO 2020; Bennett 2013; Chang 2010; Dashtidehkordi 2019; DIALY-SIZE 2016; Dobsak 2012; Dong 2011; Fernandes 2019; Giannaki 2013a; Goldberg 1983; Harter 1985; IHOPE 2019; Koh 2009; Kopple 2007; Marinho 2016; Martins do Valle 2020; McAdams-DeMarco 2018; McGregor 2018; Parsons 2004; Pellizzaro 2013; Rahimimoghadam 2017; Reboredo 2010; Rosa 2018; Segura-Orti 2009; Sheshadri 2020; Suhardjono 2019; Toussaint 2008; Wilund 2010; Wu 2014d). The remaining 50 studies did not report their source of funding.

Effects of interventions

See: **Summary of findings 1** Any exercise versus no exercise or placebo exercise for adults undergoing maintenance dialysis; **Summary of findings 2** Aerobic exercise versus no exercise or placebo exercise for adults undergoing maintenance dialysis; **Summary of findings 3** Resistance exercise versus no exercise or placebo exercise for adults undergoing maintenance dialysis; **Summary of findings 4** Combined aerobic and resistance exercise versus no exercise or placebo exercise for adults undergoing maintenance dialysis

Primary outcomes

Death (any cause)

It is uncertain whether exercise training reduces the risk of death. EXCITE 2014 reported death three years after the intervention which consisted of six months of home-based walking exercise. Deaths were similar across the two groups (Analysis 1.1 (1 study, 296 participants): RR 0.95; 95% CI 0.56 to 1.62; very low certainty evidence). This study was not powered to assess death and the report did not specify whether there was missing data for this outcome at the three-year follow-up assessment.

Studies reporting adverse events (CHAIR 2015; Chen 2010; Cho 2018; DIALY-SIZE 2016; EXCITE 2014; Marinho 2016; McAdams-DeMarco 2018; PEAK 2006; Wu 2014d) did not report any deaths related to the exercise intervention during the duration of the study (range two to six months).

Cardiovascular events

No study reported cardiovascular events.

Fatigue

Fatigue was reduced after the exercise intervention in three studies that used fatigue-specific measures (Amini 2016; Soliman 2015; Yurtkuran 2007) and was reduced but did not reach statistical significance in two (Chang 2010; Johansen 2006). One study found similar results on the fatigue domain of the Dialysis Symptom Index across treatment groups after the exercise intervention (Sheshadri 2020) (Analysis 1.2). A sensitivity analysis based on the risk of bias could not be conducted due to the low number of studies. All the studies used aerobic training interventions and one used resistance training (Johansen 2006).

Exercise may improve vitality as assessed by the SF-36 questionnaire (Analysis 1.4.7 (16 studies, 940 participants): MD 4.47, 95% CI 0.79 to 8.15 points on a 100-point scale; I^2 = 46%; low certainty evidence) where higher scores signify greater vitality. Considering a minimal clinically important difference for the individual scales of the SF-36 of two to five points (Eriksson 2016; Finkelstein 2018; Leaf 2009; Samsa 1999; Spinowitz 2019) or an SMD of 0.1 to 0.5 (Farivar 2004; Norman 2003; Samsa 1999), we judged the magnitude of the effect to be small. However, since vitality is an indirect measure of fatigue, the relevance of this result for the assessment of the outcome of fatigue is uncertain.

Health-Related Quality of Life

Physical component score

Exercise training of any type may increase the physical component of HRQoL slightly (Analysis 1.3.1 (17 studies, 656 participants): MD 4.12, 95% CI 1.88 to 6.37 points on 100 points-scale where higher scores signify a better QoL; I^2 = 49%; low certainty evidence). Considering a minimal clinically important difference for the physical component score of SF-36 of two to five points (Eriksson 2016; Erez 2016; Finkelstein 2018; Leaf 2009; Samsa 1999; Spinowitz 2019) or an SMD of 0.1 to 0.5 (Farivar 2004; Norman 2003; Samsa 1999) we estimated the size of the effect to be small. A sensitivity analysis including only the studies at low risk of bias (ACTINUT 2013; DIALY-SIZE 2016; Rosa 2018; Samara 2016; Segura-Orti 2009; Suhardjono 2019; Uchiyama 2019) led to a similar pooled estimate of the effect (7 studies, 309 participants: MD 4.33 points on 100 points-scale, 95% CI -0.11 to 8.76; I^2 = 67%).

It is uncertain whether aerobic, resistance, or combined aerobic and resistance exercise improved the physical component of QoL because the certainty of this evidence was very low (Analysis 2.3; Analysis 3.2; Analysis 4.1).

Mental component score

It is uncertain whether any exercise training improves the mental component of HR-QoL (Analysis 1.3 (17 studies, 656 participants): MD 2.53, 95% CI -0.40 to 5.47 points on 100 points-scale where higher scores signify a better QoL; I^2 = 73%; very low certainty evidence). There was evidence of significant heterogeneity in the effect of exercise training between studies that we could not explain with subgroups analyses based on the type, intensity or duration of exercise or based on the risk of bias. A sensitivity analysis including only the studies at low risk of bias (ACTINUT 2013; DIALY-SIZE 2016; Rosa 2018; Samara 2016; Segura-Orti 2009; Suhardjono 2019; Uchiyama 2019) led to a similar pooled estimate of the effect (7 studies, 309 participants: MD 3.04 points, 95% CI -2.91 to 8.98; I^2 = 67%).

It is also uncertain whether aerobic, resistance or combined aerobic and resistance exercise improves the mental component of HR-QoL as the certainty of the evidence was very low (Analysis 2.3; Analysis 3.2; Analysis 4.1).

The results of the meta-analyses for the individual domains of HR-QoL are available in Analysis 1.4 for any exercise, Analysis 2.4 for aerobic exercise, Analysis 3.3 for resistance exercise, and Analysis 4.2 for combined aerobic and resistance exercise.

Pain

Exercise training of any type may lead to lesser pain as assessed by the SF-36 or KDQOL questionnaires. However, the 95% CI indicates that exercise training might make little or no difference in the level of pain (Analysis 1.4.3 (15 studies, 872 participants): MD 5.28 95% CI -0.12 to 10.69 points on 100 points-scale where higher scores signify less pain; I^2 = 63%; low certainty evidence). There was evidence of significant heterogeneity in the effect of exercise across studies. However, the heterogeneity was completely resolved by removing Pellizzaro 2013 which reported its results in figures only (pooled estimate after removing the study (14 studies. 844 participants): MD 2.80, 95% CI -0.30 to 5.91, I^2 = 0%). Considering a minimal clinically important difference for each scale of the SF-36 of two to five points (Eriksson 2016; Finkelstein 2018; Leaf 2009; Samsa 1999; Spinowitz 2019) or an SMD of 0.1 to 0.5 (Farivar 2004; Norman 2003; Samsa 1999), we judged the magnitude of the effect to be small. A sensitivity analysis including only the studies at low risk of bias (AVANTE-HEMO 2020; Martin-Alemany 2016; Martins do Valle 2020; Parsons 2004; Uchiyama 2019; Wu 2014d) reported a similar pooled estimate of the effect (6 studies, 229 participants: MD 2.66 points on 100 points-scale, 95% CI -2.02 to 7.34; I^2 = 0%).

Aerobic exercise training may make little or no difference to pain as assessed by the SF-36 questionnaire (Analysis 2.4.3 (8 studies, 570 participants): MD 2.26 points 95% CI -1.61 to 6.12 on 100 points-scale; I^2 = 0%; low certainty evidence).

It is uncertain whether resistance exercise training and combined aerobic and resistance exercise training improves pain in adults undergoing dialysis because the certainty of this evidence was very low (Analysis 3.3.3; Analysis 4.2.3).

Depression

Exercise training of any type likely improves depression in adults undergoing dialysis (Analysis 1.5 (10 studies, 441 participants): SMD -0.65, 95% CI -1.07 to -0.22 where lower scores signify improved depressive symptoms; I^2 = 77%; moderate certainty evidence). However, there was evidence of significant heterogeneity in the effect of exercise across studies. The heterogeneity was improved after stratifying the studies by the duration of the intervention (four months or less versus longer than four months). The magnitude of the effect was very large when the intervention lasted longer than four months (Analysis 1.5.2 (4 studies, 130 participants): SMD -1.26, 95% CI -0.72 to -1.80; I^2 = 45%), while the 95% CI indicated that exercise training for four months or less may make little or no difference on depression (Analysis 1.5.1 (6 studies, 311 participants): SMD -0.30, 95% CI 0.14 to -0.74; I^2 = 71%) (Test for subgroup differences: P = 0.007).

It is uncertain whether aerobic, resistance or combined aerobic and resistance exercise improves depressive symptoms because the certainty of this evidence is very low (Analysis 2.5; Analysis 3.4;

Analysis 4.3). A sensitivity analysis based on the risk of bias could not be conducted due to the low number of studies.

Functional capacity

6-Minute Walk Test

Exercise training of any type is likely to improve functional capacity as assessed by the 6MWT (Analysis 1.6 (19 studies, 827 participants): MD 49.91 metres, 95% CI 37.22 to 62.59; I^2 = 34%; moderate certainty evidence). Considering a previously reported minimal clinically important difference for the 6MWT ranging from 14.0 to 30.5 metres in patients with comorbidities and similar baseline results on the 6MWT (Bohannon 2017), we estimated the magnitude of the effect as moderate. A sensitivity analysis limited to the studies at low risk of bias (ACTINUT 2013; Cho 2018; DIALY-SIZE 2016; Fernandes 2019; Martins do Valle 2020; Rosa 2018; Segura-Orti 2009; Wu 2014d) did not significantly alter the pooled estimate of the effect (8 studies, 298 participants: MD 48.57 metres, 95% CI 34.23 to 62.92; I^2 = 0%).

Aerobic exercise (Analysis 2.6 (10 studies, 515 participants): MD 53.00 metres, 95% CI 33.84 to 72.17; I^2 = 47%; moderate certainty evidence), resistance exercise (Analysis 3.5 (7 studies, 216 participants): MD 44.71 metres, 95% CI 27.00 to 62.43; I^2 = 0%; moderate certainty evidence) or combined aerobic and resistance exercise (Analysis 4.4 (6 studies, 138 participants): MD 53.64 meters, 95% CI 39.36 to 67.91; I^2 = 0%; moderate certainty evidence) are all likely to increase functional capacity.

Sit-To-Stand test

Exercise training of any type is likely to improve functional capacity and lower extremities strength as assessed by the 30- or 60-second STS test (Analysis 1.7 (12 studies, 478 participants): MD 2.36 repetitions in 30 seconds, 95% CI 1.73 to 2.98; I^2 = 0%; moderate certainty evidence). We found no reference in the literature of the minimal clinically important difference for this test in adults undergoing dialysis. Judging from the results in another population with similar baseline results (Wright 2011) and the SMD of 0.63 (95% CI 0.35 to 0.91) we judged the size of the effect to be moderate. A sensitivity analysis limited to the studies at low risk of bias (Cho 2018; DIALY-SIZE 2016; Rosa 2018; Segura-Orti 2009; Wu 2014d) did not significantly alter the pooled estimate of the effect (5 studies, 219 participants: 2.79 repetitions in 30 seconds, 95% CI 1.73 to 3.86; I^2 = 13%).

Exercise training is likely to improve functional lower extremities strength as assessed by the 5 to 10 repetitions STS test (Analysis 1.8 (8 studies, 508 participants) MD -1.74 seconds, 95% CI -2.25 to -1.22; I^2 = 0%; moderate certainty evidence). Using a minimal clinically important difference of 4.2 seconds in adults with CKD (Wilkinson 2019) not on dialysis and an SMD of 0.53 (95% CI 0.30 to 0.75) we judged the size of the effect to be small. A sensitivity analysis based on the risk of bias could not be conducted for the 5 to 10 repetitions STS test due to the low number of studies. Taken together, the pooled estimates for these two versions of the STS test point to a positive effect of exercise training on lower extremities strength and physical functioning.

Aerobic (Analysis 2.7 (6 studies, 227 participants): MD 1.81 repetitions in 30 seconds, 95% CI 0.86 to 2.76 ; I^2 = 0%; moderate certainty evidence) and resistance exercise (Analysis 3.6 (6 studies, 195 participants): MD 2.76 repetitions in 30 seconds, 95% CI 1.68 to 3.83; I^2 = 0%, moderate certainty evidence) are both likely to improve functional lower extremities strength as assessed by the 30- or 60-second STS test. Combined aerobic and resistance training may improve performance on the 30 or 60 seconds STS test (Analysis 4.5 (4 studies, 97 participants): MD 2.63 repetitions in 30 seconds, 95% CI 1.49 to 3.77; I^2 = 9%; low certainty evidence). Aerobic exercise is likely to improve functional lower extremities strength as assessed by the 5 or 10 repetitions STS test (Analysis 2.8 (5 studies, 374 participants): MD -1.63 seconds, 95% CI -2.33 to -0.92, 2.33; I^2 = 8%; moderate certainty evidence). It is uncertain whether resistance exercise or combined aerobic and resistance exercise improves the results of the 5 to 10 repetitions STS test because the certainty of this evidence is very low.

Peripheral resting blood pressure

The effect of exercise training on SBP and DBP was different across types of exercise (Test for subgroup differences P < 0.001 for both SBP and DBP). We will, therefore, present the results for each type of exercise separately and will not provide a pooled estimate for any exercise training.

It is uncertain whether aerobic exercise reduces SBP because the certainty of this evidence is very low (Analysis 1.9.1 (13 studies, 394 participants): MD -3.99 mm Hg, 95% CI -9.78 to 1.80; I^2 = 45%; very low certainty evidence). No study assessed the impact of resistance training alone on SBP. The evidence is very uncertain on the effect of combined aerobic and resistance training on SBP (Analysis 1.9.2 (7 studies, 282 participants): MD -8.69 mm Hg, 95% CI -13.69 to -3.69; I^2 = 57%; very low certainty evidence). The heterogeneity was entirely resolved after excluding a single study (Frih 2017a) (pooled estimate after excluding the study: MD -5.84 95% CI -9.94 to -1.74 mm Hg; I^2 = 0%).

It is uncertain whether aerobic exercise reduces DBP because the certainty of this evidence is very low (Analysis 1.10.1 (13 studies, 394 participants): MD 0.72 mm Hg, 95% CI -2.24 to 3.69; I^2 = 31%, very low certainty evidence). No study assessed the impact of resistance training alone on DBP. The evidence is very uncertain about the effect of combined aerobic and resistance training on DBP (Analysis 1.10.2 (7 studies, 282 participants): MD -4.45 mm Hg, 95% CI -5.98 to -2.91; I^2 = 0%; very low certainty evidence).

Adherence to the exercise intervention

Of the eleven studies that reported the percentage of training sessions attended by the participants allocated to the intervention, the lowest adherence was reported as a median of 60% (Cooke 2018), and the highest was a mean adherence of 88% (Kouidi 2008).

Exercise-related adverse events

It is uncertain whether exercise training is safe for adults undergoing maintenance dialysis because the certainty of this evidence is very low. Seven studies reported there were no exercise-related adverse events (AVANTE-HEMO 2020; Chen 2010; Cho 2018; DIALY-SIZE 2016; IHOPE 2019; Uchiyama 2019; Wu 2014d) within a total of 171 participants assigned to the exercise intervention. One study reported 6/26 participants assigned to the intervention presented exercise-related symptoms including shortness of breath, soreness, lower extremity pain, cramping and fatigue (Sheshadri 2020). Furthermore, two participants experienced chest pain during the intervention. One study reported that one of the six exercising participants presented with knee joint pain (CHAIR 2015).

Other outcomes

Meta-analysis for the outcomes that were frequently reported but not identified as important to patients, or previously included are available as forest plots in Analysis 1.11 to Analysis 1.30 for any exercise training, Analysis 2.10 to Analysis 2.28 for aerobic training, Analysis 3.8 to Analysis 3.22 for resistance training, and Analysis 4.8 to Analysis 4.23 for combined aerobic and resistance training but will not be discussed further.

DISCUSSION

Summary of main results

This review of the evidence supporting exercise training for adults undergoing maintenance dialysis included 89 studies involving randomising 4291 participants; 77 studies involving 3846 participants contributed to the meta-analyses. The exercise programs, a complex intervention, were heterogeneous and varied in type, intensity, duration, frequency of sessions and timing in relation to dialysis treatments. Interventions within subtypes of exercises (aerobic, resistance or a combination of the two) were more comparable; however, the duration of the intervention remained highly variable. Only one study had long-term follow-up after the completion of the study.

A single study reported death but was not sufficiently powered to assess it and no study reported long-term cardiovascular events. Compared to no or sham exercise, any exercise for two to 12 months may reduce fatigue in adults undergoing maintenance dialysis. Importantly, compared to no or sham exercise, any exercise training for two to 12 months is likely to significantly improve depression in adults undergoing maintenance dialysis, particularly when the intervention is sustained for longer than four months. Compared to no or sham exercise, any exercise training for two to six months is also likely to substantially improve functional capacity which has been associated with survival in people receiving dialysis treatments (DeOreo 1997; Knight 2003). Furthermore, compared to no or sham exercise, any exercise training for three to 12 months may increase the physical component of HRQoL. Compared to no or sham exercise, any exercise training for three to 12 months may lead to lesser pain. However, the 95% CI indicated that exercise training might make little or no difference in the level of pain. It is uncertain whether exercise training improves the mental component of HRQoL or resting blood pressure because the certainty of this evidence is very low.

Comparisons of one type of exercise to another were limited by the number of studies reporting patients-important outcomes. We observed a differential effect of the type of exercise training on resting blood pressure, but the certainty of the evidence was very low.

Overall completeness and applicability of evidence

The current review is a comprehensive assessment of the effects of structured exercise training in adults undergoing maintenance dialysis. While it includes a vast number of studies covering aerobic, resistance and combined aerobic and resistance training, many uncertainties remain. Only seven studies included participants undergoing PD. We therefore cannot conclude on the impact of exercise training in this population. Secondly, the inclusion criteria were often stringent, excluding patients with extensive comorbidities. Furthermore, participants had to be able to perform some level of exercise from baseline, thereby excluding the frailest patients. The conclusions of the review therefore cannot be applied to the debilitated dialysis patient with a heavy burden of comorbidity, loss of autonomy, physical limitation, or cognitive decline.

Most exercise interventions were conducted during the dialysis treatments. While some patients might be fearful of exercising during dialysis, little is known about the effect and feasibility of home-based exercise training for this population.

The interventions were overall of short duration, with only 10 interventions lasting longer than six months. We may have observed effects of greater magnitude where the interventions were more sustained.

Patients-important outcomes were under-represented, with many studies focusing on biomarkers and measures of exercise capacity. A single study reported long-term outcomes and death but was insufficiently powered to do so. The long-term impacts of exercise training in adults undergoing dialysis, therefore, remain unknown at this point.

Finally, the second objective of the review, which is to inform the design of exercise interventions that maximise the benefits for adults undergoing dialysis, could not be achieved due to the low number of studies reporting patient-important outcomes. A network meta-analysis, including the studies that compared one exercise intervention to another without necessarily including a no or sham exercise control group, would better address this aim.

Quality of the evidence

In general, the quality of evidence was low to very low due to the high risk of bias, the short duration of the interventions and follow-up and the low number of participants in the included studies.

Regarding the internal validity of the included studies, a majority did not report the methods of randomisation and concealment of the allocation. Blinding of participants was generally not feasible in this review due to the nature of the intervention, and only four studies attempted to blind the participants using a sham intervention. Outcome assessors were also rarely blinded to treatment allocation, and a majority of the studies were at high or unclear risk of attrition bias. Overall, the quality of the included studies was low, and the certainty of the evidence for all the outcomes was downgraded by one level for the high risk of bias in the included studies.

The interventions were of short duration with more than half lasting three months or less. The reason behind the overall short duration of the interventions and the lack of long-term outcomes may be the complexity of the intervention, a lack of adherence to the exercise intervention or costs. Furthermore, imprecision was a significant issue with most included studies relying on small convenience samples.

Potential biases in the review process

We searched the Cochrane Kidney and Transplant Specialised Register, which includes trial registries and hand-searched conference abstracts (grey literature). However, some studies may have been reported only in exercise science conference proceedings or in conference proceedings in languages other

than English and, therefore, missed by the Cochrane Kidney and Transplant Specialised Register. Despite our efforts to estimate means and SD from medians and ranges and impute missing SD, some studies still reported insufficient information for their results to be included in the meta-analyses, which could lead to biases in the pooled estimates of effect. Finally, while the lack of blinding is likely to affect subjective outcomes more substantially than objective outcomes, the definition of objective versus subjective outcome is subject to interpretation, which could affect the level of certainty of the evidence presented in this review.

Agreements and disagreements with other studies or reviews

We have identified 17 systematic reviews of exercise training interventions relating to adults undergoing dialysis published in the past five years (Barcellos 2015; Bessa 2015; Chan 2016; Chung 2017; Clarkson 2019; Ferrari 2020; Gomes 2018; Heiwe 2014; Huang 2019; Pu 2019; Qiu 2017; Salhab 2019; Scapini 2019; Sheng 2014; Song 2018; Young 2018; Zhao 2019). They included between nine and 59 studies. The considerably larger number of studies included in the current review was probably due to broader inclusions criteria and our search of the grey literature. One review reported on fatigue and, like us, found an improvement with exercise training (Zhao 2019). Eleven reviews reported on the physical component of HRQoL, of which 10 found improvement with exercise (Barcellos 2015; Chan 2016; Chung 2017; Gomes 2018; Heiwe 2014; Huang 2019; Pu 2019; Salhab 2019; Thompson 1996; Zhao 2019) and one observed no effect (Young 2018). Ten reviews reported on the mental component of HRQoL, of which six found it unchanged by exercise training (Chan 2016; Chung 2017; Gomes 2018; Pu 2019; Sheng 2014; Young 2018) and three found it improved (Huang 2019; Salhab 2019; Zhao 2019). All of the five reviews that reported depression as an outcome found it improved with exercise training (Barcellos 2015; Gomes 2018; Pu 2019; Song 2018; Zhao 2019). Of the 10 reviews that reported the 6MWT, all but one that was focusing solely on resistance training (Chan 2016) concluded that exercise improved walking capacity (Chung 2017; Clarkson 2019; Ferrari 2020; Gomes 2018; Heiwe 2014; Huang 2019; Pu 2019; Sheng 2014; Young 2018). Two of the three studies that reported on the Sit-To-Stand test also concluded to improvement with exercise (Chan 2016; Clarkson 2019; Sheng 2014). Eight studies reported resting blood pressure, of which four observed improved SBP and DBP with exercise (Ferrari 2020; Pu 2019; Scapini 2019; Sheng 2014) and four did not observe a significant effect (Heiwe 2014; Huang 2019; Qiu 2017; Young 2018). No reviews reported death, cardiovascular events, or pain.

AUTHORS' CONCLUSIONS

Implications for practice

- Exercise training of any type for two to 12 months is likely to improve depressive symptoms in adults undergoing dialysis. Low certainty evidence suggests that extending the intervention for more than four months may provide additional benefits. There is no data as to whether the effect of exercise training on depressive symptoms persist beyond the duration of the intervention.
- Exercise training of any type for two to 12 months may reduce fatigue and improve the physical component of QoL in adults undergoing maintenance dialysis.
- Exercise training of any type for three to 12 months may reduce pain in adults undergoing maintenance dialysis slightly. However, the 95% CI indicates that exercise training might make little or no difference in the level of pain.
- Exercise training of any type for two to six months may increase patient functional capacity.
- Existing studies of exercise training in adults undergoing dialysis were not designed to assess long-term outcomes such as death and cardiovascular events.
- The level of certainty is very low for the effect of exercise training on mortality, the mental component of HR-QoL and resting blood pressure.
- There is little to no information on the effect of exercise training for adults undergoing PD.
- There is little to no information regarding the sustained effects of exercise training beyond the duration of the exercise program.
- Adverse effects of exercise training in adults undergoing dialysis are rarely reported and poorly defined. The evidence for the safety of exercise training in this population is therefore very uncertain.

Implications for research

- Studies of exercise training for adults undergoing dialysis should prioritise outcomes that are important to patients, their caregivers and health professionals, including death, cardiovascular events, fatigue, and pain.
- Long-term studies with extended follow-up periods are needed to assess critical outcomes, including death and cardiovascular disease, and to assess the persistence of the effect beyond the intervention. For long-term studies of an exercise intervention to be successful, strategies to enhance adherence to the interventions should be sought.
- Studies of exercise training for adults undergoing dialysis should put measures in place to minimise the effects of the lack of blinding in the participants, particularly for patient-reported outcomes.
- Studies should avoid convenience sampling and guide their recruitment on sample size and power calculations based on an estimate of a clinically relevant effect.
- Dialysis patients that are frail or with a heavy burden of comorbidities are an important subpopulation for which dedicated studies of exercise intervention should be considered.
- Studies of exercise training for adults undergoing dialysis must thoroughly assess and report adverse effects related to the intervention.

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* Indicates the major publication for the study

CHARACTERISTICS OF STUDIES

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

Abreu 2017

Study characteristics	
Methods	• Study design: parallel RCT • Study duration: not reported • Study follow-up period: 12 weeks
Participants	• Country: Brazil • Setting: HD unit • Inclusion criteria: > 18 years; without motor skill disorders; AV fistula for vascular access in the upper limb and who have been on maintenance dialysis for at least 6 months • Number: exercise group (32); control group (29) • Mean age ± SD: 46.4 ± 14.6 years • Sex (M/F): 36/25 • Exclusion criteria: patients with autoimmune diseases, cancer, infectious diseases, acquired immunodeficiency syndrome, uncontrolled hypertension, unstable angina, malignant arrhythmias, pregnancies, lower limb amputations; history of stroke; neurological or cardiovascular disease; under catabolizing drugs; regularly exercises; smokers; complied with < 75% of the training
Interventions	Duration of intervention • 12 weeks Exercise group • Type: resistance • Description: lower limbs exercises • Position: seated • Material: ankle weights and resistance bands • Location: HD unit • Duration of training sessions: 30 minutes • Duration of warm-up/cool-down: not reported • Frequency: 3 times/week • Timing in relation to dialysis treatments: during • Intensity: 60% of 1RM • Supervised by: physiotherapist • Mode of delivery: face-to-face • Tailoring: not reported • Modifications/progression: not reported

Abreu 2017 *(Continued)*

- Strategies to enhance adherence: not reported
- Adherence to intervention: not reported
- Co-intervention: none

Control group

- Usual care

Outcomes	• BMI • Waist circumference • Albumin • HCT (%) • Hb (g/dL) • Calcium (mg/dL) • Phosphorus (mg/dL) • Potassium (mg/dL) • hs-CRP (mg/dL) • GPx (nmol/min/mL) • NF-κB expression • Nitrite (μM) • Nrf2 expression • SCr (mg/dL) • Carbohydrates • Energy intake • Energy intake • Lipids intake • Protein (g/kg/day) • Arm muscular area • Body pain • QoL (SF-36)
Notes	Funding: • Coordenação de Aperfeiçoamento de Pessoal de Nível Superior (CAPES) • Fundação de Amparo à Pesquisa do Estado do Rio de Janeiro (FAPERJ) • Conselho Nacional de Desenvolvimento Científico e Tecnológico (CNPq)

Risk of bias

Bias	Authors' judgement	Support for judgement
Random sequence generation (selection bias)	Unclear risk	Insufficient information to permit judgement
Allocation concealment (selection bias)	Unclear risk	Insufficient information to permit judgement
Blinding of participants and personnel (performance bias) All outcomes	High risk	No blinding
Blinding of outcome assessment (detection bias) Objective outcomes	Low risk	No blinding of outcome assessment (or not reported), but the outcome measurement is not likely to be influenced by lack of blinding

Abreu 2017 *(Continued)*

Blinding of outcome assessment (detection bias) Subjective outcomes	High risk	No blinding of outcome assessment, and the outcome measurement is likely to be influenced by lack of blinding
Incomplete outcome data (attrition bias) All outcomes	High risk	Plausible effect size among missing outcomes enough to induce clinically relevant bias in observed effect size
Selective reporting (reporting bias)	Low risk	Pre-specified outcomes (of interest to this review) were reported
Other bias	Low risk	The study appears to be free of other sources of bias

Abundis Mora 2017

Study characteristics	
Methods	• Study design: parallel RCT • Study duration: 8 months • Study follow-up period: 35 weeks
Participants	• Country: Mexico • Setting: HD unit • Inclusion criteria: prevalent HD patients ≥ 18 years • Number: exercise group (14); control group (14) • Age: average age 41 years • Sex: 64% males • Exclusion criteria: amputation of lower limbs; motor sequelae of cerebral vascular event; vascular accesses in the lower extremities
Interventions	Duration of intervention • 35 weeks Exercise group • Type: aerobic • Description: stationary cycling • Position: not reported • Material: ergometer • Location: HD unit • Duration of training sessions: 135 min/week minutes • Duration of warm-up/cool-down: not reported • Frequency: not reported • Timing in relation to dialysis treatments: during • Intensity: moderate (scale not reported) • Supervised by: not reported • Mode of delivery: not reported • Tailoring: not reported • Modifications/progression: not reported • Strategies to enhance adherence: not reported • Adherence to intervention: not reported • Co-intervention: none

Abundis Mora 2017 *(Continued)*

	Control group • Usual care
Outcomes	• ECG parameters
Notes	• Abstract-only publication: author contacted for full results

Risk of bias

Bias	Authors' judgement	Support for judgement
Random sequence generation (selection bias)	Unclear risk	Insufficient information to permit judgement
Allocation concealment (selection bias)	Unclear risk	Insufficient information to permit judgement
Blinding of participants and personnel (performance bias) All outcomes	High risk	No blinding
Blinding of outcome assessment (detection bias) Objective outcomes	Unclear risk	Insufficient information to permit judgement
Blinding of outcome assessment (detection bias) Subjective outcomes	Low risk	No patient-reported outcome
Incomplete outcome data (attrition bias) All outcomes	Unclear risk	Insufficient information to permit judgement
Selective reporting (reporting bias)	Unclear risk	Insufficient information to permit judgement
Other bias	Unclear risk	Insufficient information to permit judgement

ACTINUT 2013

Study characteristics

Methods	• Study design: parallel RCT • Study duration: not reported • Study follow-up period: 24 weeks
Participants	• Country: France • Setting: 2 outpatient HD units • Inclusion criteria: adults aged > 18 years; minimum HD vintage of 3 months and stable; no recent hospitalizations; no acute or chronic medical conditions that would make exercise training potentially hazardous or primary outcomes impossible to assess. Patients who meet the following criteria for PEW, meeting at least 3 of the 4 listed categories and at least 1 test in each of the selected categories: o Serum chemistry criteria: serum albumin level < 38 g/L, or serum prealbumin < 300 mg/L

ACTINUT 2013 *(Continued)*

- Body mass criteria: BMI < 23 kg/m², or unintentional weigh loss > 5% over 3 months or > 10% over 6 months
- Muscle mass criteria: lean body mass estimated by bioimpedance spectroscopy lower than the 10th percentile of an age-matched normal population. This method is validated in dialysis patients
- Dietary intake criteria: unintentional low dietary protein intake < 1 g/kg of ideal weight/day for at least 2 months, unintentional low dietary energy intake < 30 kcal/kg of ideal weight/day for at least 2 months
- Informed consent of the patient

- Number: exercise group (10); control group (11)
- Mean age ± SD (years): exercise group (68.5 ± 14.0); control group (70.8 ± 15.2)
- Sex (M/F): total (12/9)
- Exclusion criteria: contraindication or inability to perform the physical exercise; inadequate dialysis Kt/V < 1.2; presence of a cardiac pacemaker (incompatible with the BCM measures); systemic inflammation CRP > 20 mg/L; pregnancy; patient under guardianship; participation in another clinical interventional trial; unstable on dialysis

Interventions	Duration of intervention • 24 weeks Exercise group • Type: aerobic • Description: stationary cycling • Position: recumbent • Material: ergometer • Location: HD unit • Duration of training sessions: 30 minutes • Duration of warm-up/cool-down: 5 minutes/not reported • Frequency: 3 times/week • Timing in relation to dialysis treatments: during • Intensity: 3 on RPE (1 to 10) • Supervised by: nephrologists, nurses, specialist in adapted physical activities • Mode of delivery: face-to-face • Tailoring: individualised intensity • Modifications/progression: 5 minutes added monthly adding to 30 minutes • Strategies to enhance adherence: follow-up monthly • Adherence to intervention (mean ± SD of attended sessions): 88% ± 17% • Co-intervention: dietary counselling Control group • Usual care + dietary counselling
Outcomes	• PEW remission • BMI • FTI • LTI • Bicarbonate • Albumin • Hb • Calcium • Phosphate • CRP • Compliance

ACTINUT 2013 *(Continued)*

- Energy intake
- Pre-albumin
- Normalised protein catabolic rate
- Protein intake
- 6MWT
- COP area
- Knee extension maximal strength
- QoL (SF-36)

Notes	Funding: • University Hospital of Nantes • ACTICLAN prize (Fresenius Kabi France) • Region of Pays de la Loire, France

Risk of bias

Bias	Authors' judgement	Support for judgement
Random sequence generation (selection bias)	Low risk	Computer random number generator
Allocation concealment (selection bias)	Low risk	Performed by an independent collaborator
Blinding of participants and personnel (performance bias) All outcomes	High risk	No blinding
Blinding of outcome assessment (detection bias) Objective outcomes	Low risk	No blinding of outcome assessment (or not reported), but the outcome measurement is not likely to be influenced by lack of blinding
Blinding of outcome assessment (detection bias) Subjective outcomes	High risk	No blinding of outcome assessment, and the outcome measurement is likely to be influenced by lack of blinding
Incomplete outcome data (attrition bias) All outcomes	Low risk	Missing outcome data balanced in numbers across intervention groups
Selective reporting (reporting bias)	Low risk	Pre-specified outcomes (of interest to this review) were reported
Other bias	Low risk	The study appears to be free of other sources of bias

Afshar 2010

Study characteristics

Methods	• Study design: parallel RCT (3 arms) • Study duration: not reported • Study follow-up period: 8 weeks

Afshar 2010 *(Continued)*

Participants	• Country: Iran • Setting: HD unit • Inclusion criteria: maintenance HD > 3 months; age > 20 years; good compliance with the dialysis treatment (not missing more than 2 dialysis sessions in the prior month); and absence of lower extremity dialysis graft • Number: resistance group (7); aerobic group (7); control group (7) • Mean age ± SD (years): resistance group (51.0 ± 16.4); aerobic group (50.7 ± 21.1) control group (53.0 ± 19.4) • Sex (M/F): not reported • Median HD vintage ± IQR (months): resistance group (24.9 ± 18.7); aerobic group (25.7 ± 7.61); control group (24.9 ± 15.4) • Exclusion criteria: presence of active infection or inflammation, autoimmunity disorders, and malignancy; presence of severe muscle weakness or interfering skeletal deformity; history of repeated episodes of hypoglycaemia; cardiopulmonary contraindications to resistance exercise such as MI within prior 6 months, active angina, and uncompensated congestive heart failure; hospitalisation during the prior month; cerebrovascular accidents within prior 6 months; and history of prior regular exercise training.
Interventions	Duration of intervention • 8 weeks Resistance exercise group • Type: resistance • Description: lower limbs exercises • Position: not reported • Material: ankle weights • Location: HD unit • Duration of training sessions: 10 to 30 minutes • Duration of warm-up/cool-down: 5/5 minutes • Frequency: 3 times/week • Timing in relation to dialysis treatments: during • Intensity: 15 to 17 on RPE (6 to 20) • Supervised by: physician • Mode of delivery: face-to-face • Tailoring: individualised load • Modifications/progression: increase in the number of repetitions and the weights • Strategies to enhance adherence: not reported • Adherence to intervention: not reported • Co-intervention: none Aerobic exercise group • Type: aerobic • Description: stationary cycling • Position: recumbent • Material: ergometer • Location: HD unit • Duration of training sessions: 10 to 30 minutes • Duration of warm-up/cool-down: 5/5 minutes • Frequency: 3 times/week • Timing in relation to dialysis treatments: during • Intensity: 12 to 16 on RPE (6 to 20) • Supervised by: not reported

Afshar 2010 *(Continued)*

	• Mode of delivery: not reported • Tailoring: individualised intensity • Modifications/progression: not reported • Strategies to enhance adherence: not reported • Adherence to intervention: not reported • Co-intervention: none Control group • Usual care
Outcomes	• Albumin • Hb • HDL • LDL • Total cholesterol • Triglyceride • CRP
Notes	• Funding: nil

Risk of bias

Bias	Authors' judgement	Support for judgement
Random sequence generation (selection bias)	Unclear risk	Insufficient information to permit judgement
Allocation concealment (selection bias)	Unclear risk	Insufficient information to permit judgement
Blinding of participants and personnel (performance bias) All outcomes	High risk	No blinding
Blinding of outcome assessment (detection bias) Objective outcomes	Low risk	No blinding of outcome assessment (or not reported), but the outcome measurement is not likely to be influenced by lack of blinding
Blinding of outcome assessment (detection bias) Subjective outcomes	Low risk	No patient-reported outcome
Incomplete outcome data (attrition bias) All outcomes	Unclear risk	Insufficient information to permit judgement
Selective reporting (reporting bias)	Low risk	Pre-specified outcomes (of interest to this review) were reported
Other bias	Unclear risk	Insufficient information to permit judgement

Afshar 2011

Study characteristics	
Methods	• Study design: parallel RCT • Study duration: not reported • Study follow-up period: 8 weeks
Participants	• Country: Iran • Setting: HD unit • Inclusion criteria: maintenance HD > 3 months; aged > 20 years; good compliance with dialysis treatment (not missing more than 2 dialysis sessions in the prior month) • Number: exercise group (14); control group (14) • Mean age ± SD (years): exercise group (50.7 ± 21.1); control group (53.0 ± 19.4) • Sex (M/F): men only • Median HD vintage ± IQR (months): exercise group (25.7 ± 7.6); control group (24.9 ± 15.4) • Mean BMI ± SD (kg/m^2): exercise group (22.7 ± 2.98); control group (22.3 ± 2.18) • Exclusion criteria: presence of active infection or inflammation; autoimmune disorders; malignancy; presence of psychiatric diseases; severe musculoskeletal disorders; poor controlled diabetes; uncontrolled heart failure or pulmonary diseases; hospitalisation during the prior month; using drugs that influence serum cytokines levels; vascular access in the lower extremity; BMI > 25 kg/m^2
Interventions	Duration or intervention • 8 weeks Exercise group • Type: aerobic • Description: stationary cycling • Position: recumbent • Material: ergometer • Location: HD unit • Duration of training sessions: 10 to 30 minutes • Duration of warm-up/cool-down: 5/5 minutes • Frequency: 3 times/week • Timing in relation to dialysis treatments: during • Intensity: 12 to 16 on RPE (6 to 20) • Supervised by: not reported • Mode of delivery: not reported • Tailoring: individualised intensity • Modifications/progression: not reported • Strategies to enhance adherence: not reported • Adherence to intervention: not reported • Co-intervention: none Control group • Usual care
Outcomes	• Leptin • CRP • Sleep quality score
Notes	• Funding: not reported
Risk of bias	

Afshar 2011 *(Continued)*

Bias	Authors' judgement	Support for judgement
Random sequence generation (selection bias)	Unclear risk	Insufficient information to permit judgement
Allocation concealment (selection bias)	Unclear risk	Insufficient information to permit judgement
Blinding of participants and personnel (performance bias) All outcomes	High risk	No blinding
Blinding of outcome assessment (detection bias) Objective outcomes	Low risk	No blinding of outcome assessment (or not reported), but the outcome measurement is not likely to be influenced by lack of blinding
Blinding of outcome assessment (detection bias) Subjective outcomes	High risk	No blinding of outcome assessment, and the outcome measurement is likely to be influenced by lack of blinding
Incomplete outcome data (attrition bias) All outcomes	Unclear risk	Insufficient information to permit judgement
Selective reporting (reporting bias)	Unclear risk	Insufficient information to permit judgement
Other bias	Unclear risk	Insufficient information to permit judgement

Akiba 1995

Study characteristics	
Methods	• Study design: parallel RCT • Study duration: not reported • Study follow-up period: 12 weeks
Participants	• Country: Japan • Setting: HD unit • Inclusion criteria: not reported • Number: exercise group (10); control group (10) • Mean age ± SD (years): exercise group (38.4 ± 9.5); control group (40.6 ± 10.8) • Sex (M/F): exercise group (2/8); control group (7/3) • Mean HD vintage ± SD (months): exercise group (73.8 ± 47.2); control group (68.3 ± 41.5) • Exclusion criteria: not reported
Interventions	Duration of intervention • 12 weeks Exercise group • Type: aerobic • Description: stationary cycling

Akiba 1995 *(Continued)*

- Position: not reported
- Material: ergometer
- Location: HD unit
- Duration of training sessions: 20 minutes
- Duration of warm-up/cool-down: 5/5 minutes
- Frequency: 3 times/week
- Timing in relation to dialysis treatments: during
- Intensity: 12 on RPE
- Supervised by: not reported
- Mode of delivery: not reported
- Tailoring: individualised intensity
- Modifications/progression: increase in the duration and then in the workload
- Strategies to enhance adherence: not reported
- Adherence to intervention: not reported
- Co-intervention: none

Control group

- Usual care

Outcomes	• Watt max • VO_2 max • HR max • Maximum lactate level • Hb
Notes	• Funding: not reported

Risk of bias

Bias	Authors' judgement	Support for judgement
Random sequence generation (selection bias)	Unclear risk	Insufficient information to permit judgement
Allocation concealment (selection bias)	Unclear risk	Insufficient information to permit judgement
Blinding of participants and personnel (performance bias) All outcomes	High risk	No blinding
Blinding of outcome assessment (detection bias) Objective outcomes	Low risk	No blinding of outcome assessment (or not reported), but the outcome measurement is not likely to be influenced by lack of blinding
Blinding of outcome assessment (detection bias) Subjective outcomes	Low risk	No patient-reported outcome
Incomplete outcome data (attrition bias) All outcomes	High risk	Plausible effect size among missing outcomes enough to induce clinically relevant bias in observed effect size

Akiba 1995 *(Continued)*

Selective reporting (reporting bias)	Unclear risk	Insufficient information to permit judgement
Other bias	Unclear risk	Insufficient information to permit judgement

Amini 2016

Study characteristics	
Methods	• Study design: parallel group RCT (3 arms*) • Study duration: not reported • Study follow-up period: 8 weeks
Participants	• Country: Iran • Setting: in-hospital HD unit • Inclusion criteria: signing the informed consent form to participate in the study; history of undergoing regular HD for at least 12 months • Number: exercise group (32); control group (35) • Mean age (years): aerobic group (54.3); control group (55.2) • Sex (M/F): exercise group (21/11); control group (21/14) • Exclusion criteria: not reported
Interventions	Duration of intervention • 8 weeks Exercise group • Type: aerobic • Description: not reported • Position: not reported • Material: not reported • Location: HD unit • Duration of training sessions: not reported • Duration of warm-up/cool-down: not reported • Frequency: not reported • Timing in relation to dialysis treatments: not reported • Intensity: not reported • Supervised by: researcher • Mode of delivery: face-to-face and then via recorded CDs • Tailoring: not reported • Modifications/progression: not reported • Strategies to enhance adherence: checklist, researcher available by phone, follow-up every 2 weeks in person or via phone • Adherence to intervention: not reported • Co-intervention: none Control group • Usual care
Outcomes	• Anxiety • Fatigue

Amini 2016 *(Continued)*

	• Sleep quality
Notes	• *PMR (progressive muscle relaxation) group was not analysed • Funding: not reported

Risk of bias

Bias	Authors' judgement	Support for judgement
Random sequence generation (selection bias)	Unclear risk	Insufficient information to permit judgement
Allocation concealment (selection bias)	Unclear risk	Insufficient information to permit judgement
Blinding of participants and personnel (performance bias) All outcomes	High risk	No blinding
Blinding of outcome assessment (detection bias) Objective outcomes	Low risk	No objective outcomes
Blinding of outcome assessment (detection bias) Subjective outcomes	High risk	Trial described as "double blind" but no description of how the intervention, exercise, was blinded. Due to the nature of the intervention, it is unlikely that the participants were blinded to group allocation.
Incomplete outcome data (attrition bias) All outcomes	Unclear risk	Insufficient information to permit judgement
Selective reporting (reporting bias)	Low risk	Pre-specified outcomes (of interest to this review) were reported
Other bias	Unclear risk	Insufficient information to permit judgement

AVANTE-HEMO 2020

Study characteristics

Methods	• Study design: parallel RCT (3 arms) • Study duration: not reported • Study follow-up period: 12 weeks
Participants	• Country: Mexico • Setting: HD unit • Inclusion criteria: regular HD 2 or 3 times/week; any sex; age > 18 years; no previous exercise • Number: aerobic group (15); resistance group (15); control group (15) • Mean age ± SD (years): aerobic group (32 ± 10); resistance group (30 ± 9); control group (27 ± 8) • Sex (M/F): aerobic group (7/8); resistance group (5/10); control group (9/6) • Median HD vintage (IQR) (months): aerobic group (24, 4 to 36); resistance group (19, 8 to 36); control group (28, 8 to 48) • Mean BMI ± SD (kg/m^2): aerobic group (19.7 ± 3.1); resistance group (21.5 ± 1.9); control group (19 ± 1.8)

AVANTE-HEMO 2020 *(Continued)*

	• Exclusion criteria: amputation; hospitalisation in the last 3 months; 1 HD session/week; severe effort angina (CC3) or stage 4 of the NYHA scale; pregnancy; severe dyspnoea; femoral fistula; arrhythmias; precordial pain; orthopaedic or neurological compromises or cognitive alterations affecting study participation; intolerance to oral nutritional supplement or intolerance/contraindications to the exercise routine according to the nephrologist and cardiologist evaluation
Interventions	Duration of interventions • 12 weeks Aerobic exercise group • Type: aerobic • Description: stationary cycling • Position: not reported • Material: ergometer • Location: HD unit • Duration of training sessions: 20 to 30 minutes • Duration of warm-up/cool-down: not reported • Frequency: 3 times/week • Timing in relation to dialysis treatments: during • Intensity: 12 to 13 on RPE (6 to 20) • Supervised by: not reported • Mode of delivery: not reported • Tailoring: individualised intensity • Modifications/progression: increase in duration • Strategies to enhance adherence: not reported • Adherence to intervention: not reported • Co-intervention: Diet plan and nutritional supplement Resistance exercise group • Type: resistance • Description: upper and lower limbs exercises • Position: not reported • Material: resistance bands • Location: HD unit • Duration of training sessions: 40 minutes • Duration of warm-up/cool-down: not reported • Frequency: 3 times/week • Timing in relation to dialysis treatments: during • Intensity: 12 to 13 on RPE (6 to 20) • Supervised by: not reported • Mode of delivery: not reported • Tailoring: individualised intensity • Modifications/progression: increase in frequency, intensity, type and time • Strategies to enhance adherence: not reported • Adherence to intervention: not reported • Co-intervention: Diet plan and nutritional supplement Control group • Diet plan and nutritional supplement
Outcomes	• Time up and go (sec) • 6MWT

AVANTE-HEMO 2020 *(Continued)*

- Handgrip
- Sit-to-stand test
- Weight (kg)
- BMI (kg/m^2)
- Midarm circumference (cm)
- Arm muscle circumference (mm)
- Arm muscle area (cm^2)
- Fat mass (%)
- Triceps skinfold thickness (mm)
- Physical activity
- Hb (g/dL)
- Total lymphocytes
- SCr (mg/dL)
- Albumin (g/dL)
- Phosphorus (mg/dL)
- Potassium (mmol/L)
- CRP (mg/L)
- HRQoL

Notes	• Funding: National Kidney Foundation

Risk of bias

Bias	Authors' judgement	Support for judgement
Random sequence generation (selection bias)	Low risk	Computer random number generator
Allocation concealment (selection bias)	Unclear risk	Insufficient information to permit judgement
Blinding of participants and personnel (performance bias) All outcomes	High risk	No blinding
Blinding of outcome assessment (detection bias) Objective outcomes	Low risk	No blinding of outcome assessment (or not reported), but the outcome measurement is not likely to be influenced by lack of blinding
Blinding of outcome assessment (detection bias) Subjective outcomes	High risk	No blinding of outcome assessment, and the outcome measurement is likely to be influenced by lack of blinding
Incomplete outcome data (attrition bias) All outcomes	Low risk	Missing outcome data balanced in numbers across intervention groups
Selective reporting (reporting bias)	Low risk	Pre-specified outcomes (of interest to this review) were reported
Other bias	Low risk	The study appears to be free of other sources of bias

Bennett 2013

Study characteristics	
Methods	• Study design: cluster step-wedge RCT (3 arms) • Study duration: not reported • Study follow-up period: 48 weeks
Participants	• Country: Australia • Setting: community satellite HD clinics (15 sites; 5 clusters) • Inclusion criteria: ESKD receiving HD; aged ≥ 18 years; able to understand and speak English; on HD > 12 weeks • Number: group 1 (51); group 2 (61); group 3 (59) • Mean age ± SD (years): 68.1 ± 12.6 • Sex (M/F): 107/64 • Median HD vintage (IQR): 44 months (26.0 to 85.5) • Exclusion criteria: pregnancy; lower limb amputation; hospitalisation in the four weeks prior to study commencement; considered not suitable on medical grounds for the intervention
Interventions	Duration of intervention • 12 weeks • There were five clusters (clinics) in each of the 3 groups: the first group received 36 weeks of exercise training, the second group were followed for 12 weeks before receiving 24 weeks of exercise and the third group were followed for 24 weeks before receiving 12 weeks of exercise Exercise group • Type: resistance • Description: lower body exercises • Position: seated • Material: resistance bands and tubing • Location: HD unit • Duration of training sessions: varied minutes • Duration of warm-up/cool-down: not reported • Frequency: 3 times/week • Timing in relation to dialysis treatments: during • Intensity: not reported • Supervised by: exercise physiologist • Mode of delivery: face-to-face • Tailoring: individualised not further defined • Modifications/progression: increase in resistance of resistance bands • Strategies to enhance adherence: record cards reviewed weekly • Adherence to intervention: not reported • Co-intervention: none Control group • Usual care
Outcomes	• DBP • Falls and falls confidence • Dialysis exercise adequacy • Four-square step test • Time up and go • Sit-to-stand test • Community activity involvement

Bennett 2013 *(Continued)*

	• QoL
Notes	Funding: • Alfred Deakin Postdoctoral Fellowship Scheme, Deakin University • Centre for Nursing Research-Deakin University and Monash Health Partnership

Risk of bias

Bias	Authors' judgement	Support for judgement
Random sequence generation (selection bias)	Low risk	Computer random number generator
Allocation concealment (selection bias)	Low risk	Allocation concealed at the time of participant consent
Blinding of participants and personnel (performance bias) All outcomes	High risk	No blinding
Blinding of outcome assessment (detection bias) Objective outcomes	Low risk	Blinding of outcome assessment ensured, and unlikely that the blinding could have been broken
Blinding of outcome assessment (detection bias) Subjective outcomes	High risk	No blinding of outcome assessment, and the outcome measurement is likely to be influenced by lack of blinding
Incomplete outcome data (attrition bias) All outcomes	High risk	Plausible effect size among missing outcomes enough to induce clinically relevant bias in observed effect size
Selective reporting (reporting bias)	Low risk	Pre-specified outcomes (of interest to this review) were reported
Other bias	Low risk	The study appears to be free of other sources of bias

Burrows 2018

Study characteristics

Methods	• Study design: parallel RCT • Study duration: not reported • Study follow-up period: 24 weeks
Participants	• Country: USA • Setting: HD unit • Inclusion criteria: not reported • Number: exercise group (9); control group (not reported) • Mean age ± SD (years): not reported • Sex (M/F): not reported • Exclusion criteria: not reported

Burrows 2018 *(Continued)*

Interventions	Duration of intervention • 24 weeks Exercise group • Type: combined • Description: stationary cycling and total body resistance and balance exercises • Position: not reported • Material: ergometer, resistance bands • Location: HD unit and at home • Duration of training sessions: 15 to 30 intra-HD and 2 sessions at home of not reported duration minutes • Duration of warm-up/cool-down: not reported • Frequency: 5 times/week • Timing in relation to dialysis treatments: during • Intensity: moderate • Supervised by: not reported • Mode of delivery: not reported • Tailoring: individualised not further defined • Modifications/progression: progressive not further defined • Strategies to enhance adherence: not reported • Adherence to intervention: not reported • Co-intervention: volume control Control group • Volume control
Outcomes	• HRQoL (KDQOL)
Notes	• Abstract-only publication • Authors contacted for full results • Funding: not reported

Risk of bias

Bias	Authors' judgement	Support for judgement
Random sequence generation (selection bias)	Unclear risk	Insufficient information to permit judgement
Allocation concealment (selection bias)	Unclear risk	Insufficient information to permit judgement
Blinding of participants and personnel (performance bias) All outcomes	High risk	No blinding
Blinding of outcome assessment (detection bias) Objective outcomes	Unclear risk	Insufficient information to permit judgement
Blinding of outcome assessment (detection bias)	Unclear risk	No blinding of outcome assessment, and the outcome measurement is likely to be influenced by lack of blinding

Burrows 2018 *(Continued)*
Subjective outcomes

Incomplete outcome data (attrition bias) All outcomes	Unclear risk	Insufficient information to permit judgement
Selective reporting (reporting bias)	Unclear risk	Insufficient information to permit judgement
Other bias	Unclear risk	Insufficient information to permit judgement

Carmack 1995

Study characteristics	
Methods	• Study design: parallel RCT • Study duration: not reported • Study follow-up period: 14 weeks
Participants	• Country: USA • Setting: HD units • Inclusion criteria: not reported • Number: exercise group (23); control group (25) • Mean age (range): 44.09 years (20 to 72) • Sex (M/F): 29/19 • Mean HD vintage (range): 29.52 months (1 to 173) • Exclusion criteria: physical or mental impairment that precluded undergoing submaximal exercise tolerance tests and participating in an exercise programme; severe cardiac problems; leg vascular access; leg prosthesis
Interventions	Duration of intervention • 10 weeks Exercise group • Type: aerobic • Description: stationary cycling • Position: not reported • Material: ergometer • Location: HD unit • Duration of training sessions: 20 to 30 minutes • Duration of warm-up/cool-down: not reported • Frequency: 3 times/week • Timing in relation to dialysis treatments: during • Intensity: not reported • Supervised by: not reported • Mode of delivery: not reported • Tailoring: individualised not further defined • Modifications/progression: not reported • Strategies to enhance adherence: self-monitoring using report cards and letters to family members • Adherence to intervention: not reported • Co-intervention: none

Carmack 1995 *(Continued)*

	Control group • Not reported
Outcomes	• VO_2 peak • Depression • Stress appraisal measures • Anxiety • Frequency of physical complaints and symptoms
Notes	• Funding: not reported

Risk of bias

Bias	Authors' judgement	Support for judgement
Random sequence generation (selection bias)	Unclear risk	Insufficient information to permit judgement
Allocation concealment (selection bias)	Unclear risk	Insufficient information to permit judgement
Blinding of participants and personnel (performance bias) All outcomes	High risk	No blinding
Blinding of outcome assessment (detection bias) Objective outcomes	Low risk	No blinding of outcome assessment (or not reported), but the outcome measurement is not likely to be influenced by lack of blinding
Blinding of outcome assessment (detection bias) Subjective outcomes	High risk	No blinding of outcome assessment, and the outcome measurement is likely to be influenced by lack of blinding
Incomplete outcome data (attrition bias) All outcomes	High risk	Insufficient information to permit judgement
Selective reporting (reporting bias)	Low risk	Pre-specified outcomes (of interest to this review) were reported
Other bias	Unclear risk	Insufficient information to permit judgement

CHAIR 2015

Study characteristics

Methods	• Study design: parallel RCT • Study duration: not reported • Study follow-up period: 12 weeks
Participants	• Country: Japan • Setting: outpatient dialysis • Inclusion criteria: patients treated with HD; ≥ 60 years; ambulatory

CHAIR 2015 *(Continued)*

- Number: exercise group (12); control group (15)
- Median age, range (years): exercise group (69, 61 to 78); control group (69, 64 to 79)
- Sex (M/F): exercise group (8/4); control group (11/4)
- Median HD vintage, range) (years): exercise group (14, 6 to 22); control group (15, 6 to 79)
- Exclusion criteria: symptomatic ischaemic heart disease; symptomatic peripheral artery disease; arthritis; history of stroke with severe paralysis; chronic obstructive pulmonary disease; pregnancy; patient was judged as inappropriate for the study by the attending physician

Interventions	Duration of intervention • 12 weeks Exercise group • Type: aerobic • Description: chair-stand exercise • Position: seated-standing • Material: chair • Location: HD unit • Duration of training sessions: 15 minutes • Duration of warm-up/cool-down: not reported • Frequency: 3 times/week • Timing in relation to dialysis treatments: just before • Intensity: not reported • Supervised by: physician and physical therapist • Mode of delivery: face-to-face • Tailoring: individualised duration • Modifications/progression: not reported • Strategies to enhance adherence: not reported • Adherence to intervention: not reported • Co-intervention: none Control group • Passive stretch exercise with assistance by a physical therapist
Outcomes	• Serum albumin • Hb • Mini-Mental • 6MWT • Isometric knee extensor strength • FIM • QoL
Notes	• Funding: nil

Risk of bias

Bias	Authors' judgement	Support for judgement
Random sequence generation (selection bias)	Low risk	Use of an external randomisation centre
Allocation concealment (selection bias)	Low risk	Central randomisation

CHAIR 2015 *(Continued)*

Blinding of participants and personnel (performance bias) All outcomes	High risk	No blinding
Blinding of outcome assessment (detection bias) Objective outcomes	Low risk	No blinding of outcome assessment (or not reported), but the outcome measurement is not likely to be influenced by lack of blinding
Blinding of outcome assessment (detection bias) Subjective outcomes	High risk	No blinding of outcome assessment, and the outcome measurement is likely to be influenced by lack of blinding
Incomplete outcome data (attrition bias) All outcomes	High risk	Plausible effect size among missing outcomes enough to induce clinically relevant bias in observed effect size
Selective reporting (reporting bias)	Low risk	Pre-specified outcomes (of interest to this review) were reported
Other bias	Unclear risk	Insufficient information to permit judgement

Chang 2010

Study characteristics	
Methods	• Study design: quasi-RCT • Study duration: not reported • Study follow-up period: 8 weeks
Participants	• Country: Taiwan • Setting: HD units • Inclusion criteria: ≥ 18 years; given their consent to participate in the study; on maintenance dialysis for at least 3 months • Number: exercise group (36); control group (37) • Mean age ± SD (years): exercise group (50.8 ± 10.7); control group (52.0 ± 8.7) • Sex (M/F): exercise group (26/10); control group (24/11) • Mean BMI ± SD (kg/m^2): exercise group (22.3 ± 3.2); control group (22.0 ± 3.1) • Mean HD vintage ± SD (months): exercise group (77.2 ± 46.9); control group (84.5 ± 49.9) • Exclusion criteria: not reported
Interventions	Duration of intervention • 8 weeks Exercise group • Type: aerobic • Description: stationary cycling • Position: recumbent • Material: ergometer • Location: HD unit • Duration of training sessions: 10 to 30 minutes • Duration of warm-up/cool-down: 5/not reported minutes

Chang 2010 *(Continued)*

	• Frequency: 3 times/week • Timing in relation to dialysis treatments: during • Intensity: 12 to 13 on RPE (6 to 20) • Supervised by: not reported • Mode of delivery: not reported • Tailoring: individualised intensity • Modifications/progression: increase in time over the first 3 sessions • Strategies to enhance adherence: not reported • Adherence to intervention: not reported • Co-intervention: none Control group • Usual care
Outcomes	• IL-18 (pg/mL) • IL-6 (pg/mL) • QoL • Depression severity (BDI)
Notes	• Funding: Taipei Medical University and Shin Kong Memorial Hospital fund

Risk of bias

Bias	Authors' judgement	Support for judgement
Random sequence generation (selection bias)	Unclear risk	Insufficient information to permit judgement
Allocation concealment (selection bias)	Unclear risk	Insufficient information to permit judgement
Blinding of participants and personnel (performance bias) All outcomes	High risk	No blinding
Blinding of outcome assessment (detection bias) Objective outcomes	Low risk	No objective outcomes
Blinding of outcome assessment (detection bias) Subjective outcomes	High risk	No blinding of outcome assessment, and the outcome measurement is likely to be influenced by lack of blinding
Incomplete outcome data (attrition bias) All outcomes	Low risk	Missing outcome data balanced in numbers across intervention groups, with similar reasons for missing data across groups
Selective reporting (reporting bias)	Low risk	Pre-specified outcomes (of interest to this review) were reported
Other bias	Low risk	The study appears to be free of other sources of bias

Chen 2010

Study characteristics	
Methods	• Study design: parallel RCT • Study duration: 31 months • Study follow-up period: 26 weeks
Participants	• Country: USA • Setting: HD units • Inclusion criteria: ≥ 30 years; serum albumin < 4.2 g/dL; HD 3 times/week for at least 3 months with ≥ 80% compliance • Number: exercise group (25); control group (25) • Mean age ± SD (years): exercise group (71.1 ± 12.6); control group (66.9 ± 13.4) • Sex (M/F): exercise group (12/10); control group (11/11) • Mean HD vintage ± SD (years): exercise group (2.6 ± 2.6); control group (4.8 ± 5.2) • Mean BMI ± SD (kg/m^2): exercise group (25.7 ± 7.1); control group (27.7 ± 7.8) • Exclusion criteria: unstable cardiovascular disease or any uncontrolled chronic condition; cardiac surgery; retina laser therapy; MI; joint replacement or lower extremity fracture within the last 6 months; severe cognitive impairment; lower extremity amputation; or current strength training
Interventions	Duration of intervention • 26 weeks Exercise group • Type: resistance • Description: lower body exercises • Position: seated and semi-recumbent • Material: ankle weights • Location: HD unit • Duration of training sessions: not reported • Duration of warm-up/cool-down: 5 to 10/5 minutes • Frequency: 2 times/week • Timing in relation to dialysis treatments: during • Intensity: moderate (6) on modified OMNI scale • Supervised by: supervised not further defined • Mode of delivery: not reported • Tailoring: start with very low weights and increased according to individual capacity • Modifications/progression: increase in ankle weights ad 20lbs • Strategies to enhance adherence: not reported • Adherence to intervention: mean (SD) of % of adherence to prescription 81% (15%) • Co-intervention: none Control group • Stretching exercises with light resistance bands
Outcomes	• Muscular strength • Physical performance • Whole-body lean mass • Whole-body fat mass • Leisure-time physical activity • HRQoL • Adherence to exercise

Chen 2010 *(Continued)*

Notes	Funding • National Institute of Diabetes and Digestive and Kidney (NIDDK) • USDA • NIH General Clinical Research Center • William B. Schwartz Nephrology Fund at Tufts Medical Center

Risk of bias

Bias	Authors' judgement	Support for judgement
Random sequence generation (selection bias)	Unclear risk	Insufficient information to permit judgement
Allocation concealment (selection bias)	Unclear risk	Insufficient information to permit judgement
Blinding of participants and personnel (performance bias) All outcomes	Low risk	Sham exercise in the control arm
Blinding of outcome assessment (detection bias) Objective outcomes	Low risk	No blinding of outcome assessment (or not reported), but the outcome measurement is not likely to be influenced by lack of blinding
Blinding of outcome assessment (detection bias) Subjective outcomes	Low risk	Sham exercise in the control arm
Incomplete outcome data (attrition bias) All outcomes	Unclear risk	Insufficient information to permit judgement
Selective reporting (reporting bias)	Low risk	Pre-specified outcomes (of interest to this review) were reported
Other bias	Unclear risk	Insufficient information to permit judgement

Cho 2018

Study characteristics

Methods	• Study design: parallel RCT (4 arms) • Study duration: not reported • Study follow-up period: 12 weeks
Participants	• Country: South Korea • Setting: HD unit • Inclusion criteria: age ≥ 20 years; HD vintage ≥ 6 months; HD treatment 3 times/week; no hospitalisations during the previous 3 months, except for vascular access repair; no amputations or prostheses in upper and lower extremities; cognitive capacity sufficient for communication, able to ambulate and wear the physical activity monitor for 7 days; good compliance with the study protocol • Number: aerobic group (15); resistance group (14); combination group (15); control group (13)

Cho 2018 *(Continued)*

- Mean age ± SD (years): aerobic group (55.2 ± 11.9); resistance group (52.9 ± 8.8); combination group (50.0 ± 14.3); control group (59.4 ± 10.8)
- Sex (M/F): aerobic group (2/9); resistance group (6/4); combination group (8/4); control group (7/6)
- Mean BMI ± SD (kg/m^2): aerobic group (26.0 ± 1.4); resistance group (22.8 ± 1.2); combination group (23.5 ± 0.8); control group (25.4 ± 1.3)
- Mean HD vintage ± SD (months): aerobic group (54.8 ± 96.4); resistance group (47.6 ± 79.2); combination group (87.8 ± 70.5); control group (61.4 ± 36.5)
- Exclusion criteria: any acute infectious or other inflammatory illnesses; current malignancy except basal cell carcinoma; acute MI or unstable angina within the past 12 months; current heart or lung failure or severe liver disease; severe uncontrolled diabetes; severe retinal diseases, such as proliferative diabetic retinopathy and vitreous haemorrhage; and orthopaedic disorders exacerbated by activity

Interventions

Duration of intervention

- 12 weeks

Aerobic exercise group

- Type: aerobic
- Description: stationary cycling
- Position: recumbent
- Material: ergometer
- Location: HD unit
- Duration of training sessions: 30 minutes
- Duration of warm-up/cool-down: not reported
- Frequency: 3 times/week
- Timing in relation to dialysis treatments: during
- Intensity: not reported
- Supervised by: not reported
- Mode of delivery: not reported
- Tailoring: individualised intensity
- Modifications/progression: training load adjusted to performance
- Strategies to enhance adherence: not reported
- Adherence to intervention: not reported
- Co-intervention: none

Resistance exercise group

- Type: resistance
- Description: upper and lower limbs exercise with resistance bands
- Position: seated or supine
- Material: resistance bands and soft weights
- Location: HD unit
- Duration of training sessions: not reported
- Duration of warm-up/cool-down: not reported
- Frequency: 3 times/week
- Timing in relation to dialysis treatments: during
- Intensity: not reported
- Supervised by: not reported
- Mode of delivery: not reported
- Tailoring: "progression tailored to performance"
- Modifications/progression: increased resistance of the resistance bands
- Strategies to enhance adherence: not reported
- Adherence to intervention: not reported
- Co-intervention: none

Cho 2018 *(Continued)*

	Combination (aerobic and resistance) exercise group • Type: combined • Description: combination of aerobic and resistance exercise • Position: seated or supine • Material: ergometer, resistance bands and soft weights • Location: HD unit • Duration of training sessions: not reported • Duration of warm-up/cool-down: not reported • Frequency: 3 times/week • Timing in relation to dialysis treatments: during • Intensity: not reported • Supervised by: not reported • Mode of delivery: not reported • Tailoring: combination of aerobic and resistance exercise • Modifications/progression: not reported • Strategies to enhance adherence: not reported • Adherence to intervention: not reported • Co-intervention: none Control group • Warm-up stretches
Outcomes	• Average total sleep time (min) • Average wake after sleep onset (min) • Average movement index (%) • Average fragmentation index (%) • Average sleep fragmentation index (%) • Average sleep efficiency (%) • Sit-to-stand test • 6MWT • LVEF • LVMI • Cardiac performance index
Notes	• Funding: not reported

Risk of bias

Bias	Authors' judgement	Support for judgement
Random sequence generation (selection bias)	Low risk	Bloc randomisation; assumed computer-generated
Allocation concealment (selection bias)	Low risk	Sealed envelopes
Blinding of participants and personnel (performance bias) All outcomes	High risk	No blinding
Blinding of outcome assessment (detection bias)	Low risk	No blinding of outcome assessment (or not reported), but the outcome measurement is not likely to be influenced by lack of blinding

Cho 2018 *(Continued)*

Objective outcomes		
Blinding of outcome assessment (detection bias) Subjective outcomes	Low risk	No patient-reported outcome
Incomplete outcome data (attrition bias) All outcomes	Low risk	Missing outcome data balanced in numbers across intervention groups
Selective reporting (reporting bias)	Low risk	Pre-specified outcomes (of interest to this review) were reported
Other bias	Unclear risk	Insufficient information to permit judgement

Cooke 2018

Study characteristics	
Methods	• Study design: parallel RCT • Study duration: not reported • Study follow-up period: 16 weeks
Participants	• Country: Canada • Setting: HD unit • Inclusion criteria: stage 5 CKD; stable in-centre HD regimen for ≥ 12 weeks prior to recruitment; recent cardiac evaluation (< 1 year) showing sufficient cardiac function to undergo the exercise program • Number: exercise group (15); control group (12) • Mean age ± SD (years): exercise group (58.2 ± 17.2); control group (52.5 ± 15.4) • Sex (M/F): exercise group (7/3); control group (7/3) • Mean BMI ± SD (kg/m^2): exercise group (25.6 ± 4.3); control group (27.2 ± 6.1) • Exclusion criteria: any physical or psychological disability that would impact study participation; iPTH > 250 pmol/L within 30 days prior; dysrhythmia or severe cardiac disease or peripheral arterial disease; severe hyperkalaemia (> 6.5 mmol/L) for the last 2 weeks; active cancer; postdialytic SBP ≥ 160 mm Hg or DBP ≥100 mm Hg within 4 weeks prior; anticipated living donor kidney transplant or other planned major surgery over the study duration
Interventions	Duration of intervention • 16 weeks Exercise group • Type: aerobic • Description: stationary cycling • Position: not reported • Material: ergometer • Location: HD unit • Duration of training sessions: to reach the intensity minutes • Duration of warm-up/cool-down: not reported • Frequency: 3 times/week • Timing in relation to dialysis treatments: during • Intensity: 12 to 16 on RPE (6 to 20) • Supervised by: not reported

Cooke 2018 *(Continued)*

	• Mode of delivery: not reported • Tailoring: individualised intensity • Modifications/progression: not reported • Strategies to enhance adherence: not reported • Adherence to intervention (median (IQR) of attended sessions): 60% (42% to 79%) • Co-intervention: none Control group • Usual care
Outcomes	• Adherence • BMI (kg/m^2) • Waist:hip ratio • Interdialytic weight gain (kg) • Gait speed (m/sec) • Grip strength (kg) • Peripheral SBP (mm Hg) • Peripheral DBP (mm Hg) • Central SBP (mm Hg) • Central DBP (mm Hg) • Central pulse pressure (mm Hg) • MAP (mm Hg) • Carotid-femoral pulse wave velocity (m/sec) • Augmentation index 75 (%) • HR (bpm)
Notes	• Funding: not reported

Risk of bias

Bias	Authors' judgement	Support for judgement
Random sequence generation (selection bias)	Low risk	Randomisation stratified by age and sex; assumed computer-generated
Allocation concealment (selection bias)	Unclear risk	Insufficient information to permit judgement
Blinding of participants and personnel (performance bias) All outcomes	High risk	No blinding
Blinding of outcome assessment (detection bias) Objective outcomes	Low risk	No blinding of outcome assessment (or not reported), but the outcome measurement is not likely to be influenced by lack of blinding
Blinding of outcome assessment (detection bias) Subjective outcomes	Low risk	No patient-reported outcome
Incomplete outcome data (attrition bias) All outcomes	Unclear risk	Insufficient information to permit judgement

Cooke 2018 *(Continued)*

Selective reporting (reporting bias)	Low risk	Pre-specified outcomes (of interest to this review) were reported
Other bias	Unclear risk	Insufficient information to permit judgement

CYCLE-HD 2016

Study characteristics	
Methods	• Study design: cluster parallel RCT • Study duration: not reported • Study follow-up period: 30 weeks
Participants	• Country: UK • Setting: HD units • Inclusion criteria: prevalent HD patient (> 3 months), aged ≥ 18 years; able and willing to give informed consent • Number: exercise group (65); control group (65) • Mean age ± SD (years): exercise group (55.5 ± 15.5); control group (58.9 ± 14.9) • Sex (M/F): exercise group (53/8); control group (42/23) • Mean HD vintage, range (years): exercise group (1.2, 0.5 to 3.7); control group (1.3, 0.4 to 3.2) • Exclusion criteria: unable to participate in current exercise programme due to perceived physical or psychological barriers; unable to undergo MRI scanning (metal implants, severe claustrophobia); unfit to undertake exercise according to the American College of Sports Medicine guidelines
Interventions	Duration of intervention • 26 weeks Exercise group • Type: aerobic • Description: stationary cycling • Position: not reported • Material: ergometer • Location: HD unit • Duration of training sessions: 30 minutes • Duration of warm-up/cool-down: not reported • Frequency: 3 times/week • Timing in relation to dialysis treatments: during • Intensity: 12 to 14 on RPE • Supervised by: not reported • Mode of delivery: not reported • Tailoring: individualised intensity • Modifications/progression: duration and resistance adjusted to progress training • Strategies to enhance adherence: regular visits • Adherence to intervention: not reported • Co-intervention: none Control group • Usual care

CYCLE-HD 2016 *(Continued)*

Outcomes	• DBP • Mean BP • SBP • Cardiac index • HR • Stroke volume index • Total peripheral resistance index • Length of stay • Adverse outcomes • Anxiety • Depression
Notes	• Abstract-only data • Authors contacted for full results • Funding: NIHR in the United Kingdom (grant reference number CS-2013-13-014; JOB) and supported by Kidney Research UK

Risk of bias

Bias	Authors' judgement	Support for judgement
Random sequence generation (selection bias)	Low risk	Block randomisation; assumed computer-generated
Allocation concealment (selection bias)	Low risk	Cluster trial, dialysis shifts were randomised. Participants were assigned to a shift before inclusion in the study
Blinding of participants and personnel (performance bias) All outcomes	High risk	No blinding
Blinding of outcome assessment (detection bias) Objective outcomes	Low risk	No blinding of outcome assessment (or not reported), but the outcome measurement is not likely to be influenced by lack of blinding
Blinding of outcome assessment (detection bias) Subjective outcomes	High risk	No blinding of outcome assessment, and the outcome measurement is likely to be influenced by lack of blinding
Incomplete outcome data (attrition bias) All outcomes	Unclear risk	Insufficient information to permit judgement
Selective reporting (reporting bias)	Unclear risk	Insufficient information to permit judgement
Other bias	Unclear risk	Insufficient information to permit judgement

Dashtidehkordi 2019

Study characteristics

Methods	• Study design: parallel RCT

Dashtidehkordi 2019 *(Continued)*

- Study duration: not reported
- Study follow-up period: 8 weeks

Participants	• Country: Iran • Setting: HD units • Inclusion criteria: aged between 18 and 65; history of at least 3 months of HD; no physical and mental disability, no known ischaemic heart disease; no MI and angina during the last 3 months; based on the patients' history, no acute pulmonary disease so that the patient needs oxygen therapy during dialysis; no history of stroke or transient ischaemic attacks over the past 3 months; no skeletal-muscle disorder that prevent the patient from exercising (pedalling the stationary bicycle); doing 3 sessions of 4-hour dialysis/week • Number: exercise group (30); control group (30) • Mean age (years): exercise group (51.2); control group (55.6) • Sex (M/F): exercise group (3/24); control group (3/22) • Mean HD vintage (years): exercise group (5.5); control group (4.5) • Exclusion criteria: unwillingness to continue participating in the study; the presence of any disorder, including cardiovascular, pulmonary and musculoskeletal disorders during the study which may prevent the patient from exercise; not doing the exercises for 3 consecutive sessions and 6 non-consecutive sessions
Interventions	Duration of intervention • 8 weeks Exercise group • Type: aerobic • Description: stationary cycling • Position: not reported • Material: ergometer • Location: HD unit • Duration of training sessions: 2 x 30 minutes • Duration of warm-up/cool-down: not reported • Frequency: 3 times/week • Timing in relation to dialysis treatments: during • Intensity: not reported • Supervised by: not reported • Mode of delivery: not reported • Tailoring: individualised intensity • Modifications/progression: not reported • Strategies to enhance adherence: not reported • Adherence to intervention: not reported • Co-intervention: none Control group • Stretching exercises
Outcomes	• Heath promoting behaviours
Notes	• Funding: nil

Risk of bias

Bias	Authors' judgement	Support for judgement

Dashtidehkordi 2019 *(Continued)*

Random sequence generation (selection bias)	Unclear risk	Insufficient information to permit judgement
Allocation concealment (selection bias)	Low risk	"closed packets"
Blinding of participants and personnel (performance bias) All outcomes	Unclear risk	Stretching program in the control group but did not specify whether the participants were blinded
Blinding of outcome assessment (detection bias) Objective outcomes	Low risk	No objective outcomes
Blinding of outcome assessment (detection bias) Subjective outcomes	High risk	No blinding of outcome assessment, and the outcome measurement is likely to be influenced by lack of blinding
Incomplete outcome data (attrition bias) All outcomes	Low risk	Missing outcome data balanced in numbers across intervention groups, with similar reasons for missing data across groups
Selective reporting (reporting bias)	Low risk	Pre-specified outcomes (of interest to this review) were reported
Other bias	Low risk	The study appears to be free of other sources of bias

Deligiannis 1999

Study characteristics	
Methods	• Study design: parallel RCT • Study duration: not reported • Study follow-up period: 26 weeks
Participants	• Country: Greece • Setting: not reported • Inclusion criteria: undergoing HD • Number: exercise group (30); control group (30) • Mean age ± SD (years): exercise group (48.0 ± 12.0); control group (48.0 ± 11.0) • Sex (M/F): exercise group (17/13); control group (15/15) • Mean HD vintage ± SD (years): exercise group (6.3 ± 3.0); control group (6.2 ± 3.6) • Exclusion criteria: documented MI during the previous 6 months; symptoms of angina or heart failure (NYHA class ≥ II); severe hypertension, DM, or any other disease that might interfere with autonomic regulation; sinus rhythm during a resting ECG; medication that might interfere with autonomic regulation (i.e. beta-blockers)
Interventions	Duration of intervention • 26 weeks Exercise group • Type: combined

Deligiannis 1999 *(Continued)*

- Description: bicycling and/or walking, callisthenics, steps, swimming, or ball games followed by a low-intensity resistance program
- Position: not reported
- Material: not reported
- Location: not reported
- Duration of training sessions: 70 minutes
- Duration of warm-up/cool-down: 10/10 minutes
- Frequency: 3 to 4 times/week
- Timing in relation to dialysis treatments: on non-HD days
- Intensity: 60% to 70% of max HR
- Supervised by: physician, exercise physiologist, and physical education instructor
- Mode of delivery: face-to-face
- Tailoring: individualised intensity
- Modifications/progression: adjusted every 15 days to maintain intensity
- Strategies to enhance adherence: not reported
- Adherence to intervention: not reported
- Co-intervention: none

Control group

- Usual care

Outcomes	• HCT (%) • Hb • Urea (mg%) • SCr (mg%) • Potassium (mEq/L) • Sodium (mEq/L) • Calcium (mEq/L) • Phosphate (mg%) • 24-hour mean HR • HR variability index • Mean RR interval (sec) • SDNN (sec) • Sum of beats • VO max • Lactic acid
Notes	• Funding: not reported

Risk of bias

Bias	Authors' judgement	Support for judgement
Random sequence generation (selection bias)	Unclear risk	Insufficient information to permit judgement
Allocation concealment (selection bias)	Unclear risk	Insufficient information to permit judgement
Blinding of participants and personnel (performance bias) All outcomes	High risk	No blinding

Deligiannis 1999 *(Continued)*

Blinding of outcome assessment (detection bias) Objective outcomes	Low risk	No blinding of outcome assessment (or not reported), but the outcome measurement is not likely to be influenced by lack of blinding
Blinding of outcome assessment (detection bias) Subjective outcomes	Low risk	No patient-reported outcome
Incomplete outcome data (attrition bias) All outcomes	Unclear risk	Insufficient information to permit judgement
Selective reporting (reporting bias)	Low risk	Pre-specified outcomes (of interest to this review) were reported
Other bias	Unclear risk	Insufficient information to permit judgement

Deligiannis 1999a

Study characteristics	
Methods	• Study design: parallel RCT (3 arms) • Study duration: not reported • Study follow-up period: 26 weeks
Participants	• Country: Greece • Setting: not reported • Inclusion criteria: undergoing HD treatments • Number: exercise group 1 (16); exercise group 2 (10); control group (12) • Mean age ± SD (years): exercise group 1 (46.4 ± 3.9); exercise group 2 (51.4 ± 12.5); control group (50.2 ± 7.9) • Sex (M/F): exercise group 1 (11/5); exercise group 2 (8/2); control group (4/8) • Mean HD vintage ± SD (months): exercise group 1 (78.0 ± 62.0); exercise group 2 (62.0 ± 37.0); control group (79.0 ± 86.0) • Exclusion criteria: unstable hypertension; congestive heart failure; cardiac arrhythmias (III according to Lown); recent MI or unstable angina; DM; active liver disease; serious anaemia; peripheral vascular disease
Interventions	Duration of intervention • 26 weeks Exercise group 1 • Type: combined • Description: stationary cycling, callisthenics, steps and flexibility exercises • Position: not reported • Material: ergometer or treadmill • Location: not reported • Duration of training sessions: 50 to 70 minutes • Duration of warm-up/cool-down: 10/10 minutes • Frequency: 3 times/week • Timing in relation to dialysis treatments: on non-HD days • Intensity: 50% to 70% of max HR

Deligiannis 1999a *(Continued)*

- Supervised by: physician and physical education teachers
- Mode of delivery: face-to-face
- Tailoring: individualised intensity
- Modifications/progression: Intensity adjusted
- Strategies to enhance adherence: not reported
- Adherence to intervention: not reported
- Co-intervention: none

Exercise group 2

- Type: aerobic
- Description: cycling on ergometer + simple flexibility and muscular extension exercises
- Position: not reported
- Material: ergometer
- Location: home
- Duration of training sessions: 30 minutes
- Duration of warm-up/cool-down: not reported
- Frequency: 5 times/week
- Timing in relation to dialysis treatments: not during
- Intensity: 50% to 60% of max HR
- Supervised by: physician and physical education teachers
- Mode of delivery: face-to-face
- Tailoring: individualised not further defined
- Modifications/progression: program modified to physical adaptation
- Strategies to enhance adherence: monthly follow-up at home
- Adherence to intervention: not reported
- Co-intervention: none

Control group

- Usual care

Outcomes

- HR (resting)
- SBP
- DBP
- Left ventricular internal dimension (diastole and systole)
- Intra-ventricular septal thickness
- Left ventricular posterior wall
- Left ventricular mass index
- HCT
- WBC
- Urea
- SCr
- Uric acid
- Glucose
- Potassium (mEq/L)
- Sodium (mEq/L)
- Calcium (mg%)
- Phosphorus (mg%)
- Fe (mg%)
- Exercise time
- Maximal metabolic equivalents
- HR peak at exercise

Deligiannis 1999a *(Continued)*

	• Maximum pulmonary ventilation • VO_2 max • Lactic acid
Notes	• Funding: not reported

Risk of bias

Bias	Authors' judgement	Support for judgement
Random sequence generation (selection bias)	Unclear risk	Insufficient information to permit judgement
Allocation concealment (selection bias)	Unclear risk	Insufficient information to permit judgement
Blinding of participants and personnel (performance bias) All outcomes	High risk	No blinding
Blinding of outcome assessment (detection bias) Objective outcomes	Low risk	No blinding of outcome assessment (or not reported), but the outcome measurement is not likely to be influenced by lack of blinding
Blinding of outcome assessment (detection bias) Subjective outcomes	Low risk	No patient-reported outcome
Incomplete outcome data (attrition bias) All outcomes	Unclear risk	Insufficient information to permit judgement
Selective reporting (reporting bias)	Low risk	Pre-specified outcomes (of interest to this review) were reported
Other bias	Unclear risk	Insufficient information to permit judgement

de Lima 2013

Study characteristics

Methods	• Study design: parallel RCT (3 arms) • Study duration: not reported • Study follow-up period: 8 weeks
Participants	• Country: Brazil • Setting: HD unit • Inclusion criteria: HD 3 times/week; aged 18 and 75 years; not practising any physical activity • Number: resistance group (11); aerobic group (11); control group (11) • Mean age ± SD (years): resistance group (49.6 ± 9.1); aerobic group (43.1 ± 13.3); control group (43.5 ± 11.1) • Sex (M/F): resistance group (7/4); aerobic group (7/4); control group (6/5) • Mean BMI ± SD (kg/m^2): resistance group (26.0 ± 5.1); aerobic group (23.0 ± 5.6); control group (27.4 ± 3.7)

de Lima 2013 *(Continued)*

- Mean HD vintage ± SD (years): resistance group (5.4 ± 4.0); aerobic group (6.4 ± 4.4); control group (6.5 ± 4.2)
- Exclusion criteria: uncontrolled arterial hypertension; ischaemic cardiopathy; amputation; deep vein thrombosis; excessive pallor; severe dyspnoea; femoral fistula; arrhythmias; precordial pain; orthopaedic or neurological compromising; cognitive alterations affecting participation in the proposed protocol

Interventions	Duration of intervention • 8 weeks Resistance exercise group • Type: resistance • Description: lower limbs exercises • Position: seated • Material: not reported • Location: HD unit • Duration of training sessions: not reported • Duration of warm-up/cool-down: not reported • Frequency: 3 times/week • Timing in relation to dialysis treatments: during • Intensity: not reported • Supervised by: not reported • Mode of delivery: not reported • Tailoring: individualised intensity • Modifications/progression: adjusted every 15 days to maintain intensity • Strategies to enhance adherence: not reported • Adherence to intervention: not reported • Co-intervention: none Aerobic exercise group • Type: aerobic • Description: stationary cycling • Position: seated • Material: ergometer • Location: HD unit • Duration of training sessions: 20 minutes • Duration of warm-up/cool-down: not reported • Frequency: 3 times/week • Timing in relation to dialysis treatments: during • Intensity: 2 to 3 on RPE • Supervised by: not reported • Mode of delivery: not reported • Tailoring: individualised intensity • Modifications/progression: not reported • Strategies to enhance adherence: not reported • Adherence to intervention: not reported • Co-intervention: none Control group • Usual care
Outcomes	• Prurit symptoms

de Lima 2013 *(Continued)*

	• Hb • Calcium • Phosphorus • Potassium • FEV1 • FVC • Maximal expiratory pressure • Maximal inspiratory pressure • Step test • QoL
Notes	• Funding: not reported

Risk of bias

Bias	Authors' judgement	Support for judgement
Random sequence generation (selection bias)	Low risk	Shuffling envelopes
Allocation concealment (selection bias)	Low risk	Quote: "envelops, without external marks"
Blinding of participants and personnel (performance bias) All outcomes	High risk	No blinding
Blinding of outcome assessment (detection bias) Objective outcomes	Low risk	No blinding of outcome assessment (or not reported), but the outcome measurement is not likely to be influenced by lack of blinding
Blinding of outcome assessment (detection bias) Subjective outcomes	Low risk	No patient-reported outcome
Incomplete outcome data (attrition bias) All outcomes	Low risk	Missing outcome data balanced in numbers across intervention groups, with similar reasons for missing data across groups
Selective reporting (reporting bias)	Low risk	Pre-specified outcomes (of interest to this review) were reported
Other bias	Unclear risk	Insufficient information to permit judgement

DePaul 2002

Study characteristics

Methods	• Study design: parallel RCT • Study duration: not reported • Study follow-up period: 12 weeks
Participants	• Country: Canada

DePaul 2002 *(Continued)*

- Setting: HD unit
- Inclusion criteria: on HD for > 3 months; administered EPO for the treatment of anaemia; Hb level > 9.0 g/dL; able to maintain sitting and standing balance without assistance; ambulatory without assistance
- Number: exercise group (20); control group (18)
- Mean age ± SD (years): exercise group (55 ± 16); control group (54 ± 14)
- Sex (M/F): exercise group (10/10); control group (13/14)
- Exclusion criteria: ischaemic heart disease; recent MI < 6 months; uncontrolled hypertension; pericardial or pleural friction rub; aortic stenosis; active musculoskeletal lower-extremity problem; history of vertebral fraction caused by osteoporosis; patients who participated in team sports or formally organized exercise programs

Interventions	Duration of intervention • 12 weeks Exercise group • Type: combined • Description: stationary cycling + lower limbs strength training • Position: seated • Material: ergometer and response seated leg curl thigh extension pulley weight system • Location: HD unit • Duration of training sessions: 20-varied minutes • Duration of warm-up/cool-down: 2 minutes/not reported • Frequency: 3 times/week • Timing in relation to dialysis treatments: during and just before or after • Intensity: somewhat strong on RPE • Supervised by: kinesiologist • Mode of delivery: face-to-face • Tailoring: individualised intensity and duration • Modifications/progression: intensity adjusted • Strategies to enhance adherence: not reported • Adherence to intervention: not reported • Co-intervention: none Control group • Progressive, no resistance, low-intensity, range-of-motion exercises
Outcomes	• Muscular strength • 6MWT (metres) • HRQoL • Dialysis symptoms (Laupacis KDQ)
Notes	Funding: • Father Sean O'Sullivan Research Centre, St Joseph's Healthcare, Hamilton • Ortho Biotech/Janssen-Ortho Inc, North York, Ontario, Canada

Risk of bias

Bias	Authors' judgement	Support for judgement
Random sequence generation (selection bias)	Low risk	Random numbers table

DePaul 2002 *(Continued)*

Allocation concealment (selection bias)	Unclear risk	Insufficient information to permit judgement
Blinding of participants and personnel (performance bias) All outcomes	Low risk	Sham exercise in the control arm
Blinding of outcome assessment (detection bias) Objective outcomes	Low risk	Blinding of outcome assessment ensured, and unlikely that the blinding could have been broken
Blinding of outcome assessment (detection bias) Subjective outcomes	Low risk	Sham exercise in the control arm
Incomplete outcome data (attrition bias) All outcomes	Low risk	Missing outcome data balanced in numbers across intervention groups
Selective reporting (reporting bias)	Low risk	Pre-specified outcomes (of interest to this review) were reported
Other bias	High risk	Private funding. Funder's involvement not specified

DIALY-SIZE 2016

Study characteristics	
Methods	• Study design: parallel RCT (4 arms) • Study duration: not reported • Study follow-up period: 12 weeks
Participants	• Country: Canada • Setting: HD unit • Inclusion criteria: adults aged ≥18 years; dialysis-dependent for ≥ 3 consecutive months; receiving ≥ 3 dialysis treatments/week; mobile (any distance, walking aid permitted); at least one non-prosthetic limb; capable of providing consent • Number: cycling group (8); weights group (7); combined group (8); control group (8) • Median age, IQR (years): cycling group (66.9, 55.8 to 82.4); weights group (59.7, 45.9 to 81.4); combined group (60.3, 54.7 to 68.4); control group (49.3, 43.0 to 62.3) • Sex (M/F): cycling group (8/0); weights group (6/1); combined group (3/5); control group (7/1) • Median HD vintage, IQR (years): cycling group (3.7, 2.4 to 4.6); weights group (2.8, 2.0 to 4.0); combined group (2.9, 0.7 to 2.3); control group (3.3, 1.2 to 6.2) • Median BMI, IQR (kg/m^2): cycling group (23.6, 22.2 to 25.7); weights group (25.9, 24.6 to 29.9); combined group (25.3, 20.0 to 30.8); control group (24.2, 20.4 to 33.8) • Exclusion criteria: currently enrolled in a clinical trial; missing an average of > 2 dialysis sessions/month; planned move or modality change within the next 4 months; currently enrolled in a structured exercise programme; scheduled hospitalisation for > 1 week; unstable during HD; any uncontrolled medical condition that would preclude participation in a low/moderate-intensity exercise program
Interventions	Duration of intervention • 12 weeks

DIALY-SIZE 2016 *(Continued)*

Aerobic exercise group

- Type: aerobic
- Description: stationary cycling
- Position: not reported
- Material: ergometer
- Location: HD unit
- Duration of training sessions: 15 to 43 minutes
- Duration of warm-up/cool-down: 5/5 minutes
- Frequency: 3 times/week
- Timing in relation to dialysis treatments: during
- Intensity: 12 to 14 on RPE
- Supervised by: kinesiologist
- Mode of delivery: face-to-face
- Tailoring: individualised intensity
- Modifications/progression: weekly increase in duration by 2.5 minutes
- Strategies to enhance adherence: not reported
- Adherence to intervention: 904 sessions completed over 1039 offered
- Co-intervention: none

Resistance exercise group

- Type: resistance
- Description: lower limbs exercises
- Position: not reported
- Material: ankle weights and resistance bands
- Location: HD unit
- Duration of training sessions: varied minutes
- Duration of warm-up/cool-down: not reported
- Frequency: 3 times/week
- Timing in relation to dialysis treatments: during
- Intensity: 12 to 14 on RPE
- Supervised by: kinesiologist
- Mode of delivery: face-to-face
- Tailoring: individualised intensity
- Modifications/progression: increase in weights or resistance to maintain intensity
- Strategies to enhance adherence: not reported
- Adherence to intervention: not reported
- Co-intervention: none

Combined aerobic and resistance exercise group:

- Type: combined
- Description: all aerobic and resistance exercise groups
- Position: not reported
- Material: aerobic + resistance
- Location: HD unit
- Duration of training sessions: varied minutes
- Duration of warm-up/cool-down: not reported
- Frequency: 3 times/week
- Timing in relation to dialysis treatments: during
- Intensity: 12 to 14 on RPE
- Supervised by: kinesiologist
- Mode of delivery: face-to-face

DIALY-SIZE 2016 *(Continued)*

	• Tailoring: individualised intensity • Modifications/progression: aerobic + resistance • Strategies to enhance adherence: not reported • Adherence to intervention: not reported • Co-intervention: none Control group • Stretching
Outcomes	• 6MWT • Physical performance • Strength (quadriceps) • Sit-to-stand test • QoL
Notes	Funding • University Hospital Foundation • Clinical Research Fellowship award from Alberta Innovates-Health Solutions

Risk of bias

Bias	**Authors' judgement**	**Support for judgement**
Random sequence generation (selection bias)	Low risk	Computer random number generator
Allocation concealment (selection bias)	Low risk	Serial numbered, opaque, sealed envelopes
Blinding of participants and personnel (performance bias) All outcomes	High risk	Participants were blinded to aim and hypothesis but intervention was not blinded
Blinding of outcome assessment (detection bias) Objective outcomes	Low risk	Blinding of outcome assessment ensured, and unlikely that the blinding could have been broken
Blinding of outcome assessment (detection bias) Subjective outcomes	High risk	Participants were blinded to aim and hypothesis. Lack of blinding on the intervention may still affect patient-reported outcomes.
Incomplete outcome data (attrition bias) All outcomes	Low risk	Missing outcome data balanced in numbers across intervention groups, with similar reasons for missing data across groups
Selective reporting (reporting bias)	Low risk	Pre-specified outcomes (of interest to this review) were reported
Other bias	Low risk	The study appears to be free of other sources of bias

Dobsak 2012

Study characteristics	
Methods	• Study design: parallel RCT (3 arms*) • Study duration: not reported • Study follow-up period: 20 weeks
Participants	• Country: Czech Republic • Setting: HD unit • Inclusion criteria: at least 12 months of regular HD; clinically stable; optimised pharmacological treatment unchanged for 1 month before the start of the study • Number: exercise group (11); control group (10) • Mean age ± SD (years): exercise group (58.4 ± 7.2); control group (60.1 ± 0.0) • Sex (M/F): exercise group (4/7); control group (4/6) • Mean BMI ± SD (kg/m^2): exercise group (28.6 ± 3.0); control group (26.9 ± 3.6) • Mean HD vintage ± SD (years): exercise group (4.1 ± 2.1); control group (4.1 ± 2.3) • Exclusion criteria: uncontrolled hypertension; venous thromboembolism; implanted cardiac pacemakers; unstable angina pectoris; heart failure; severe neurological diseases (epilepsy, multiple sclerosis, parkinsonism), severe orthopaedic complications (total hip or knee replacement); chronic bronchopulmonary disease; low urea clearance (Kt/V > 1.2)
Interventions	Duration of intervention • 20 weeks Exercise group • Type: aerobic • Description: stationary cycling • Position: not reported • Material: ergometer • Location: HD unit • Duration of training sessions: 20 to 40 minutes • Duration of warm-up/cool-down: 5/5 minutes • Frequency: 3 times/week • Timing in relation to dialysis treatments: during • Intensity: 30% to 60% of peak power • Supervised by: not reported • Mode of delivery: not reported • Tailoring: individualised intensity • Modifications/progression: increased duration at 5 weeks to 40 minutes • Strategies to enhance adherence: not reported • Adherence to intervention: not reported • Co-intervention: none Control group • Usual care
Outcomes	• Walking test • Strength (leg extensor) • QoL
Notes	* electrostimulation group not included in this review • Funding ○ grant IGA MZ CR No. NS/10096-4

Dobsak 2012 *(Continued)*

- grant MSM 0021622402

Risk of bias

Bias	Authors' judgement	Support for judgement
Random sequence generation (selection bias)	Unclear risk	Insufficient information to permit judgement
Allocation concealment (selection bias)	Unclear risk	Insufficient information to permit judgement
Blinding of participants and personnel (performance bias) All outcomes	High risk	No blinding
Blinding of outcome assessment (detection bias) Objective outcomes	Low risk	No blinding of outcome assessment (or not reported), but the outcome measurement is not likely to be influenced by lack of blinding
Blinding of outcome assessment (detection bias) Subjective outcomes	High risk	No blinding of outcome assessment, and the outcome measurement is likely to be influenced by lack of blinding
Incomplete outcome data (attrition bias) All outcomes	Unclear risk	Insufficient information to permit judgement
Selective reporting (reporting bias)	Low risk	Pre-specified outcomes (of interest to this review) were reported
Other bias	Low risk	The study appears to be free of other sources of bias

Dong 2011

Study characteristics

Methods	• Study design: parallel RCT • Study duration: not reported • Study follow-up period: 24 weeks
Participants	• Country: USA • Setting: HD unit • Inclusion criteria: ≥ 18 years; HD > 3 months; adequate dose of dialysis (double pool Kt/V ≥ 1.2) on a 3 times/week HD program using a biocompatible HD membrane • Number: exercise group (15); control group (17) • Mean age ± SD (years): exercise group (46.5 ± 12.1); control group (40.2 ± 13.5) • Sex (M/F): exercise group (9/6); control group (12/5) • Mean BMI ± SD (kg/m^2): exercise group (27.5 ± 6.3); control group (29.1 ± 6.4) • Exclusion criteria: active inflammatory or infectious disease; pregnancy; hospitalisation within 1 month prior to the study; not capable of exercise due to cardiovascular disease or osteoarthritis
Interventions	Duration of intervention

Dong 2011 *(Continued)*

- 20 weeks

Exercise group

- Type: resistance
- Description: lower limbs exercises
- Position: seated
- Material: pneumatic leg press machine
- Location: HD unit
- Duration of training sessions: 3 sets of 12 repetitions minutes
- Duration of warm-up/cool-down: not reported
- Frequency: 3 times/week
- Timing in relation to dialysis treatments: just before
- Intensity: 70% of 1RM
- Supervised by: study personnel
- Mode of delivery: face-to-face
- Tailoring: individualised intensity
- Modifications/progression: 1RM re-evaluated and training adjusted at 3 months and 6 months
- Strategies to enhance adherence: not reported
- Adherence to intervention: not reported
- Co-intervention: nutritional supplementation

Control group

- Nutritional supplementation

Outcomes	• BMI (kg/m^2) • Weight (kg) • FM% from BIA • FM% from anthropometry • FM (kg) • LBM (%) • Leg LBM (%) • LBM (kg) • Leg LBM (kg) • Waist/hip ratio • Bicarbonate • Serum albumin • Total protein (g/dL) • Hb • Cholesterol (mmol/L) • Glucose (mg/dl) • CRP (mg/L) • SCr (mg/dL) • Dietary energy intake (kcal/kg/day) • Pre-albumin (mg/dL) • Dietary protein intake (g/kg/day) • 1-RM (lb)
Notes	Funding • National Institutes of Health • Diabetes Research Training Center • National Institute of Diabetes, Digestive and Kidney Diseases

Dong 2011 *(Continued)*

- Clinical Translational Science Award from the National Center for Research Resources
- Chinese Society of Nephrology
- International Society of Peritoneal Dialysis
- National Kidney Foundation
- Council of Renal Nutrition

Risk of bias

Bias	Authors' judgement	Support for judgement
Random sequence generation (selection bias)	Low risk	Computer random number generator
Allocation concealment (selection bias)	Unclear risk	Insufficient information to permit judgement
Blinding of participants and personnel (performance bias) All outcomes	High risk	No blinding
Blinding of outcome assessment (detection bias) Objective outcomes	Low risk	No blinding of outcome assessment (or not reported), but the outcome measurement is not likely to be influenced by lack of blinding
Blinding of outcome assessment (detection bias) Subjective outcomes	Low risk	No patient-reported outcome
Incomplete outcome data (attrition bias) All outcomes	Unclear risk	Insufficient information to permit judgement
Selective reporting (reporting bias)	Low risk	Pre-specified outcomes (of interest to this review) were reported
Other bias	Low risk	The study appears to be free of other sources of bias

EXCITE 2014

Study characteristics

Methods	• Study design: parallel RCT • Study duration: 15 months • Study follow-up period: 6 months
Participants	• Country: Italy • Setting: HD unit • Inclusion criteria: stage G5 CKD • Number: exercise group (151); control group (145) • Mean age ± SD (years): exercise group (63.0 ± 13.0); control group (64.0 ± 14.0) • Sex (M/F): exercise group (70/34); control group (103/20) • Mean BMI ± SD (kg/m^2): exercise group (26.0 ± 4.0); control group (27.0 ± 6.0)

EXCITE 2014 *(Continued)*

	• Exclusion criteria: physical (e.g. amputation) or clinical (severe effort angina or stage 4 NYHA heart failure, any intercurrent illness requiring hospitalisation) limitations to mobility or a high degree of fitness, that is the ability to walk a distance of 0.550 m in 6 minutes during the standard walking test
Interventions	Duration of intervention • 26 weeks Exercise group • Type: aerobic • Description: home walking sessions • Position: not applicable • Material: not reported • Location: home • Duration of training sessions: varied according to baseline level minutes • Duration of warm-up/cool-down: not reported • Frequency: 3 times/week • Timing in relation to dialysis treatments: on non-HD days • Intensity: varied according to baseline 6MWT but described as low intensity • Supervised by: prehabilitation team ensure training of dialysis personnel but exercise sessions were not directly supervised • Mode of delivery: not reported • Tailoring: individualised not further defined • Modifications/progression: adjusted according to 6MWT • Strategies to enhance adherence: encouragement by dialysis personnel • Adherence to intervention: not reported • Co-intervention: none Control group • Usual care
Outcomes	• Need for medication • Hospitalisations • AV fistula events • Adverse events • Death • FEV1 (L) • FVC (L) • Maximal inspiratory mouth pressure (kPa) • Vital capacity (L) • 6MWT • Sit-to-stand test • Lower extremity strength • QoL
Notes	• Funding: not reported

Risk of bias

Bias	Authors' judgement	Support for judgement
Random sequence generation (selection bias)	Low risk	Stratified. Assumed computer-generated

EXCITE 2014 *(Continued)*

Allocation concealment (selection bias)	Low risk	Central allocation
Blinding of participants and personnel (performance bias) All outcomes	High risk	No blinding
Blinding of outcome assessment (detection bias) Objective outcomes	Low risk	Blinding of outcome assessment ensured, and unlikely that the blinding could have been broken
Blinding of outcome assessment (detection bias) Subjective outcomes	High risk	No blinding of outcome assessment, and the outcome measurement is likely to be influenced by lack of blinding
Incomplete outcome data (attrition bias) All outcomes	High risk	Reason for missing outcome data likely to be related to true outcome, with either imbalance in numbers or reasons for missing data across intervention groups
Selective reporting (reporting bias)	Low risk	Pre-specified outcomes (of interest to this review) were reported
Other bias	Unclear risk	Insufficient information to permit judgement

Fernandes 2019

Study characteristics	
Methods	• Study design: parallel RCT • Study duration: not reported • Study follow-up period: 8 weeks
Participants	• Country: Brazil • Setting: HD unit • Inclusion criteria: ≥ 18 years; undergoing HD > 6 months; clinically stable; no pulmonary, musculoskeletal, or neurological disease; agreed to participate in the study by signing the informed consent form • Number: exercise group (22); control group (22) • Mean age ± SD (years): exercise group (44.3 ± 11.3); control group (42.6 ± 11.2) • Sex (M/F): exercise group (8/12); control group (9/10) • Mean BMI ± SD (kg/m^2): exercise group (22.8 ± 2.8); control group (22.8 ± 1.9) • Mean HD vintage ± SD (years): exercise group (6.7 ± 4.7); control group (7.2 ± 3.8) • Exclusion criteria: need for urgent or elective surgical intervention during the protocol; decompensation of prior heart disease with arrhythmia and/or precordial pain; ischaemic cardiac event (< 3 months); significant valvular heart disease or dysrhythmia; continuous and/or night-time oxygen; need for gait assistance devices or lower-limb orthoses
Interventions	Duration of intervention • 8 weeks Exercise group • Type: aerobic

Fernandes 2019 *(Continued)*

- Description: stationary cycling
- Position: seated
- Material: ergometer
- Location: HD unit
- Duration of training sessions: 30 minutes
- Duration of warm-up/cool-down: 10/10 minutes
- Frequency: 3 times/week
- Timing in relation to dialysis treatments: during (1 hour after commencement of dialysis)
- Intensity: 50% to 70% of max HR
- Supervised by: not reported
- Mode of delivery: not reported
- Tailoring: individualised intensity
- Modifications/progression: not reported
- Strategies to enhance adherence: not reported
- Adherence to intervention: not reported
- Co-intervention: none

Control group

- Usual care

Outcomes	• FCV • FEV • Peak expiratory flow • Maximal inspiratory pressure • Maximal expiratory pressure • Peak flow • SBP • DBP • HR • Respiratory frequency • Peripheral oxygen saturation • Borg during 6MWT • 6MWT • HCT • Hb • SCr • Urea • Kt/V • Albumin
Notes	• Funding: CAPES

Risk of bias

Bias	Authors' judgement	Support for judgement
Random sequence generation (selection bias)	Low risk	Computer random number generator
Allocation concealment (selection bias)	Low risk	Sealed and opaque envelopes

Fernandes 2019 *(Continued)*

Blinding of participants and personnel (performance bias) All outcomes	High risk	No blinding
Blinding of outcome assessment (detection bias) Objective outcomes	Low risk	Blinding of outcome assessment ensured, and unlikely that the blinding could have been broken
Blinding of outcome assessment (detection bias) Subjective outcomes	Low risk	No patient-reported outcome
Incomplete outcome data (attrition bias) All outcomes	Low risk	Missing outcome data balanced in numbers across intervention groups, with similar reasons for missing data across groups
Selective reporting (reporting bias)	Low risk	Pre-specified outcomes (of interest to this review) were reported
Other bias	Low risk	The study appears to be free of other sources of bias

Frey 1999

Study characteristics	
Methods	• Study design: parallel RCT • Study duration: not reported • Study follow-up period: 8 weeks
Participants	• Country: USA • Setting: HD unit • Inclusion criteria: 25 to 65 years undergoing HD • Number: exercise group (5); control group (6) • Mean age ± SD (years): exercise group (40.0 ± 11.0); control group (53.0 ± 13.0) • Sex (M/F): exercise group (3/2); control group (3/3) • Exclusion criteria: SBP > 160 mm Hg and DBP > 95 mm Hg at the beginning of the second hour of dialysis; average inter-dialytic weight gain > 3.5 kg between dialysis treatments; DM; unstable angina
Interventions	Duration of intervention • 8 weeks Exercise group • Type: aerobic • Description: stationary cycling • Position: seated • Material: multigym • Location: HD unit • Duration of training sessions: 45 minutes • Duration of warm-up/cool-down: 5/5 minutes • Frequency: 3 times/week • Timing in relation to dialysis treatments: during

Frey 1999 *(Continued)*

- Intensity: 60% to 80% of max HR
- Supervised by: not reported
- Mode of delivery: not reported
- Tailoring: individualised intensity
- Modifications/progression: duration increased by 3 min/day from week 5 to 8
- Strategies to enhance adherence: not reported
- Adherence to intervention: not reported
- Co-intervention: none

Control group

- Usual care

Outcomes	• Kilocalories • Protein intake • Serum prealbumin • Serum transferrin • Albumin • Kt/V
Notes	• Funding: not reported

Risk of bias

Bias	Authors' judgement	Support for judgement
Random sequence generation (selection bias)	Unclear risk	Insufficient information to permit judgement
Allocation concealment (selection bias)	Unclear risk	Insufficient information to permit judgement
Blinding of participants and personnel (performance bias) All outcomes	High risk	No blinding
Blinding of outcome assessment (detection bias) Objective outcomes	Low risk	No blinding of outcome assessment (or not reported), but the outcome measurement is not likely to be influenced by lack of blinding
Blinding of outcome assessment (detection bias) Subjective outcomes	High risk	No blinding of outcome assessment, and the outcome measurement is likely to be influenced by lack of blinding
Incomplete outcome data (attrition bias) All outcomes	High risk	Plausible effect size among missing outcomes enough to induce clinically relevant bias in observed effect size
Selective reporting (reporting bias)	Low risk	Pre-specified outcomes (of interest to this review) were reported
Other bias	Unclear risk	Insufficient information to permit judgement

Frih 2017a

Study characteristics	
Methods	• Study design: parallel RCT • Study duration: 15 months • Study follow-up period: 16 weeks
Participants	• Country: Tunisia • Setting: HD unit • Inclusion criteria: undergoing HD • Number: exercise group (28); control group (22) • Mean age ± SD (years): exercise group (64.2 ± 3.4); control group (65.2 ± 3.1) • Sex (M/F): all males • Mean HD vintage ± SD (months): exercise group (72.7 ± 12.7); control group (73.6 ± 13.4) • Mean BMI ± SD (kg/m^2): exercise group (25.4 ± 2.8); control group (24.3 ± 3.2) • Exclusion criteria: chronic lung disease; ischaemic heart disease; uncontrolled arrhythmias or hypertension; haemodynamic instability or musculoskeletal disorders exacerbated by exercise; exercising regularly before starting the experiment
Interventions	Duration of intervention • 16 weeks Exercise group • Type: combined • Description: upper and lower limbs strengthening exercises + cycling and treadmill walking • Position: not applicable • Material: ergometer, treadmill, multigym • Location: multigym • Duration of training sessions: 40 minutes • Duration of warm-up/cool-down: 10/10 minutes • Frequency: 4 times/week • Timing in relation to dialysis treatments: on non-HD days • Intensity: 50% of 1-RM and 5 to 6 on RPE • Supervised by: physiotherapy and physical training technicians • Mode of delivery: face-to-face • Tailoring: individualised intensity • Modifications/progression: load increased by 5% of 1RM every month • Strategies to enhance adherence: not reported • Adherence to intervention: not reported • Co-intervention: none Control group: • Usual care
Outcomes	• STS-10 (sec) • Sit-to-stand test (60 sec) • Handgrip strength • TUG test (sec) • 6MWT (metres) • SBP • DBP • CRP

Frih 2017a *(Continued)*

	• Hb (g/dL) • Albumin (g/L) • Total cholesterol • HDL cholesterol • LDL cholesterol • Mini nutritional assessment long-form score • QoL (SF-36) • Anxiety score • Depression score
Notes	• Funding: not reported

Risk of bias

Bias	Authors' judgement	Support for judgement
Random sequence generation (selection bias)	Low risk	Computer random number generator
Allocation concealment (selection bias)	Unclear risk	Insufficient information to permit judgement
Blinding of participants and personnel (performance bias) All outcomes	High risk	No blinding
Blinding of outcome assessment (detection bias) Objective outcomes	Low risk	Blinding of outcome assessment ensured, and unlikely that the blinding could have been broken
Blinding of outcome assessment (detection bias) Subjective outcomes	High risk	No blinding of outcome assessment, and the outcome measurement is likely to be influenced by lack of blinding
Incomplete outcome data (attrition bias) All outcomes	High risk	Reason for missing outcome data likely to be related to true outcome, with either imbalance in numbers or reasons for missing data across intervention groups
Selective reporting (reporting bias)	Low risk	Pre-specified outcomes (of interest to this review) were reported
Other bias	Unclear risk	Insufficient information to permit judgement

Giannaki 2013a

Study characteristics

Methods	• Study design: parallel RCT (3 arms) • Study duration: 25 months • Study follow-up period: 26 weeks
Participants	• Country: Greece • Setting: HD unit

Giannaki 2013a *(Continued)*

- Inclusion criteria: dialysis for ≥ 3 months; adequate dialysis delivery; stable clinical condition; have RLS, no medication for RLS prior to the study
- Number: exercise group (12); control group (12)
- Mean age ± SD (years): exercise group (59.2 ± 11.8); control group (58.0 ± 10.7)
- Sex (M/F): exercise group (9/3); control group (8/4)
- Mean BMI ± SD (kg/m^2): exercise group (27.7 ± 3.6); control group (26.5 ± 4.4)
- Mean HD vintage ± SD (months): Exercise group (24.0 ± 15); control group (30 ± 26)
- Exclusion criteria: diagnosed neuropathies or reasons for being in a catabolic state within 3 months prior to the start of the study; CRP > 3.0 mg/L; unable to exercise

Interventions	Duration of intervention • 26 weeks Exercise group • Type: aerobic • Description: stationary cycling • Position: recumbent • Material: ergometer • Location: HD unit • Duration of training sessions: not reported • Duration of warm-up/cool-down: not reported • Frequency: 3 times/week • Timing in relation to dialysis treatments: during • Intensity: 60% to 65% of Wmax • Supervised by: not reported • Mode of delivery: not reported • Tailoring: individualised intensity • Modifications/progression: adjusted intensity every monthly • Strategies to enhance adherence: not reported • Adherence to intervention: not reported • Co-intervention: none Control group • Usual care
Outcomes	• Total body fat • % leg fat • Extramyocellular lipids • Subcutaneous adipose tissue • Muscle percentage • Total LBM • RLS severity • North Staffordshire Royal Infirmary walk test • Gait speed test (fast walk) • Gait speed test (normal walk) • Muscle cross-sectional area • Sit-to-stand test • Depression • Daily sleepiness • Quality of sleep • QoL

Giannaki 2013a *(Continued)*

Notes	Funding • National and Community Funds of the Greek Ministry of Development-General Secretariat of Research and Technology • European Social Fund

Risk of bias

Bias	Authors' judgement	Support for judgement
Random sequence generation (selection bias)	Unclear risk	Insufficient information to permit judgement
Allocation concealment (selection bias)	Unclear risk	Insufficient information to permit judgement
Blinding of participants and personnel (performance bias) All outcomes	High risk	No blinding
Blinding of outcome assessment (detection bias) Objective outcomes	Low risk	No blinding of outcome assessment (or not reported), but the outcome measurement is not likely to be influenced by lack of blinding
Blinding of outcome assessment (detection bias) Subjective outcomes	High risk	No blinding of outcome assessment, and the outcome measurement is likely to be influenced by lack of blinding
Incomplete outcome data (attrition bias) All outcomes	Unclear risk	Insufficient information to permit judgement
Selective reporting (reporting bias)	Low risk	Pre-specified outcomes (of interest to this review) were reported
Other bias	Low risk	The study appears to be free of other sources of bias

Goldberg 1983

Study characteristics

Methods	• Study design: parallel RCT • Study duration: not reported • Study follow-up period: not reported
Participants	• Country: USA • Setting: not reported • Inclusion criteria: HD patients receiving treatments for 4 to 6 hours, 3 times/week using either a coil or hollow-fibre dialyser • Number: exercise group (14); control group (11) • Mean age ± SD (years): exercise group (38.0 ± 15.0); control group (37.0 ± 12.0) • Sex (M/F): exercise group (8/6); control group (7/4) • Mean HD vintage ± SD (months): exercise group (22.2 ± 17.1); control group (40.1 ± 29.7)

Goldberg 1983 *(Continued)*

	• Exclusion criteria: unstable angina pectoris; cardiac arrhythmias; haemodynamically significant valvular heart disease; congestive heart failure; poorly controlled hypertension; severe retinal disease; insulin-dependent DM; hypothyroidism
Interventions	Duration of intervention • 26 weeks Exercise group • Type: aerobic • Description: stationary cycling • Position: recumbent • Material: ergometer • Location: HD unit • Duration of training sessions: not reported • Duration of warm-up/cool-down: not reported • Frequency: 3 times/week • Timing in relation to dialysis treatments: during • Intensity: 60% to 65% of Wmax • Supervised by: not reported • Mode of delivery: not reported • Tailoring: individualised intensity • Modifications/progression: adjusted intensity every monthly • Strategies to enhance adherence: not reported • Adherence to intervention: not reported • Co-intervention: none Control group • Usual care
Outcomes	• Graded exercise treadmill duration • VO_2 max • HR • BP • Psychological function • Plasma triglyceride levels • Plasma HGL cholesterol levels • Fasting plasma glucose • Fasting plasma insulin • Glucose disappearance • Body weight • Hb • Red cell mass • HCT
Notes	• Funding: NIH

Risk of bias

Bias	Authors' judgement	Support for judgement
Random sequence generation (selection bias)	Unclear risk	Insufficient information to permit judgement

Goldberg 1983 *(Continued)*

Allocation concealment (selection bias)	Unclear risk	Insufficient information to permit judgement
Blinding of participants and personnel (performance bias) All outcomes	High risk	No blinding
Blinding of outcome assessment (detection bias) Objective outcomes	Low risk	No blinding of outcome assessment (or not reported), but the outcome measurement is not likely to be influenced by lack of blinding
Blinding of outcome assessment (detection bias) Subjective outcomes	High risk	No blinding of outcome assessment, and the outcome measurement is likely to be influenced by lack of blinding
Incomplete outcome data (attrition bias) All outcomes	Unclear risk	Insufficient information to permit judgement
Selective reporting (reporting bias)	Low risk	Pre-specified outcomes (of interest to this review) were reported
Other bias	Low risk	The study appears to be free of other sources of bias

Groussard 2015

Study characteristics	
Methods	• Study design: parallel RCT • Study duration: not reported • Study follow-up period: 24 weeks
Participants	• Country: France • Setting: HD unit • Inclusion criteria: aged 20 to 85 years; dialysis for at least 2 years; consent of the patient's cardiologist • Number: exercise group (10); control group (10) • Mean age ± SD (years): exercise group (66.5 ± 4.6); control group (68.4 ± 3.7) • Sex (M/F): exercise group (5/3); control group (7/3) • Mean HD vintage ± SD (months): exercise group (36.6 ± 8.2); Control group (41.2 ± 8.1) • Exclusion criteria: orthopaedic problems that prevented cycling during dialysis; participation in another study
Interventions	Duration of intervention • 12 weeks Exercise group • Type: aerobic • Description: stationary cycling • Position: seated • Material: ergometer • Location: HD unit • Duration of training sessions: 15 to 30 minutes

Groussard 2015 *(Continued)*

- Duration of warm-up/cool-down: 5/5 minutes
- Frequency: 3 times/week
- Timing in relation to dialysis treatments: during
- Intensity: 55% to 60% of Wpeak
- Supervised by: professional team with expertise in physical activity
- Mode of delivery: face-to-face
- Tailoring: individualised intensity
- Modifications/progression: duration increased by 15 minutes over the first 2 weeks; intensity monitored and adapted
- Strategies to enhance adherence: not reported
- Adherence to intervention: not reported
- Co-intervention: none

Control group

- Usual care

Outcomes	• HDL (g/L) • LDL (g/L) • Ox-LDL (U/L) • Total cholesterol (g/L) • Triglycerides (g/L) • GPx/g Hb • GSH/GSSG • SOD/g Hb • Peak power (W) • Peak power (W/kg) • VO_2 peak (L/min) • VO_2 peak (mL/min/kg) • 6MWT
Notes	Funding • Amgen • Baxter • Hemotech • Meditor • Roche • Association des Néphrologues Centre Auvergne

Risk of bias

Bias	Authors' judgement	Support for judgement
Random sequence generation (selection bias)	Unclear risk	Insufficient information to permit judgement
Allocation concealment (selection bias)	Unclear risk	Insufficient information to permit judgement
Blinding of participants and personnel (performance bias) All outcomes	High risk	No blinding

Groussard 2015 *(Continued)*

Blinding of outcome assessment (detection bias) Objective outcomes	Low risk	No blinding of outcome assessment (or not reported), but the outcome measurement is not likely to be influenced by lack of blinding
Blinding of outcome assessment (detection bias) Subjective outcomes	Low risk	No patient-reported outcome
Incomplete outcome data (attrition bias) All outcomes	Low risk	No missing outcome data
Selective reporting (reporting bias)	Low risk	Pre-specified outcomes (of interest to this review) were reported
Other bias	High risk	Private funding. Funder's involvement not specified

Harter 1985

Study characteristics	
Methods	• Study design: parallel RCT • Study duration: not reported • Study follow-up period: 26 weeks
Participants	• Country: USA • Setting: not reported • Inclusion criteria: HD patients receiving treatments for 4 to 6 hours, 3 times/week • Number: exercise group (15); control group (12) • Mean age ± SD (years): exercise group (40.0 ± 4.0); control group (36.0 ± 3.0) • Sex (M/F): Exercise group (8/5); control group (7/5) • Mean HD vintage ± SD (months): exercise group (23.0 ± 5.0); control group (40.0 ± 9.0) • Exclusion criteria: unstable angina pectoris; cardiac arrhythmias; haemodynamically significant valvular heart disease; clinically significant or symptomatic cerebrovascular; peripheral vascular, or coronary atherosclerosis; congestive heart failure; poorly controlled hypertension; electrolyte imbalance; severe retinal disease; insulin-dependent DM, hypothyroidism
Interventions	Duration of intervention • 52 weeks Exercise group • Type: aerobic • Description: cycling or walking • Position: not applicable • Material: ergometer, running track • Location: not reported • Duration of training sessions: 45 minutes • Duration of warm-up/cool-down: not reported • Frequency: not reported • Timing in relation to dialysis treatments: on non-HD days • Intensity: first 50% to 60%, then 70% to 80% of VO_2 max • Supervised by: physician, nurse, exercise physiologist

Harter 1985 *(Continued)*

	• Mode of delivery: face-to-face • Tailoring: individualised intensity and duration • Modifications/progression: progressive in duration and intensity • Strategies to enhance adherence: not reported • Adherence to intervention: not reported • Co-intervention: none Control group • Usual care and nandrolone or placebo (factorial RCT)
Outcomes	• BDI • Minnesota Multiphasix Personality Inventory • Pleasant event schedule • Unpleasant event schedule • VO_2 peak • Triglyceride • HDL • Plasma glucose level
Notes	• Funding: NIH • We have contacted the author who has confirmed that the publications by Goldberg 1985 and Carney 1987 were reports of the same trial

Risk of bias

Bias	Authors' judgement	Support for judgement
Random sequence generation (selection bias)	Unclear risk	Insufficient information to permit judgement
Allocation concealment (selection bias)	Unclear risk	Insufficient information to permit judgement
Blinding of participants and personnel (performance bias) All outcomes	High risk	No blinding
Blinding of outcome assessment (detection bias) Objective outcomes	Low risk	No blinding of outcome assessment (or not reported), but the outcome measurement is not likely to be influenced by lack of blinding
Blinding of outcome assessment (detection bias) Subjective outcomes	Low risk	No patient-reported outcome
Incomplete outcome data (attrition bias) All outcomes	High risk	'As-treated' analysis done with substantial departure of the intervention received from that assigned at randomisation
Selective reporting (reporting bias)	Unclear risk	Insufficient information to permit judgement
Other bias	Low risk	The study appears to be free of other sources of bias

IHOPE 2019

Study characteristics	
Methods	• Study design: parallel RCT (3 arms*) • Study duration: 5 years • Study follow-up period: 52 weeks
Participants	• Country: USA • Setting: HD units • Inclusion criteria: receiving HD treatment ≥ 3 days/week, dialysis vintage ≥ 3 months, aged 30 to 80 years not currently receiving intradialytic oral nutritional supplementation or participating in intradialytic exercise • Number: exercise + protein group (49); protein group (45) • Mean age ± SD (years): exercise + protein group (53.7 ± 11.4), protein group (56.6 ± 13.0) • Sex (M/F): exercise + protein group (29/20), protein group (23/22) • Mean HD vintage ± SD (months): exercise + protein group (34.3 ± 34.8), protein group (45.6 ± 38.7) • Mean BMI ± SD (kg/m): exercise + protein group (31.9 ± 8.3), protein group (30.6 ± 7.1) • Exclusion criteria: persistent Hb levels < 10 g/dL; weight > 300 pounds; currently receiving any form of intradialytic protein supplementation (oral, enteral, or parenteral) or participating in any form of intradialytic exercise training; chronic obstructive pulmonary disease and decompensated chronic heart failure; on dialysis treatment for < 3 months (or enrolment may be postponed)
Interventions	Duration of intervention • 52 weeks Exercise group • Type: aerobic • Description: stationary cycling • Position: not reported • Material: ergometer • Location: HD unit • Duration of training sessions: 30 to 45 minutes • Duration of warm-up/cool-down: not reported • Frequency: 3 times/week • Timing in relation to dialysis treatments: during • Intensity: 12 to 14 on RPE • Supervised by: supervised by research staff • Mode of delivery: face-to-face • Tailoring: individualised intensity • Modifications/progression: progressive in duration • Strategies to enhance adherence: not reported • Adherence to intervention: 80% • Co-intervention: protein supplementation Protein group • Protein supplementation: 30 g whey protein supplement at each dialysis session
Outcomes	• Shuttle walk test • Gait speed • Sit-to-stand test (rep) • TUG test (sec)

IHOPE 2019 *(Continued)*

- leg extension
- leg flexion
- BMI (kg/m^2)
- Whole body lean mass (kg)
- Whole body fat percent (%)
- Leg lean mass (kg)
- Whole body BMD (g/cm^2)
- Leg BMD (g/cm^2)
- Hip BMD (g/cm^2)
- BP
- Augmentation index at HR 75 bpm
- energy intake (Kcal/kg/day)
- protein intake (g/kg/day)
- Albumin (g/L)
- IL-6
- CRP (mg/L)
- central pulse wave velocity
- QoL: Physical
- QoL: Mental

Notes	• * Patients receiving non-nutritive beverage were not included in this review (44 participants) • Funding: NIH

Risk of bias

Bias	Authors' judgement	Support for judgement
Random sequence generation (selection bias)	Low risk	Computer random number generator
Allocation concealment (selection bias)	Low risk	Performed by a research member that was not involved in data collection at that site
Blinding of participants and personnel (performance bias) All outcomes	High risk	No blinding
Blinding of outcome assessment (detection bias) Objective outcomes	Low risk	No blinding of outcome assessment (or not reported), but the outcome measurement is not likely to be influenced by lack of blinding
Blinding of outcome assessment (detection bias) Subjective outcomes	High risk	No blinding of outcome assessment, and the outcome measurement is likely to be influenced by lack of blinding
Incomplete outcome data (attrition bias) All outcomes	High risk	Reason for missing outcome data likely to be related to true outcome, with either imbalance in numbers or reasons for missing data across intervention groups
Selective reporting (reporting bias)	Low risk	Pre-specified outcomes (of interest to this review) were reported
Other bias	Low risk	The study appears to be free of other sources of bias

Johansen 2006

Study characteristics	
Methods	• Study design: factorial RCT (4 arms) • Study duration: unclear • Study follow-up period: 12 weeks
Participants	• Country: USA • Setting: outpatient HD units • Inclusion criteria: adequate dialysis delivery with Kt/V 1.2 and good compliance with dialysis treatment (i.e., not missing more than 2 dialysis treatments in the month before enrolment) • Number: exercise/exercise + nandrolone group (40); placebo/nandrolone group (39) • Mean age ± SD (years): exercise/exercise + nandrolone group (55.0 ± 13.1); placebo/nandrolone group (31.9 ± 13.6) • Sex (M/F): exercise/exercise + nandrolone group (25/15); placebo/nandrolone group (24/15) • Mean BMI ± SD (kg/m^2): exercise/exercise + nandrolone group (27.6 ± 7.8); placebo/nandrolone group (26.3 ± 5.7) • Median HD vintage, range (months): exercise (33, 3.5 to 108); exercise + nandrolone group (14, 4 to 152); placebo group (25.5, 3 to 156); nandrolone group (40.0, 3 to 288) • Exclusion criteria: dialysis < 3 months; catabolic state; unable to give informed consent; active IV drug users; thigh dialysis graft; contraindications to resistance training such as MI within 6 months; active angina; uncompensated congestive heart failure; orthopaedic or musculoskeletal limitations
Interventions	Duration of intervention • 12 weeks Exercise group • Type: resistance • Description: lower limbs exercises • Position: not reported • Material: ankle weights • Location: HD unit • Duration of training sessions: varied minutes • Duration of warm-up/cool-down: not reported • Frequency: 3 times/week • Timing in relation to dialysis treatments: during • Intensity: 60% of 3-RM • Supervised by: study personnel • Mode of delivery: face-to-face • Tailoring: individualised load • Modifications/progression: increase for 2 to 3 sets of 10 reps; weight also increased • Strategies to enhance adherence: not reported • Adherence to intervention: not reported • Co-intervention: none or anabolic steroid (factorial design) Control group • Usual care or usual care and anabolic steroid (factorial design)
Outcomes	• Weight • Lean body mass • Fat mass

Johansen 2006 *(Continued)*

- Muscle size (quadriceps muscle area)
- SCr
- Muscular strength: knee extension 3RM (lb)
- Muscular strength: hip abduction 3RM (lb)
- Muscular strength: hip flexion 3RM (lb)
- Muscular strength: isokinetic knee extension at 90 degrees/s (Nm)
- Muscular strength: isokinetic knee extension at 120 degrees/s (Nm)
- Gait speed (cm/s)
- Stairs
- Sit-to-stand test
- Accelerometry
- Human activity profile, maximum activity score
- Human activity profile, adjusted activity score
- SF-36 physical functioning
- Fatigue
- Anger

Notes	Funding • National Institute of Diabetes and Digestive and Kidney Diseases • Organon, Inc., Roseland, NJ

Risk of bias

Bias	Authors' judgement	Support for judgement
Random sequence generation (selection bias)	Low risk	Block randomisation. Assumed computer-based
Allocation concealment (selection bias)	Low risk	Performed independently from investigators and block sizes unknown
Blinding of participants and personnel (performance bias) All outcomes	High risk	No blinding
Blinding of outcome assessment (detection bias) Objective outcomes	Low risk	No blinding of outcome assessment (or not reported), but the outcome measurement is not likely to be influenced by lack of blinding
Blinding of outcome assessment (detection bias) Subjective outcomes	High risk	No blinding of outcome assessment, and the outcome measurement is likely to be influenced by lack of blinding
Incomplete outcome data (attrition bias) All outcomes	Low risk	Missing outcome data balanced in numbers across intervention groups, with similar reasons for missing data across groups
Selective reporting (reporting bias)	Low risk	Pre-specified outcomes (of interest to this review) were reported
Other bias	High risk	Private funding. Funder's involvement not specified

Jong 2004

Study characteristics	
Methods	• Study design: parallel RCT • Study duration: 7 months • Study follow-up period: 12 weeks
Participants	• Country: Korea • Setting: not reported • Inclusion criteria: not reported, adults undergoing CAPD • Number: exercise group (19); control group (17) • Mean age (years): exercise group (48.8); control group (49.8) • Sex (M/F): exercise group (12/7); control group (11/6) • Exclusion criteria: not reported
Interventions	Duration of intervention • 12 weeks Exercise group • Type: aerobic • Description: walking • Position: not applicable • Material: not applicable • Location: at home • Duration of training sessions: varied • Duration of warm-up/cool-down: not reported • Frequency: 2 to 4 times/week • Timing in relation to dialysis treatments: outside treatments • Intensity: not reported • Supervised by: none • Mode of delivery: phone or face-to-face • Tailoring: not reported • Modifications/progression: not reported • Strategies to enhance adherence: verbal persuasion • Adherence to intervention: not reported • Co-intervention: none Control group • Usual care
Outcomes	• Physical functioning (SF-36) • VO_2 max • Serum albumin • Cholesterol • Triglyceride • HDL cholesterol • LDL cholesterol • HCT • Serum urea • SCr
Notes	• Abstract-only publication

Jong 2004 *(Continued)*

- Funding: not reported

Risk of bias

Bias	Authors' judgement	Support for judgement
Random sequence generation (selection bias)	Unclear risk	Insufficient information to permit judgement
Allocation concealment (selection bias)	Unclear risk	Insufficient information to permit judgement
Blinding of participants and personnel (performance bias) All outcomes	High risk	No blinding
Blinding of outcome assessment (detection bias) Objective outcomes	Unclear risk	Insufficient information to permit judgement
Blinding of outcome assessment (detection bias) Subjective outcomes	High risk	No blinding of outcome assessment, and the outcome measurement is likely to be influenced by lack of blinding
Incomplete outcome data (attrition bias) All outcomes	Unclear risk	Insufficient information to permit judgement
Selective reporting (reporting bias)	Unclear risk	Insufficient information to permit judgement
Other bias	Unclear risk	Insufficient information to permit judgement

Koh 2009

Study characteristics

Methods	• Study design: parallel RCT (3 arms) • Study duration: not reported • Study follow-up period: 24 weeks
Participants	• Country: Australia • Setting: renal units • Inclusion criteria: ≥ 18 years on stable adequate dialysis therapy; URR 70% for 3 months were eligible for inclusion • Number: intra-HD exercise group (27); home exercise group (21); control group (22) • Mean age ± SD (years): intra-HD exercise group (52.3 ± 10.9); home exercise group (52.1 ± 13.6); control group (51.3 ± 14.4) • Sex (M/F): intra-HD intra-HD exercise group (10/5); home exercise group 2 (11/4); control group (8/8) • Mean BMI ± SD (kg/m^2): intra-HD exercise group (27.6 ± 7.2); home exercise group 2 (27.9 ± 4.9); control group (28.6 ± 7.3) • Mean HD vintage ± SD (months): intra-HD exercise group (32.1 ± 26.7); home exercise group 2 (37.0 ± 31.1); control group (25.8 ± 22.2)

Koh 2009 *(Continued)*

	• Exclusion criteria: unstable angina, lower limb amputation, already meet or exceed the exercise recommendation of 120 minutes of moderate-intensity physical activity/week, participating in, or propose to participate in, another clinical intervention study within 30 days prior to study entry
Interventions	Duration of intervention • 24 weeks Intra-HD exercise group • Type: aerobic • Description: stationary cycling • Position: not reported • Material: ergometer • Location: HD unit • Duration of training sessions: 15 to 45 minutes • Duration of warm-up/cool-down: not reported • Frequency: 3 times/week • Timing in relation to dialysis treatments: during • Intensity: 12 to 13 on RPE (6 to 20) • Supervised by: supervised not further defined • Mode of delivery: face-to-face • Tailoring: individualised intensity • Modifications/progression: increasing duration and resistance • Strategies to enhance adherence: not reported • Adherence to intervention: not reported • Co-intervention: none Home exercise group • Type: aerobic • Description: walking • Position: not applicable • Material: not reported • Location: home • Duration of training sessions: 15 to 45 minutes • Duration of warm-up/cool-down: not reported • Frequency: 3 times/week • Timing in relation to dialysis treatments: not reported • Intensity: 12 to 13 on RPE (6 to 20) • Supervised by: unsupervised • Mode of delivery: not reported • Tailoring: individualised intensity • Modifications/progression: increase in duration from 15 to 45 minutes • Strategies to enhance adherence: fortnightly phone calls • Adherence to intervention: not reported • Co-intervention: none Control group • Usual care
Outcomes	• 6MWT • Timed up-and-go test • Grip strength

Koh 2009 *(Continued)*

- Weekly physical activity
- SF-36
- HR
- SBP
- DBP
- Pulse pressure
- Central SBP
- Central DBP
- Central pulse pressure
- Mean arterial pressure
- Ejection duration
- Time to reflection
- Pulse pressure amplification
- P1 height
- Augmentation
- Augmentation index
- Augmentation index at HR of 75 bpm
- Pulse wave velocity aortic
- Pulse wave velocity peripheral

Notes	• Funding: Renal Research Tasmania

Risk of bias

Bias	Authors' judgement	Support for judgement
Random sequence generation (selection bias)	Low risk	Computer random number generator
Allocation concealment (selection bias)	Low risk	External to the investigators
Blinding of participants and personnel (performance bias) All outcomes	High risk	No blinding
Blinding of outcome assessment (detection bias) Objective outcomes	Low risk	No blinding of outcome assessment (or not reported), but the outcome measurement is not likely to be influenced by lack of blinding
Blinding of outcome assessment (detection bias) Subjective outcomes	High risk	No blinding of outcome assessment, and the outcome measurement is likely to be influenced by lack of blinding
Incomplete outcome data (attrition bias) All outcomes	High risk	'As-treated' analysis done with substantial departure of the intervention received from that assigned at randomisation
Selective reporting (reporting bias)	Low risk	Pre-specified outcomes (of interest to this review) were reported
Other bias	Low risk	The study appears to be free of other sources of bias

Konstantinidou 2002

Study characteristics	
Methods	• Study design: parallel RCT (4 arms) • Study duration: not reported • Study follow-up period: 26 weeks
Participants	• Country: Greece • Setting: renal units • Inclusion criteria: undergoing regular HD with an artificial kidney for at least 6 months, 3 sessions/week, 4 hours each session • Number: exercise group 1 (21); exercise group 2 (12); exercise group 3 (12); control group (13) • Mean age ± SD (years): exercise group 1 (46.4 ± 13.9); exercise group 2 (48.3 ± 12.1); exercise group 3 (51.4 ± 12.5); control group (50.2 ± 7.9) • Sex (M/F): exercise group 1 (11/5); exercise group 2 (8/2); exercise group 3 (8/2); control group (4/8) • Mean HD vintage ± SD (months): exercise group 1 (78.0 ± 62.0); exercise group 2 (72.0 ± 66.0); exercise group 3 (62.0 ± 37.0); control group (79.0 ± 86.0) • Exclusion criteria: unstable hypertension; congestive heart failure (grade > II according to NYHA); cardiac arrhythmias (≥ III according to Lown); recent MI or unstable angina; persistent hyperkalaemia before dialysis; DM; active liver disease; bone disease that puts the patient at risk of fracture; arthritic or orthopaedic problems limiting exercise; peripheral vascular disease; undisciplined patients
Interventions	Duration of intervention • 26 weeks Exercise group 1 • Type: combined • Description: callisthenics, steps and flexibility exercises + stretching and low-weight resistance program • Position: not reported • Material: ergometer • Location: rehab centre • Duration of training sessions: 30 to 40 minutes • Duration of warm-up/cool-down: 10/10 minutes • Frequency: 3 times/week • Timing in relation to dialysis treatments: on non-HD days • Intensity: 60% to 70% of HR max • Supervised by: sports physician, physical education teachers • Mode of delivery: face-to-face • Tailoring: individualised intensity • Modifications/progression: progressive not further defined • Strategies to enhance adherence: not reported • Adherence to intervention: not reported • Co-intervention: EPO • Duration: 26 weeks Exercise group 2 • Type: combined • Description: stationary cycling + lower limbs exercises • Position: not reported • Material: ergometer, resistance bands and weights • Location: HD unit

Konstantinidou 2002 *(Continued)*

- Duration of training sessions: 20 min cycling + resistance minutes
- Duration of warm-up/cool-down: 5/5 minutes
- Frequency: 3 times/week
- Timing in relation to dialysis treatments: during
- Intensity: 70% of HR max
- Supervised by: sports physician, physical education teachers
- Mode of delivery: face-to-face
- Tailoring: individualised intensity
- Modifications/progression: not reported
- Strategies to enhance adherence: not reported
- Adherence to intervention: not reported
- Co-intervention: EPO

Exercise group 3

- Type: combined
- Description: stationary cycling
- Position: not reported
- Material: ergometer
- Location: home
- Duration of training sessions: 30 + resistance minutes
- Duration of warm-up/cool-down: not reported
- Frequency: 5 times/week
- Timing in relation to dialysis treatments: not during, home-based
- Intensity: 50% to 60% of max HR
- Supervised by: unsupervised
- Mode of delivery: not reported
- Tailoring: individualised intensity
- Modifications/progression: not reported
- Strategies to enhance adherence: monthly home visits
- Adherence to intervention: not reported
- Co-intervention: EPO

Control group

- EPO

Outcomes	• Maximum HR • VO_2 peak • Exercise time • Ventilation max • VO_2 at anaerobic threshold • Lactic acid • Respiratory exchange ratio
Notes	• Funding: not reported

Risk of bias

Bias	Authors' judgement	Support for judgement
Random sequence generation (selection bias)	Unclear risk	Insufficient information to permit judgement

Konstantinidou 2002 *(Continued)*

Allocation concealment (selection bias)	Unclear risk	Insufficient information to permit judgement
Blinding of participants and personnel (performance bias) All outcomes	High risk	No blinding
Blinding of outcome assessment (detection bias) Objective outcomes	Low risk	No blinding of outcome assessment (or not reported), but the outcome measurement is not likely to be influenced by lack of blinding
Blinding of outcome assessment (detection bias) Subjective outcomes	Low risk	No patient-reported outcome
Incomplete outcome data (attrition bias) All outcomes	Low risk	Missing outcome data balanced in numbers across intervention groups
Selective reporting (reporting bias)	Low risk	Pre-specified outcomes (of interest to this review) were reported
Other bias	Unclear risk	Insufficient information to permit judgement

Kopple 2007

Study characteristics	
Methods	• Study design: parallel RCT (4 arms) • Study duration: not reported • Study follow-up period: 20 weeks
Participants	• Country: USA • Setting: not reported • Inclusion criteria: clinically stable HD patients; aged 25 to 65 years; undergoing HD 3 times/week for at least 6 months • Number: endurance training (10); strength training (15); endurance + strength training (12); control group (14) • Mean age ± SE (years): endurance training (46 ± 4); strength training (46 ± 3); endurance + strength training (43 ± 4); control group (41 ± 3) • Sex (M/F): endurance training (6/4); strength training (9/6); endurance + strength training (7/5); control group (9/5) • Mean HD vintage ± SE (months): endurance training (45.9 ± 14.1); strength training (51.9 ± 12.4); endurance + strength training (38.3 ± 5.8); control group (51.4 ± 21.0) • Exclusion criteria: no history of hospitalisation or systemic infection for at least 3 months; active cancer other than basal cell carcinoma; severe heart, lung, or liver disease; poorly controlled hypertension; acute or chronic inflammatory disease including tuberculosis or acquired immunodeficiency disease; insulin-dependent diabetes; severe osteoporosis, neuropathy, or musculoskeletal disease; amputations involving the lower extremities; or a joint infirmity that would prevent participants from exercising
Interventions	Duration of intervention • 20 weeks

Kopple 2007 *(Continued)*

Endurance training group

- Type: aerobic
- Description: stationary cycling
- Position: recumbent
- Material: ergometer
- Location: HD unit
- Duration of training sessions: 60 minutes
- Duration of warm-up/cool-down: 5 to 10/not reported minutes
- Frequency: 3 times/week
- Timing in relation to dialysis treatments: during
- Intensity: 50% of peak oxygen consumption
- Supervised by: investigator
- Mode of delivery: face-to-face
- Tailoring: individualised intensity
- Modifications/progression: increasing duration and attempt to go from interval to continuous training
- Strategies to enhance adherence: not reported
- Adherence to intervention: not reported
- Co-intervention: none

Strength training group

- Type: resistance
- Description: lower limbs exercises
- Position: NA
- Material: leg extension/leg curl and leg press/calf extension apparatus
- Location: HD unit
- Duration of training sessions: not reported
- Duration of warm-up/cool-down: not reported
- Frequency: 3 times/week
- Timing in relation to dialysis treatments: just before
- Intensity: 70% of RM-5
- Supervised by: investigator
- Mode of delivery: face-to-face
- Tailoring: individualised intensity
- Modifications/progression: increasing resistance
- Strategies to enhance adherence: not reported
- Adherence to intervention: not reported
- Co-intervention: none

Combined exercise group

- Type: combined
- Description: 50% of endurance + 50% of strength
- Position: recumbent
- Material: endurance and strength
- Location: HD unit
- Duration of training sessions: not reported
- Duration of warm-up/cool-down: not reported
- Frequency: 3 times/week
- Timing in relation to dialysis treatments: just before and during
- Intensity: same as endurance and strength
- Supervised by: investigator
- Mode of delivery: face-to-face

Kopple 2007 *(Continued)*

	• Tailoring: endurance and strength • Modifications/progression: endurance and strength • Strategies to enhance adherence: not reported • Adherence to intervention: not reported • Co-intervention: none Control group • Usual care
Outcomes	• Mean body mass • Fat mass • BMI • Mid-thigh muscle area • Hb • HCT • Albumin • CRP • Protein intake • Energy intake • Growth factors mRNA levels
Notes	Funding • National Institutes of Health • General Clinical Research Center

Risk of bias

Bias	Authors' judgement	Support for judgement
Random sequence generation (selection bias)	Low risk	Computer random number generator
Allocation concealment (selection bias)	Unclear risk	Insufficient information to permit judgement
Blinding of participants and personnel (performance bias) All outcomes	High risk	No blinding
Blinding of outcome assessment (detection bias) Objective outcomes	Low risk	No blinding of outcome assessment (or not reported), but the outcome measurement is not likely to be influenced by lack of blinding
Blinding of outcome assessment (detection bias) Subjective outcomes	Low risk	No patient-reported outcome
Incomplete outcome data (attrition bias) All outcomes	High risk	Reason for missing outcome data likely to be related to true outcome, with either imbalance in numbers or reasons for missing data across intervention groups
Selective reporting (reporting bias)	Low risk	Pre-specified outcomes (of interest to this review) were reported

Kopple 2007 *(Continued)*

Other bias	Low risk	The study appears to be free of other sources of bias

Koufaki 2002

Study characteristics	
Methods	• Study design: parallel RCT • Study duration: not reported • Study follow-up period: 12 weeks
Participants	• Country: UK • Setting: renal rehabilitation gym • Inclusion criteria: undergoing CAPD or HD • Number: exercise group (26); control group (22) • Mean age ± SD (years): exercise group (57.8 ± 14.3); control group (51.0 ± 18.9) • Sex (M/F): exercise group (13/5); control group (11/4) • Mean BMI ± SD (kg/m^2): exercise group (25.7 ± 3.3); control group (24.7 ± 3.5) • Mean HD vintage ± SD (months): exercise group (41.4 ± 45.2); control group (53.4 ± 52.5) • Exclusion criteria: evidence of recent MI (within 6 weeks); uncontrolled dysrhythmias; uncontrolled hypertension; unstable angina; severe uncontrolled DM; symptomatic left ventricular dysfunction or neurological disorder with a functional deficit; demonstrating an inter-dialytic weight ≥ 2.5 kg, pre-dialysis potassium ≥ 5.5 mmol/L and urea clearance (Kt/V ≤ 1 mL/min/L)
Interventions	Duration of intervention • 12 weeks Exercise group • Type: aerobic • Description: stationary cycling • Position: not reported • Material: ergometer • Location: HD unit • Duration of training sessions: 18 to 40 minutes • Duration of warm-up/cool-down: not reported • Frequency: 3 times/week • Timing in relation to dialysis treatments: during • Intensity: 90% of VO_2 max • Supervised by: not reported • Mode of delivery: not reported • Tailoring: individualised intensity • Modifications/progression: not reported • Strategies to enhance adherence: not reported • Adherence to intervention: not reported • Co-intervention: none Control group • Usual care
Outcomes	• VO_2 peak • VO_2 peak/kg

Koufaki 2002 *(Continued)*

- VE peak
- Power output
- HR peak
- VO_2/HR
- Body mass
- BMI
- Self-reported physical activity level
- Hb
- Albumin
- TCO_2
- PTH
- Nutritional status
- Sit-to-stand test 5 cycles (sec)
- Sit-to-stand test in 60 sec
- NSRI walk test

Notes	• Funding: Jansen-Cilag Ltd research scholarship

Risk of bias

Bias	Authors' judgement	Support for judgement
Random sequence generation (selection bias)	Low risk	Coin tossing
Allocation concealment (selection bias)	Low risk	Coin tossing
Blinding of participants and personnel (performance bias) All outcomes	High risk	No blinding
Blinding of outcome assessment (detection bias) Objective outcomes	Low risk	Blinding of outcome assessment ensured, and unlikely that the blinding could have been broken
Blinding of outcome assessment (detection bias) Subjective outcomes	High risk	No blinding of outcome assessment, and the outcome measurement is likely to be influenced by lack of blinding
Incomplete outcome data (attrition bias) All outcomes	Low risk	Missing outcome data balanced in numbers across intervention groups
Selective reporting (reporting bias)	Low risk	Pre-specified outcomes (of interest to this review) were reported
Other bias	High risk	Private funding. Funder's involvement not specified

Koufaki 2003

Study characteristics

Koufaki 2003 *(Continued)*

Methods	• Study design: parallel RCT • Study duration: not reported • Study follow-up period: 12 weeks
Participants	• Country: UK • Setting: not reported • Inclusion criteria: undergoing dialysis (HD or PD) • Number: 12 (numbers per group not reported) • Mean age ± SD: 47.8 ± 20.3 years • Sex (M/F): all males • Exclusion criteria: not reported
Interventions	Duration of intervention • 12 weeks Exercise group • Type: aerobic • Description: stationary cycling • Position: not reported • Material: ergometer • Location: HD unit • Duration of training sessions: 40 minutes • Duration of warm-up/cool-down: not reported • Frequency: 3 times/week • Timing in relation to dialysis treatments: during • Intensity: at ventilatory threshold • Supervised by: not reported • Mode of delivery: not reported • Tailoring: individualised intensity • Modifications/progression: increasing duration • Strategies to enhance adherence: not reported • Adherence to intervention: not reported • Co-intervention: EPO Control group • EPO
Outcomes	• VO_2 peak • Walk performance • Hb • Oxygen uptake at the ventilatory threshold • Oxygen uptake kinetics
Notes	• Abstract-only publication • Funding: not reported

Risk of bias

Bias	Authors' judgement	Support for judgement

Koufaki 2003 *(Continued)*

Random sequence generation (selection bias)	Unclear risk	Insufficient information to permit judgement
Allocation concealment (selection bias)	Unclear risk	Insufficient information to permit judgement
Blinding of participants and personnel (performance bias) All outcomes	High risk	No blinding
Blinding of outcome assessment (detection bias) Objective outcomes	Unclear risk	Insufficient information to permit judgement
Blinding of outcome assessment (detection bias) Subjective outcomes	Low risk	No patient-reported outcome
Incomplete outcome data (attrition bias) All outcomes	Unclear risk	Insufficient information to permit judgement
Selective reporting (reporting bias)	Unclear risk	Insufficient information to permit judgement
Other bias	Unclear risk	Insufficient information to permit judgement

Kouidi 1997

Study characteristics	
Methods	• Study design: parallel RCT • Study duration: not reported • Study follow-up period: 26 weeks
Participants	• Country: Greece • Setting: single centre • Inclusion criteria: undergoing HD • Number: exercise group (24); control group (12) • Mean age ± SD (years): exercise group (49.6 ± 12.1); control group (52.8 ± 10.2) • Sex (M/F): exercise group (11/9); control group (4/7) • Mean BMI ± SD (kg/m^2): exercise group (25.7 ± 3.3); control group (24.7 ± 3.5) • Mean HD vintage ± SD (years): exercise group (5.9 ± 4.9); control group (6.2 ± 5.4) • Exclusion criteria: symptomatic cardiovascular disease; DM; musculoskeletal limitation or other medical problems contraindicating participation in an exercise training program
Interventions	Duration of intervention • 26 weeks Exercise group • Type: aerobic

Kouidi 1997 *(Continued)*

- Description: stationary cycling, walking or jogging, callisthenics, aerobics, swimming and/or game sports
- Position: not applicable
- Material: not reported
- Location: not reported
- Duration of training sessions: 90 minutes
- Duration of warm-up/cool-down: not reported
- Frequency: 3 to 4 times/week
- Timing in relation to dialysis treatments: on non-HD days
- Intensity: 50% to 60% of VO_2 max or 60% to 70% of max HR
- Supervised by: physician, exercise physiologist, trainer
- Mode of delivery: face-to-face
- Tailoring: individualised intensity
- Modifications/progression: increasing intensity
- Strategies to enhance adherence: not reported
- Adherence to intervention: not reported
- Co-intervention: none

Control group

- Usual care

Outcomes	• Potassium • Sodium • Calcium • Phosphorus • VO_2 max • HR • BP • HRQoL • Severity of depression • Traits of personality
Notes	• Funding: not reported

Risk of bias

Bias	Authors' judgement	Support for judgement
Random sequence generation (selection bias)	Unclear risk	Insufficient information to permit judgement
Allocation concealment (selection bias)	Unclear risk	Insufficient information to permit judgement
Blinding of participants and personnel (performance bias) All outcomes	High risk	No blinding
Blinding of outcome assessment (detection bias) Objective outcomes	Low risk	No blinding of outcome assessment (or not reported), but the outcome measurement is not likely to be influenced by lack of blinding

Kouidi 1997 *(Continued)*

Blinding of outcome assessment (detection bias) Subjective outcomes	High risk	No blinding of outcome assessment, and the outcome measurement is likely to be influenced by lack of blinding
Incomplete outcome data (attrition bias) All outcomes	Low risk	Missing outcome data balanced in numbers across intervention groups
Selective reporting (reporting bias)	Low risk	Pre-specified outcomes (of interest to this review) were reported
Other bias	Unclear risk	Insufficient information to permit judgement

Kouidi 2003

Study characteristics	
Methods	• Study design: parallel RCT • Study duration: not reported • Study follow-up period: 52 weeks
Participants	• Country: Greece • Setting: not reported • Inclusion criteria: HD patients • Number: exercise group (15), control group (15) • Mean age ± SD (years): exercise group (50.6 ± 10.8); control group (51.3 ± 9.9) • Sex (M/F): not reported • Exclusion criteria: other systemic disease; clinical symptoms of heart disease
Interventions	Duration of intervention • 52 weeks Exercise group • Type: aerobic • Description: stationary cycling • Position: not reported • Material: not reported • Location: HD unit • Duration of training sessions: not reported • Duration of warm-up/cool-down: not reported • Frequency: 3 times/week • Timing in relation to dialysis treatments: during • Intensity: not reported • Supervised by: supervised not further defined • Mode of delivery: not reported • Tailoring: not reported • Modifications/progression: not reported • Strategies to enhance adherence: not reported • Adherence to intervention: not reported • Co-intervention: none

Kouidi 2003 *(Continued)*

	Control group • Usual care
Outcomes	• VO_2 peak • SDNN • LVEF • LF/HF • ECG late potentials • TWA
Notes	• Abstract-only publication; authors were contacted for full results • Funding: not reported

Risk of bias

Bias	Authors' judgement	Support for judgement
Random sequence generation (selection bias)	Unclear risk	Insufficient information to permit judgement
Allocation concealment (selection bias)	Unclear risk	Insufficient information to permit judgement
Blinding of participants and personnel (performance bias) All outcomes	High risk	No blinding
Blinding of outcome assessment (detection bias) Objective outcomes	Unclear risk	Insufficient information to permit judgement
Blinding of outcome assessment (detection bias) Subjective outcomes	Low risk	No patient-reported outcome
Incomplete outcome data (attrition bias) All outcomes	Unclear risk	Insufficient information to permit judgement
Selective reporting (reporting bias)	Unclear risk	Insufficient information to permit judgement
Other bias	Unclear risk	Insufficient information to permit judgement

Kouidi 2004a

Study characteristics

Methods	• Study design: parallel RCT • Study duration: not reported • Study follow-up period: 26 weeks
Participants	• Country: Greece

Kouidi 2004a *(Continued)*

- Setting: not reported
- Inclusion criteria: sedentary HD patients
- Number: exercise group (11); control group (10)
- Age range: 60 to 72 years
- Exclusion criteria: severe cardiovascular abnormalities; DM; active hepatitis

Interventions	Duration of intervention • 26 weeks Exercise group • Type: aerobic • Description: stationary cycling • Position: not reported • Material: not reported • Location: HD unit • Duration of training sessions: not reported • Duration of warm-up/cool-down: not reported • Frequency: 3 times/week • Timing in relation to dialysis treatments: during • Intensity: not reported • Supervised by: supervised not further defined • Mode of delivery: not reported • Tailoring: not reported • Modifications/progression: not reported • Strategies to enhance adherence: not reported • Adherence to intervention: not reported • Co-intervention: none Control group • Usual care
Outcomes	• VO_2 peak • Peak torque • Ejection fraction • Cardiac output index • Transmittal flow • Isovolemic relaxation time
Notes	• Abstract-only publication: authors were contacted, but full results could not me obtained • Funding: not reported

Risk of bias

Bias	Authors' judgement	Support for judgement
Random sequence generation (selection bias)	Unclear risk	Insufficient information to permit judgement
Allocation concealment (selection bias)	Unclear risk	Insufficient information to permit judgement

Kouidi 2004a *(Continued)*

Blinding of participants and personnel (performance bias) All outcomes	High risk	No blinding
Blinding of outcome assessment (detection bias) Objective outcomes	Unclear risk	Insufficient information to permit judgement
Blinding of outcome assessment (detection bias) Subjective outcomes	Low risk	No patient-reported outcome
Incomplete outcome data (attrition bias) All outcomes	Unclear risk	Insufficient information to permit judgement
Selective reporting (reporting bias)	Unclear risk	Insufficient information to permit judgement
Other bias	Unclear risk	Insufficient information to permit judgement

Kouidi 2005

Study characteristics	
Methods	• Study design: parallel RCT • Study duration: not reported • Study follow-up period: 10 months
Participants	• Country: Greece • Setting: not reported • Inclusion criteria: undergoing HD treatments • Number: exercise group (19); control group (14) • Mean age ± SD: 48.8 ± 13.9 years • Sex (M/F): 27/6 • Exclusion criteria: not reported
Interventions	Duration of intervention • 43.4 weeks Exercise group • Type: aerobic • Description: stationary cycling • Position: not reported • Material: not reported • Location: HD unit • Duration of training sessions: not reported • Duration of warm-up/cool-down: not reported • Frequency: 3 times/week • Timing in relation to dialysis treatments: during • Intensity: not reported

Kouidi 2005 *(Continued)*

	• Supervised by: supervised not further defined • Mode of delivery: not reported • Tailoring: not reported • Modifications/progression: not reported • Strategies to enhance adherence: not reported • Adherence to intervention: not reported • Co-intervention: EPO Control group • EPO
Outcomes	• VO_2 peak • Depression scores • QoL • Personality traits
Notes	• Abstract-only publication: authors were contacted, but full results could not me obtained • Funding: not reported

Risk of bias

Bias	Authors' judgement	Support for judgement
Random sequence generation (selection bias)	Unclear risk	Insufficient information to permit judgement
Allocation concealment (selection bias)	Unclear risk	Insufficient information to permit judgement
Blinding of participants and personnel (performance bias) All outcomes	High risk	No blinding
Blinding of outcome assessment (detection bias) Objective outcomes	Unclear risk	Insufficient information to permit judgement
Blinding of outcome assessment (detection bias) Subjective outcomes	High risk	No blinding of outcome assessment, and the outcome measurement is likely to be influenced by lack of blinding
Incomplete outcome data (attrition bias) All outcomes	Unclear risk	Insufficient information to permit judgement
Selective reporting (reporting bias)	Unclear risk	Insufficient information to permit judgement
Other bias	Unclear risk	Insufficient information to permit judgement

Kouidi 2008

Study characteristics	
Methods	• Study design: parallel RCT • Study duration: not reported • Study follow-up period: 10 months
Participants	• Country: Greece • Setting: multicentre • Inclusion criteria: undergoing HD treatments for at least 6 months • Number: exercise group (32); control group (31) • Mean age ± SD (years): exercise group (55 ± 9); control group (53 ± 6) • Sex (M/F): exercise group (18/12); control group (16/13) • HD vintage (mean ± SD years): exercise group (6.3 ± 3.7); control group (6.2 ± 3.9) • Exclusion criteria: bundle branch block; unstable hypertension; DM; severe congestive heart failure; recent MI; unstable angina
Interventions	Duration of intervention • 43.4 weeks Exercise group • Type: combined • Description: stationary cycling + abdominal and lower limbs strength and flexibility exercises • Position: seated • Material: ergometer, weights and elastic bands • Location: HD unit • Duration of training sessions: 90 minutes • Duration of warm-up/cool-down: 10/10 minutes • Frequency: 3 times/week • Timing in relation to dialysis treatments: during • Intensity: 60% to 70% of max HR • Supervised by: exercise trainers, physician • Mode of delivery: face-to-face • Tailoring: individualised intensity • Modifications/progression: increasing repetitions, duration, weights and resistance • Strategies to enhance adherence: not reported • Adherence to intervention: not reported • Co-intervention: none Control group • Usual care
Outcomes	• Hb (g/dL) • Urea (mg/dL) • SCr (mg/dL) • Potassium (mEq/L) • Sodium (mEq/L) • Calcium (mEq/L) • Phosphorus (mg/dL) • Peak oxygen consumption • LVMI • SD of the normal RR intervals

Kouidi 2008 *(Continued)*

	• Mean RR interval • LVEF • Mean 24-hour HR • LF/HF ratio • Signal-averaged ECG • Adherence with the exercise program • Resting SBP and DBP
Notes	• Funding: not reported

Risk of bias

Bias	Authors' judgement	Support for judgement
Random sequence generation (selection bias)	Low risk	Drawing of lots
Allocation concealment (selection bias)	Unclear risk	Insufficient information to permit judgement
Blinding of participants and personnel (performance bias) All outcomes	High risk	No blinding
Blinding of outcome assessment (detection bias) Objective outcomes	Low risk	No blinding of outcome assessment (or not reported), but the outcome measurement is not likely to be influenced by lack of blinding
Blinding of outcome assessment (detection bias) Subjective outcomes	Low risk	No patient-reported outcome
Incomplete outcome data (attrition bias) All outcomes	Low risk	Missing outcome data balanced in numbers across intervention groups, with similar reasons for missing data across groups
Selective reporting (reporting bias)	Low risk	Pre-specified outcomes (of interest to this review) were reported
Other bias	Unclear risk	Insufficient information to permit judgement

Kouidi 2010

Study characteristics

Methods	• Study design: parallel RCT • Study duration: not reported • Study follow-up period: 52 weeks
Participants	• Country: Greece • Setting: HD unit • Inclusion criteria: underwent HD 3 times/week for 4 hours for at least 6 months • Number: exercise group (25); control group (25)

Kouidi 2010 *(Continued)*

- Mean age ± SD (years): exercise group (46.3 ± 11.2); control group (45.8 ± 10.9)
- Sex (M/F): exercise group (14/10); control group (12/8)
- Mean HD vintage ± SD (years): exercise group (6.1 ± 4.6); control group (6.3 ± 4.9)
- Exclusion criteria: no history, clinical signs, or symptoms of psychiatric, neurological, cardiologic, or pulmonary disorders; absence of DM; no significant electrolytic instability or undisciplined patients; no musculoskeletal limitation or other medical problems contraindicating participation in an ET program

Interventions	Duration of intervention • 52 weeks Exercise group • Type: combined • Description: stationary cycling and resistance exercises of the lower limbs • Position: not reported • Material: ergometer, free weights and resistance bands • Location: HD unit • Duration of training sessions: 60 to 90 minutes • Duration of warm-up/cool-down: 5/5 minutes • Frequency: 3 times/week • Timing in relation to dialysis treatments: during • Intensity: 70% of VO_2 max • Supervised by: physician and exercise trainer • Mode of delivery: face-to-face • Tailoring: individualised intensity and duration • Modifications/progression: increasing duration and workload • Strategies to enhance adherence: not reported • Adherence to intervention: not reported • Co-intervention: none Control group • Usual care
Outcomes	• Hb • Calcium (mEq/L) • Phosphorous (mg/dL) • Potassium (mEq/L) • LF/HF • Mean square successive difference (ms) • pNN50 (ms) • SDNN (ms) • Urea (mg/dL) • SCr (mg/dL) • Sodium (mEq/L) • VO_2 peak (ml/kg/min) • Hospital anxiety and depression scale • Depression (BDI)
Notes	• Funding: not reported
Risk of bias	

Kouidi 2010 *(Continued)*

Bias	Authors' judgement	Support for judgement
Random sequence generation (selection bias)	Unclear risk	Insufficient information to permit judgement
Allocation concealment (selection bias)	Unclear risk	Insufficient information to permit judgement
Blinding of participants and personnel (performance bias) All outcomes	High risk	No blinding
Blinding of outcome assessment (detection bias) Objective outcomes	Low risk	No blinding of outcome assessment (or not reported), but the outcome measurement is not likely to be influenced by lack of blinding
Blinding of outcome assessment (detection bias) Subjective outcomes	High risk	No blinding of outcome assessment, and the outcome measurement is likely to be influenced by lack of blinding
Incomplete outcome data (attrition bias) All outcomes	Low risk	Missing outcome data balanced in numbers across intervention groups
Selective reporting (reporting bias)	Low risk	Pre-specified outcomes (of interest to this review) were reported
Other bias	Unclear risk	Insufficient information to permit judgement

Lee 2001

Study characteristics	
Methods	• Study design: parallel RCT • Study duration: not reported • Study follow-up period: 12 weeks
Participants	• Country: Korea • Setting: not reported • Inclusion criteria: prevalent HD patients receiving dialysis 2 to 3 times/week • Number: exercise group (25); control group (21) • Mean age ± SD (years): exercise group (45 ± 12.8); control group (53.1 ± 14.2) • Sex (M/F): exercise group (12/13); control group (9/12) • Mean HD vintage ± SD (months): exercise group (37 ± 34.9); control group (41.7 ± 30.9) • Exclusion criteria: not reported
Interventions	Duration of intervention • 12 weeks Exercise group • Type: aerobic • Description: stationary cycling and walking

Lee 2001 *(Continued)*

- Position: not reported
- Material: ergometer, treadmill
- Location: HD
- Duration of training sessions: 5 to 30 minutes
- Duration of warm-up/cool-down: 5 to 10/not reported minutes
- Frequency: 2 to 4 times/week
- Timing in relation to dialysis treatments: just prior
- Intensity: 12 to 14 on RPE
- Supervised by: not reported
- Mode of delivery: not reported
- Tailoring: individualised intensity
- Modifications/progression: increasing intensity and duration
- Strategies to enhance adherence: not reported
- Adherence to intervention: not reported
- Co-intervention: none

Control group

- Usual care

Outcomes	• Serum lipids • Hb • Physical work capacity (measured in the intervention group only) • Physical fitness (measured in the intervention group only)
Notes	• Funding: not reported

Risk of bias

Bias	Authors' judgement	Support for judgement
Random sequence generation (selection bias)	Unclear risk	Insufficient information to permit judgement
Allocation concealment (selection bias)	Unclear risk	Insufficient information to permit judgement
Blinding of participants and personnel (performance bias) All outcomes	High risk	No blinding
Blinding of outcome assessment (detection bias) Objective outcomes	Low risk	No blinding of outcome assessment (or not reported), but the outcome measurement is not likely to be influenced by lack of blinding
Blinding of outcome assessment (detection bias) Subjective outcomes	Low risk	No patient-reported outcome
Incomplete outcome data (attrition bias) All outcomes	High risk	Reason for missing outcome data likely to be related to true outcome, with either imbalance in numbers or reasons for missing data across intervention groups
Selective reporting (reporting bias)	High risk	One or more outcomes of interest in the review are reported incompletely so that they cannot be entered in a meta-analysis

Lee 2001 *(Continued)*

Other bias	Unclear risk	Insufficient information to permit judgement

Liao 2016

Study characteristics	
Methods	• Study design: parallel RCT • Study duration: not reported • Study follow-up period: 12 weeks
Participants	• Country: Taiwan • Setting: HD unit • Inclusion criteria: receiving maintenance HD for at least 6 months with 3 times/week and 4 hours for each session • Number: exercise group (20); control group (20) • Mean age ± SD (years): exercise group (62.0 ± 8.0); control group (62.0 ± 9.0) • Sex (M/F): exercise group (8/12); control group (9/11) • Mean BMI ± SD (kg/m^2): exercise group (22.9 ± 3.3); control group (23.7 ± 4.2) • Mean HD vintage ± SD (months): exercise group (71.0 ± 46.0); control group (83.0 ± 71.0) • Exclusion criteria: presence of active infection or inflammation, autoimmune disorders, malignancy, psychiatric diseases, severe musculoskeletal disorders, poorly controlled DM or secondary hyperparathyroidism; uncontrolled heart failure or pulmonary diseases; hospitalisation during the previous month; use of drugs that influence serum cytokine levels; vascular access in the lower extremities; BMI > 25 kg/m^2
Interventions	Duration of intervention • 12 weeks Exercise group • Type: aerobic • Description: stationary cycling • Position: recumbent • Material: ergometer • Location: HD unit • Duration of training sessions: 20 minutes • Duration of warm-up/cool-down: 5/5 minutes • Frequency: 3 times/week • Timing in relation to dialysis treatments: during • Intensity: 12 to 15 on RPE • Supervised by: physician and rehabilitation nurse • Mode of delivery: face-to-face • Tailoring: individualised intensity and duration • Modifications/progression: increasing duration • Strategies to enhance adherence: not reported • Adherence to intervention: not reported • Co-intervention: none Control group • Usual care

Liao 2016 *(Continued)*

Outcomes	• Pre HD SBP • Pre HD DBP • Pre HD HR • iPTH (pg/mL) • Calcium (mg/dL) • tHcy (mol/L) • hs-CRP (mg/dL) • IL-6 (pg/mL) • SCr (mg/dL) • Albumin (g/dL) • ALT (mu/L) • Cholesterol (mg/dL) • HCT (%) • KT/V • nPCR (g/kg/day) • Mean BP (mm Hg) • Weight (kg) • BMI (kg/m^2) • Number of endothelial progenitor cells • BMD femoral neck • BMD spine • 6MWT
Notes	Funding • Research Fund of the Cardinal Tien Hospital • TaoYuan Army Hospital • Tri-Service General Hospital • Ministry of Science and Technology

Risk of bias

Bias	Authors' judgement	Support for judgement
Random sequence generation (selection bias)	Unclear risk	Insufficient information to permit judgement
Allocation concealment (selection bias)	Unclear risk	Insufficient information to permit judgement
Blinding of participants and personnel (performance bias) All outcomes	High risk	No blinding
Blinding of outcome assessment (detection bias) Objective outcomes	Low risk	No blinding of outcome assessment (or not reported), but the outcome measurement is not likely to be influenced by lack of blinding
Blinding of outcome assessment (detection bias) Subjective outcomes	Low risk	No patient-reported outcome
Incomplete outcome data (attrition bias)	Low risk	No missing outcome data

Liao 2016 *(Continued)*

All outcomes

Selective reporting (reporting bias)	High risk	Not all of the study's pre-specified outcomes have been reported
Other bias	Unclear risk	Insufficient information to permit judgement

Ma 2018

Study characteristics	
Methods	• Study design: parallel RCT • Study duration: not reported • Study follow-up period: 104 weeks
Participants	• Country: China • Setting: HD unit • Inclusion criteria: maintenance HD > 3 months; aged 18 to 70 years; dialysis 3/week; Kt/V > 1.2 • Number: total (132) • Mean age ± SD: 55.2 ± 12.2 years • Sex (M/F): 79/53 • Median HD vintage (IQR): 44 months (2, 254) • Exclusion criteria: cardiac function NYHA class IV; severe osteoarthrosis; walking distance < 200 m; quiet condition of blood oxygen saturation < 90%; patients with limbs missing who cannot exercise
Interventions	Duration of intervention • 104 weeks Exercise group • Type: combined • Description: aerobics, resistance, and flexibility training not further defined • Position: not reported • Material: not reported • Location: HD unit • Duration of training sessions: 20 minutes • Duration of warm-up/cool-down: not reported • Frequency: 3 times/week • Timing in relation to dialysis treatments: during • Intensity: not reported • Supervised by: not reported • Mode of delivery: not reported • Tailoring: not reported • Modifications/progression: not reported • Strategies to enhance adherence: not reported • Adherence to intervention: not reported • Co-intervention: none Control group • Usual care
Outcomes	• Cardiopulmonary endurance index

Ma 2018 *(Continued)*

	• Hb • Albumin • Total cholesterol • 6MWT • Anxiety score • Depression score
Notes	• Abstract-only publication: authors contacted for full results • Funding: not reported

Risk of bias

Bias	Authors' judgement	Support for judgement
Random sequence generation (selection bias)	Unclear risk	Insufficient information to permit judgement
Allocation concealment (selection bias)	Unclear risk	Insufficient information to permit judgement
Blinding of participants and personnel (performance bias) All outcomes	High risk	No blinding
Blinding of outcome assessment (detection bias) Objective outcomes	Unclear risk	Insufficient information to permit judgement
Blinding of outcome assessment (detection bias) Subjective outcomes	High risk	No blinding of outcome assessment, and the outcome measurement is likely to be influenced by lack of blinding
Incomplete outcome data (attrition bias) All outcomes	Unclear risk	Insufficient information to permit judgement
Selective reporting (reporting bias)	Unclear risk	Insufficient information to permit judgement
Other bias	Unclear risk	Insufficient information to permit judgement

Makhlough 2012

Study characteristics

Methods	• Study design: parallel RCT • Study duration: 2 months • Study follow-up period: 8 weeks
Participants	• Country: Iran • Setting: HD unit • Inclusion criteria: HD > 3 months • Number: exercise group (25); control group (23)

Makhlough 2012 *(Continued)*

- Mean age ± SD (years): exercise group (53.3 ± 14.3); control group (56.2 ± 10.8)
- Sex (M/F): exercise group (18/7); control group (12/11)
- Mean HD vintage ± SD (months): exercise group (25.5 ± 10.7); control group (23.5 ± 13.6)
- Exclusion criteria: poorly controlled hypertension; uncompensated heart failure; cardiac arrhythmia requiring treatment; recent unstable angina; persistent hyperkalaemia before dialysis; significant valvular heart disease; MI within the past 6 months; significant cerebral or peripheral arteriosclerosis; bone disease with a risk of fracture; orthopaedic or musculoskeletal limitations; weight gains > 4 kg from Friday to Monday or from Saturday to Tuesday; recent significant change in the resting ECG; third-degree atrioventricular heart block without pacemaker; severe aortic stenosis; suspected or known dissecting aneurysm; active or suspected myocarditis or pericarditis; thrombophlebitis or intracardiac thrombi; recent systemic or pulmonary embolus; acute infections

Interventions	Duration of intervention • 8 weeks Exercise group • Type: range of motion • Description: rotating the wrist, wrist up and down, ankle-twisting motion • Position: not reported • Material: not reported • Location: HD unit • Duration of training sessions: 15 minutes • Duration of warm-up/cool-down: not reported • Frequency: 3 times/week • Timing in relation to dialysis treatments: during • Intensity: not reported • Supervised by: not reported • Mode of delivery: not reported • Tailoring: individualised duration • Modifications/progression: not reported • Strategies to enhance adherence: not reported • Adherence to intervention: not reported • Co-intervention: none Control group • Usual care
Outcomes	• Serum phosphate (mg/dL) • Serum calcium (mg/dL) • Serum potassium (mg/dL) • Hb (g/dL)
Notes	• The total number of participants and the number per group do not add up. Percentages of men and women are not consistent with the number of participants per group • Funding: Mazandaran University of Medical Sciences

Risk of bias

Bias	Authors' judgement	Support for judgement
Random sequence generation (selection bias)	Low risk	Computer random number generator

Makhlough 2012 *(Continued)*

Allocation concealment (selection bias)	Unclear risk	Insufficient information to permit judgement
Blinding of participants and personnel (performance bias) All outcomes	High risk	No blinding
Blinding of outcome assessment (detection bias) Objective outcomes	Low risk	Blinding of outcome assessment ensured, and unlikely that the blinding could have been broken
Blinding of outcome assessment (detection bias) Subjective outcomes	Low risk	No patient-reported outcome
Incomplete outcome data (attrition bias) All outcomes	Unclear risk	Insufficient information to permit judgement
Selective reporting (reporting bias)	Low risk	Pre-specified outcomes (of interest to this review) were reported
Other bias	High risk	Multiple errors and discrepancies in the reporting of the study

Marchesan 2016

Study characteristics	
Methods	• Study design: parallel RCT • Study duration: not reported • Study follow-up period: 24 weeks
Participants	• Country: Brazil • Setting: HD unit • Inclusion criteria: HD for at least 3 months • Number: exercise group (8); control group (7) • Mean age ± SD (years): exercise group (63 ± 4); control group (65 ± 5) • Sex (M/F): exercise group (6/2); control group (5/2) • Exclusion criteria: having a central catheter; < 60 years; severe heart disease, respiratory problems, and not having been released by the physician to participate in the program due to unstable clinical conditions; unstable medical conditions encompassed biochemical aspects; weight gain on the opposite dialysis day; uncontrolled anaemia; complications and hospitalisations in the last 6 months
Interventions	Duration of intervention • 24 weeks Exercise group • Type: combined • Description: stationary cycling and resistance exercises for upper and lower limbs, thorax, abdomen and the posterior region of the trunk • Position: seated • Material: ergometer and step

Marchesan 2016 *(Continued)*

	• Location: HD unit • Duration of training sessions: 15 to 45 + resistance minutes • Duration of warm-up/cool-down: not reported • Frequency: 3 times/week • Timing in relation to dialysis treatments: during • Intensity: 60% to 70% of max HR and 3 to 4 on RPE (1 to 10) • Supervised by: not reported • Mode of delivery: not reported • Tailoring: individualised intensity • Modifications/progression: increasing intensity and duration • Strategies to enhance adherence: not reported • Adherence to intervention: not reported • Co-intervention: none Control group • Usual care
Outcomes	• 6MWT • Sit-to-stand test (30 sec) • Respiratory muscle strength test
Notes	• Funding: not reported

Risk of bias

Bias	Authors' judgement	Support for judgement
Random sequence generation (selection bias)	Unclear risk	Insufficient information to permit judgement
Allocation concealment (selection bias)	Unclear risk	Insufficient information to permit judgement
Blinding of participants and personnel (performance bias) All outcomes	High risk	No blinding
Blinding of outcome assessment (detection bias) Objective outcomes	Low risk	No blinding of outcome assessment (or not reported), but the outcome measurement is not likely to be influenced by lack of blinding
Blinding of outcome assessment (detection bias) Subjective outcomes	Low risk	No patient-reported outcome
Incomplete outcome data (attrition bias) All outcomes	Low risk	Missing outcome data balanced in numbers across intervention groups, with similar reasons for missing data across groups
Selective reporting (reporting bias)	Low risk	Pre-specified outcomes (of interest to this review) were reported
Other bias	Unclear risk	Insufficient information to permit judgement

Marinho 2016

Study characteristics	
Methods	• Study design: parallel RCT • Study duration: not reported • Study follow-up period: 8 weeks
Participants	• Country: France • Setting: HD unit • Inclusion criteria: ≥ 18 years; treatment by maintenance dialysis for at least 3 months • Number: exercise group (7); control group (7) • Median age, IQR (years): exercise group (71.5, 58.5 to 87.2); control group (76.0, 59.0 to 83.0) • Sex (M/F): exercise group (3/3); control group (3/4) • Median BMI, IQR (kg/m^2): exercise group (28.50, 21.1 to 35.8); control group (28.40, 20.8 to 35.2) • Exclusion criteria: cancer; AIDS; autoimmune disease; taking catabolizing drugs or vitamin D receptor activator
Interventions	Duration of intervention • 8 weeks Exercise group • Type: resistance • Description: lower limbs exercises • Position: not reported • Material: resistance bands and ankle cuffs • Location: HD unit • Duration of training sessions: varied minutes • Duration of warm-up/cool-down: not reported • Frequency: 3 times/week • Timing in relation to dialysis treatments: during • Intensity: 60% to 70% of 3-RM • Supervised by: physical educator • Mode of delivery: face-to-face • Tailoring: individualised intensity • Modifications/progression: not reported • Strategies to enhance adherence: not reported • Adherence to intervention: not reported • Co-intervention: none Control group • Usual care
Outcomes	• CRP (mg/L) • Calcium (mmol/L) • Phosphate (m/dL) • Potassium (mmol/L) • SCr (mg/dL) • Hb (g/dL) • Lean mass (%) • BMI (kg/m^2) • Body fat (%)

Marinho 2016 *(Continued)*

	• Sclerostin (ng/mL) • BAP (U/L) • BAP/PTH • Leptin (ng/mL) • PTH (pg/mL) • 25 (OH) vitD (ng/mL) • 1,25 (OH)2 vitD (pg/mL)
Notes	• Funding: Coordination of Improvement of Superior Education Personnel (CAPES)

Risk of bias

Bias	Authors' judgement	Support for judgement
Random sequence generation (selection bias)	Low risk	Computer random number generator
Allocation concealment (selection bias)	Unclear risk	Insufficient information to permit judgement
Blinding of participants and personnel (performance bias) All outcomes	High risk	No blinding
Blinding of outcome assessment (detection bias) Objective outcomes	Low risk	No blinding of outcome assessment (or not reported), but the outcome measurement is not likely to be influenced by lack of blinding
Blinding of outcome assessment (detection bias) Subjective outcomes	Low risk	No patient-reported outcome
Incomplete outcome data (attrition bias) All outcomes	Low risk	Missing outcome data balanced in numbers across intervention groups
Selective reporting (reporting bias)	Low risk	Pre-specified outcomes (of interest to this review) were reported
Other bias	Low risk	The study appears to be free of other sources of bias

Martin-Alemany 2016

Study characteristics

Methods	• Study design: parallel RCT • Study duration: not reported • Study follow-up period: 12 weeks
Participants	• Country: Mexico • Setting: HD unit • Inclusion criteria: regular HD 2 times/week; signed informed consent; any gender; > 18 years; no physical activity

Martin-Alemany 2016 *(Continued)*

- Number: exercise group (22); control group (22)
- Median age, IQR (years): exercise group (35, 24 to 41.5); control group (30, 24 to 47)
- Sex (M/F): exercise group (10/7); control group (11/8)
- Median BMI, IQR (kg/m^2): exercise group (20.4, 19.4 to 23); control group (21, 18.3 to 22.1)
- Exclusion criteria: amputation; hospitalisation in the last 3 months; unsatisfactory attendance at HD sessions; pregnancy; excessive pallor; severe dyspnoea; femoral fistula; arrhythmias; precordial pain; orthopaedic or neurological compromises or cognitive alterations affecting their participation; intolerance to ONS; intolerance/contraindications to the exercise routine; infectious or cardiovascular complications during the study

Interventions	Duration of intervention • 12 weeks Exercise group • Type: resistance • Description: upper and lower limbs exercises • Position: seated and semi-recumbent • Material: ankle weights and resistance springs • Location: HD unit • Duration of training sessions: 4 x 10 min with 3 min rest in between minutes • Duration of warm-up/cool-down: not reported • Frequency: 2 times/week • Timing in relation to dialysis treatments: during • Intensity: 12 to 13 on RPE • Supervised by: not reported • Mode of delivery: not reported • Tailoring: individualised intensity • Modifications/progression: not reported • Strategies to enhance adherence: not reported • Adherence to intervention: not reported • Co-intervention: oral nutritional supplementation Control group • Oral nutritional supplement
Outcomes	• Weight • BMI (kg/m^2) • Mid-arm circumference • Arm muscle circumference • Arm muscle area • Triceps skinfold thickness (mm) • FM% from anthropometry • Handgrip strength • Resistance at 50 kHz • Reactance at 50 kHz • Phase angle (°) • Hb (g/dL) • Total lymphocyte count (cells/mm^3) • SCr (mg/dL) • Albumin (g/dL) • Phosphorus (mg/dL) • Potassium (mmol/dL)

Martin-Alemany 2016 *(Continued)*

	• QoL
Notes	• Funding: not reported

Risk of bias

Bias	Authors' judgement	Support for judgement
Random sequence generation (selection bias)	Low risk	Computer random number generator
Allocation concealment (selection bias)	Unclear risk	Insufficient information to permit judgement
Blinding of participants and personnel (performance bias) All outcomes	High risk	No blinding
Blinding of outcome assessment (detection bias) Objective outcomes	Low risk	No blinding of outcome assessment (or not reported), but the outcome measurement is not likely to be influenced by lack of blinding
Blinding of outcome assessment (detection bias) Subjective outcomes	High risk	No blinding of outcome assessment, and the outcome measurement is likely to be influenced by lack of blinding
Incomplete outcome data (attrition bias) All outcomes	Low risk	Missing outcome data balanced in numbers across intervention groups, with similar reasons for missing data across groups
Selective reporting (reporting bias)	Low risk	Pre-specified outcomes (of interest to this review) were reported
Other bias	Unclear risk	Insufficient information to permit judgement

Martins do Valle 2020

Study characteristics

Methods	• Study design: parallel RCT • Study duration: not reported • Study follow-up period: 12 weeks
Participants	• Country: Brazil • Setting: HD unit • Inclusion criteria: adult ESKD patients who were under chronic HD treatment, 3 times/week totalling 12 hours weekly, for at least 3 months • Number: exercise group (12); control group (12) • Mean age ± SD (years): exercise group (49.3 ± 12.4); control group (60.4 ± 10.6) • Sex (M/F): exercise group (5/7); control group (8/4) • Mean BMI ± SD (kg/m^2): exercise group (22.7 ± 3.8); control group (23.2 ± 5.1) • Median HD vintage, IQR (years): exercise group (6.8, 11.4); control group (3.9, 12.5) • Exclusion criteria: any limitation that prevents the physical tests; presence of severe and unstable comorbidities or hospitalisation in the 3 months prior to inclusion in the study (unstable angina; decom-

Martins do Valle 2020 *(Continued)*

	pensated heart failure; MI in the last 6 months; uncontrolled arrhythmia; uncontrolled hypertension with SBP 200mm Hg and/or DBP 120mm Hg; uncontrolled DM; severe pneumopathies; acute systemic infection; neurological, musculoskeletal and disabling osteoarticular disturbances; or other conditions according to clinical judgment)
Interventions	Duration of intervention • 12 weeks Exercise group • Type: resistance • Description: lower and upper limbs exercises • Position: seated or supine • Material: ankle weights and dumbbells • Location: HD unit • Duration of training sessions: varied minutes • Duration of warm-up/cool-down: not reported • Frequency: 3 times/week • Timing in relation to dialysis treatments: during • Intensity: 3 to 5 on RPE • Supervised by: supervised not further defined • Mode of delivery: not reported • Tailoring: individualised intensity • Modifications/progression: not reported • Strategies to enhance adherence: not reported • Adherence to intervention (sessions attended): 80% • Co-intervention: none Control group • Stretching exercises
Outcomes	• Adherence • Time spent in activities of daily living • Physical activity in daily life (steps/day) • 6MWT distance (m) • Maximum voluntary isometric contraction (Kgf) • QoL • Hb (g/dL) • Serum iron (µg/dL) • Ferritin (ng/mL) • Transferrin saturation index • Adequacy of dialysis (Kt/V) • Albumin (g/dL) • Sodium (mEq/L) • Calcium (mg/dL) • Potassium (mEq/L) • Phosphorous (mg/dL) • PTH (pg/mL)
Notes	Funding • Fundaçao de Amparoa Pesquisa do Estado de Minas Gerais – FAPEMIG • Coordenacao de Aperfeicoamento de Pessoal de Nıvel Superior – Brasil (CAPES)

Martins do Valle 2020 *(Continued)*

Risk of bias

Bias	Authors' judgement	Support for judgement
Random sequence generation (selection bias)	Low risk	Computer random number generator
Allocation concealment (selection bias)	Low risk	Sealed opaque envelopes
Blinding of participants and personnel (performance bias) All outcomes	High risk	No blinding
Blinding of outcome assessment (detection bias) Objective outcomes	Low risk	No blinding of outcome assessment (or not reported), but the outcome measurement is not likely to be influenced by lack of blinding
Blinding of outcome assessment (detection bias) Subjective outcomes	High risk	No blinding of outcome assessment, and the outcome measurement is likely to be influenced by lack of blinding
Incomplete outcome data (attrition bias) All outcomes	Low risk	No missing outcome data
Selective reporting (reporting bias)	Low risk	Pre-specified outcomes (of interest to this review) were reported
Other bias	Low risk	Study appears free of other biases

Matsumoto 2007

Study characteristics

Methods	• Study design: parallel RCT • Study duration: not reported • Study follow-up period: 12 weeks
Participants	• Country: Japan • Setting: HD unit • Inclusion criteria: ≥ 30 years; HD 3 times/week (4 hours/dialysis) > 3 years • Number: exercise group (22); control group (33) • Mean age ± SD (years): exercise group (61 ± 10); control group (57 ± 8) • Sex (M/F): exercise group (5/12); control group (15/17) • Mean HD vintage ± SD (years): exercise group (12 ± 7); control group (13 ± 8) • Exclusion criteria: chronic lung disease; current ischaemic heart disease; uncontrolled arrhythmias or hypertension; haemodynamic instability; inability to pedal a stationary cycle; Hb < 85 mmol/L; albumin > 40 mg/dL
Interventions	Duration of intervention • 52 weeks

Matsumoto 2007 *(Continued)*

	Exercise group • Type: aerobic • Description: stationary cycling • Position: not reported • Material: ergometer • Location: HD unit • Duration of training sessions: 20 minutes • Duration of warm-up/cool-down: not reported • Frequency: 3 times/week • Timing in relation to dialysis treatments: just before • Intensity: 60% to 70% of max HR • Supervised by: study staff • Mode of delivery: face-to-face • Tailoring: individualised intensity • Modifications/progression: not reported • Strategies to enhance adherence: not reported • Adherence to intervention: not reported • Co-intervention: none Control group • Usual care
Outcomes	• Albumin • HRQoL • Creatinine generation rate
Notes	• Data extracted from figures • Funding: not reported

Risk of bias

Bias	Authors' judgement	Support for judgement
Random sequence generation (selection bias)	Unclear risk	Insufficient information to permit judgement
Allocation concealment (selection bias)	Unclear risk	Insufficient information to permit judgement
Blinding of participants and personnel (performance bias) All outcomes	High risk	No blinding
Blinding of outcome assessment (detection bias) Objective outcomes	Low risk	No objective outcomes
Blinding of outcome assessment (detection bias) Subjective outcomes	High risk	No blinding of outcome assessment, and the outcome measurement is likely to be influenced by lack of blinding
Incomplete outcome data (attrition bias)	Low risk	Missing outcome data balanced in numbers across intervention groups

Matsumoto 2007 *(Continued)*
All outcomes

Selective reporting (reporting bias)	Low risk	Pre-specified outcomes (of interest to this review) were reported
Other bias	Unclear risk	Insufficient information to permit judgement

McAdams-DeMarco 2018

Study characteristics	
Methods	• Study design: parallel RCT (3 arms*) • Study duration: not reported • Study follow-up period: 12 weeks
Participants	• Country: USA • Setting: HD unit • Inclusion criteria: undergoing maintenance HD; ≥ 18 years; English speaking; able to provide informed consent • Number: exercise group (6); control group (7) • Mean age ± SD (years): exercise group (48.0 ± 7.0); control group (55.0 ± 9.7) • Sex (M/F): exercise group (4/2); control group (7/0) • Mean BMI ± SD (kg/m^2): exercise group (32.0 ± 10.1); control group (30.4 ± 6.9) • Exclusion criteria: angina pectoris; chronic lung disease; cerebral vascular disease; musculoskeletal or orthopaedic conditions limiting physical activity; lower or upper extremity amputation; decreased mental capacity; diagnosed dementia
Interventions	Duration of intervention • 12 weeks Exercise group • Type: aerobic • Description: stationary cycling • Position: seated • Material: ergometer • Location: HD unit • Duration of training sessions: ad tolerance minutes • Duration of warm-up/cool-down: not reported • Frequency: 3 times/week • Timing in relation to dialysis treatments: during • Intensity: not reported • Supervised by: research assistants • Mode of delivery: face-to-face • Tailoring: no • Modifications/progression: not reported • Strategies to enhance adherence: not reported • Adherence to intervention: not reported • Co-intervention: none Control group

McAdams-DeMarco 2018 *(Continued)*

	• Usual care
Outcomes	• Modified Mini Mental Status • Trail Making Test A time • Trail Making Test A-Trail Making Test B time (sec) • Trail Making Test B time (sec)

Notes	• * Cognitive training group not included in this review
	• Funding
	  ○ Johns Hopkins Faculty Innovation Fund
	  ○ National Institutes of Health
	  ○ Johns Hopkins Bloomberg School of Public Health Faculty Innovation Fund
	  ○ American Society of Nephrology Carl W. Gottschalk Research Scholar Grant
	  ○ Johns Hopkins University Claude D. Pepper Older Americans Independence Center
	  ○ National Institute on Aging

Risk of bias

Bias	Authors' judgement	Support for judgement
Random sequence generation (selection bias)	Unclear risk	Insufficient information to permit judgement
Allocation concealment (selection bias)	Unclear risk	Insufficient information to permit judgement
Blinding of participants and personnel (performance bias) All outcomes	High risk	No blinding
Blinding of outcome assessment (detection bias) Objective outcomes	Low risk	No blinding of outcome assessment (or not reported), but the outcome measurement is not likely to be influenced by lack of blinding
Blinding of outcome assessment (detection bias) Subjective outcomes	Low risk	No patient-reported outcome
Incomplete outcome data (attrition bias) All outcomes	High risk	Reason for missing outcome data likely to be related to true outcome, with either imbalance in numbers or reasons for missing data across intervention groups
Selective reporting (reporting bias)	High risk	Not all of the study's pre-specified outcomes have been reported
Other bias	Low risk	The study appears to be free of other sources of bias

McGregor 2018

Study characteristics

Methods	• Study design: parallel RCT (3 arms*) • Study duration: 18 months

McGregor 2018 *(Continued)*

	• Study follow-up period: 10 weeks
Participants	• Country: UK • Setting: in-centre and satellite HD units • Inclusion criteria: > 18 years, dialysis 3 time/week for 3 to 4 hours; dialysis vintage of > 3 months; URR > 65%; ability to complete dynamic exercise testing and training • Number: exercise group (16); control group (18) • Mean age (95% CI) (years): exercise group (52.1 (44.2; 59.9)); control group (54.3 (46.0; 62.5)) • Sex (M/F): exercise group (13/3); control group (11/7) • Mean dialysis vintage (95% CI) (months): exercise group (48.1 (26.2; 70.0)); control group (49.3 (29.6; 69.0)) • Mean BMI (95% CI) (kg/m^2): exercise group (29.2 (25.2; 33.2)); control group (27.5 (24.6; 30.37)) • Exclusion criteria: active malignant disease; ischaemic cardiac event (< 3 months); significant valvular heart disease or dysrhythmia; planned kidney transplant during the study period; life expectancy of < 6 months
Interventions	Duration of intervention • 10 weeks Exercise group • Type: aerobic • Description: stationary cycling • Position: semi-recumbent • Material: ergometer • Location: HD unit • Duration of training sessions: 50 to 60 minutes • Duration of warm-up/cool-down: 5/5 minutes • Frequency: 3 times/week • Timing in relation to dialysis treatments: during • Intensity: 40% to 60% of VO_2 reserve and 12 to 14 on RPE • Supervised by: clinical exercise physiologists • Mode of delivery: face-to-face • Tailoring: individualised intensity • Modifications/progression: not reported • Strategies to enhance adherence: not reported • Adherence to intervention: not reported • Co-intervention: none Control group • Usual care
Outcomes	• HR rest (bpm) • HR peak (bpm) • VO_2 AT (mL/kg/min) • VO_2 peak (mL/kg/min) • Respiratory exchange rate at VO_2 AT • Respiratory exchange rate at VO_2 peak • Max. load (Watts) • Leg strength (Newtons) • LVMI (g/m^2) • LVED volume index (mL/m^2)

McGregor 2018 *(Continued)*

- LV end diastolic volume index (mL/m^2)
- LVEF (%)
- E/A ratio
- Mean E/e'
- Left atrium diameter (cm)
- SBP rest (mm Hg)
- DBP Rest (mm Hg)
- Pulse wave velocity
- Flow-mediated dilatation Delta (cm)
- Flow-mediated dilatation Delta (%)

Notes	• *Low-frequency electrical muscle stimulation group was not included in this review • Funding: West Midlands Comprehensive Local Research Network

Risk of bias

Bias	Authors' judgement	Support for judgement
Random sequence generation (selection bias)	Low risk	Permuted stratified block randomisation. Assumed computer-generated.
Allocation concealment (selection bias)	Low risk	Performed independently by the trial statistician
Blinding of participants and personnel (performance bias) All outcomes	High risk	No blinding
Blinding of outcome assessment (detection bias) Objective outcomes	Low risk	Blinding of outcome assessment ensured, and unlikely that the blinding could have been broken
Blinding of outcome assessment (detection bias) Subjective outcomes	Low risk	No patient-reported outcome
Incomplete outcome data (attrition bias) All outcomes	High risk	Reason for missing outcome data likely to be related to true outcome, with either imbalance in numbers or reasons for missing data across intervention groups
Selective reporting (reporting bias)	Low risk	Pre-specified outcomes (of interest to this review) were reported
Other bias	Low risk	Study appears free of other biases

Mitsiou 2015

Study characteristics

Methods	• Study design: factorial RCT (4 arms) • Study duration: not reported • Study follow-up period: not reported

Mitsiou 2015 *(Continued)*

Participants	• Country: Greece • Setting: not reported • Inclusion criteria: HD patients free of other systemic disease • Number: joint music + exercise training group (10); sole music program group (10); sole exercise training group (10); control group (10) • Mean age ± SD: 50 ± 14.7 years • Sex (M/F): not reported • Exclusion criteria: not reported
Interventions	Duration of intervention • 26 weeks Exercise group • Type: not reported • Description: not reported • Position: not reported • Material: not reported • Location: not reported • Duration of training sessions: not reported • Duration of warm-up/cool-down: not reported • Frequency: not reported • Timing in relation to dialysis treatments: during • Intensity: not reported • Supervised by: not reported • Mode of delivery: not reported • Tailoring: not reported • Modifications/progression: not reported • Strategies to enhance adherence: not reported • Adherence to intervention: not reported • Co-intervention: none Control group • Music and usual care (factorial RCT)
Outcomes	• 6MWT • Mean HR • SD of NN intervals • Root mean square of successive differences • Components of the autoregressive power spectrum of the NN intervals
Notes	• Abstract-only publication: authors contacted for full results • Funding: not reported

Risk of bias

Bias	Authors' judgement	Support for judgement
Random sequence generation (selection bias)	Unclear risk	Insufficient information to permit judgement
Allocation concealment (selection bias)	Unclear risk	Insufficient information to permit judgement

Mitsiou 2015 *(Continued)*

Blinding of participants and personnel (performance bias) All outcomes	High risk	No blinding
Blinding of outcome assessment (detection bias) Objective outcomes	Unclear risk	Insufficient information to permit judgement
Blinding of outcome assessment (detection bias) Subjective outcomes	Low risk	No patient-reported outcome
Incomplete outcome data (attrition bias) All outcomes	Unclear risk	Insufficient information to permit judgement
Selective reporting (reporting bias)	Unclear risk	Insufficient information to permit judgement
Other bias	Unclear risk	Insufficient information to permit judgement

Miura 2015

Study characteristics	
Methods	• Study design: parallel RCT (3 arms) • Study duration: not reported • Study follow-up period: 12 weeks
Participants	• Country: Japan • Setting: not reported • Inclusion criteria: ESKD patients • Number: exercise group (19); control group (10); electrical stimulation (6) • Mean age ± SD: 70.2 ± 11.7 years • Sex (M/F): 20/15 • Exclusion criteria: not reported
Interventions	Duration of intervention • 12 weeks Exercise group • Type: aerobic • Description: stationary cycling • Position: not reported • Material: ergometer • Location: not reported • Duration of training sessions: 60 minutes • Duration of warm-up/cool-down: not reported • Frequency: 3 times/week • Timing in relation to dialysis treatments: during • Intensity: 11 to 13 on RPE

Miura 2015 *(Continued)*

	• Supervised by: not reported • Mode of delivery: not reported • Tailoring: not reported • Modifications/progression: not reported • Strategies to enhance adherence: not reported • Adherence to intervention: not reported • Co-intervention: none Control group • Usual care
Outcomes	• Grip strength • Quad muscle torque • Workout time • Activities • Dialysis efficacy • HDL-cholesterol • LDL-cholesterol • CRP • IL-6 • BP
Notes	• Abstract-only publication: authors contacted for full results • Funding: not reported

Risk of bias

Bias	Authors' judgement	Support for judgement
Random sequence generation (selection bias)	Unclear risk	Insufficient information to permit judgement
Allocation concealment (selection bias)	Unclear risk	Insufficient information to permit judgement
Blinding of participants and personnel (performance bias) All outcomes	High risk	No blinding
Blinding of outcome assessment (detection bias) Objective outcomes	Unclear risk	Insufficient information to permit judgement
Blinding of outcome assessment (detection bias) Subjective outcomes	Low risk	No patient-reported outcome
Incomplete outcome data (attrition bias) All outcomes	Unclear risk	Insufficient information to permit judgement
Selective reporting (reporting bias)	Unclear risk	Insufficient information to permit judgement

Miura 2015 *(Continued)*

Other bias	Unclear risk	Insufficient information to permit judgement

Molsted 2004

Study characteristics	
Methods	• Study design: parallel RCT • Study duration: not reported • Study follow-up period: 5 months
Participants	• Country: Denmark • Setting: HD unit • Inclusion criteria: > 18 years old; undergoing HD > 3 months • Number: exercise group (22); control group (11) • Median age, range (years): exercise group (59, 25 to 58); control group (48, 23 to 58) • Sex (M/F): exercise group (14/8); control group (8/3) • Mean dialysis vintage (years): exercise group (2); control group (1.5) • Exclusion criteria: DM; symptomatic heart disease; orthopaedic limitations; severe peripheral polyneuropathy; dementia; participation in other studies with the risk of affecting the results; inability to speak either Danish or English; patients able to speak English were only excluded from the questionnaire
Interventions	Duration of intervention • 21.7 weeks Exercise group • Type: combined • Description: step and circuit training, high and low impact aerobics and stationary cycling • Position: not reported • Material: ergometer, step • Location: not reported • Duration of training sessions: 50 minutes • Duration of warm-up/cool-down: 10/10 minutes • Frequency: 2 times/week • Timing in relation to dialysis treatments: not reported • Intensity: 14 to 17 on RPE • Supervised by: physiotherapist • Mode of delivery: face-to-face • Tailoring: individualised intensity • Modifications/progression: not reported • Strategies to enhance adherence: not reported • Adherence to intervention: not reported • Co-intervention: none Control group • Usual care
Outcomes	• HRQoL • Physical functioning • VO_2 max

Molsted 2004 *(Continued)*

	• BP • Lipids
Notes	Funding • Roche A/S • Janssen-Cilag A/S • The Association of Danish Physiotherapists Research Foundation • Danish Kidney Association • Danish Society of Nephrology, Copenhagen Hospital Corporation • Chr. Andersen and Ingeborg Andersen of the Schmidt Foundation • Anna & Jakob Jakobsen's Foundation

Risk of bias

Bias	Authors' judgement	Support for judgement
Random sequence generation (selection bias)	Unclear risk	Insufficient information to permit judgement
Allocation concealment (selection bias)	Low risk	Envelops
Blinding of participants and personnel (performance bias) All outcomes	High risk	No blinding
Blinding of outcome assessment (detection bias) Objective outcomes	Low risk	No blinding of outcome assessment (or not reported), but the outcome measurement is not likely to be influenced by lack of blinding
Blinding of outcome assessment (detection bias) Subjective outcomes	High risk	No blinding of outcome assessment, and the outcome measurement is likely to be influenced by lack of blinding
Incomplete outcome data (attrition bias) All outcomes	High risk	Reason for missing outcome data likely to be related to true outcome, with either imbalance in numbers or reasons for missing data across intervention groups
Selective reporting (reporting bias)	Low risk	Pre-specified outcomes (of interest to this review) were reported
Other bias	High risk	Private funding. Funder's involvement not specified

Momeni 2014

Study characteristics

Methods	• Study design: parallel RCT • Study duration: 8 months • Study follow-up period: 12 weeks
Participants	• Country: Iran • Setting: HD unit

Momeni 2014 *(Continued)*

- Inclusion criteria: > 18 years; dialysis duration > 3 months
- Number: total (40)
- Mean age ± SD: 43.1 ± 10.5 years
- Sex (M/F): 30/10
- Exclusion criteria: > 60 years; history of ischaemic heart disease; use of anti-arrhythmic agents; LVEF < 40% on ECG; inability of doing Intradialysis exercise; dyspnoea or chest pain during exercise; BP ≥ 160/100 mm Hg before exercise program

Interventions	Duration of intervention • 12 weeks Exercise group • Type: aerobic • Description: stationary cycling • Position: not reported • Material: mini bike • Location: HD unit • Duration of training sessions: 30 minutes • Duration of warm-up/cool-down: not reported • Frequency: 3 times/week • Timing in relation to dialysis treatments: during • Intensity: not reported • Supervised by: not reported • Mode of delivery: not reported • Tailoring: not reported • Modifications/progression: not reported • Strategies to enhance adherence: not reported • Adherence to intervention: not reported • Co-intervention: none Control group • Usual care
Outcomes	• HCT • Hb • Serum calcium (mg/dL) • Serum phosphorus (mg/dL) • Serum potassium (mg/dL) • E/A ratio • Left atrial size (cm) • Left ventricular end-diastolic diameter (cm) • Left ventricular end-systolic diameter (cm) • LVEF (%) • Mitral valve maximum pressure • Mitral valve minimum pressure gradient • Mitral valve velocity time integral • Right ventricular size (cm) • Systolic pulmonary artery pressure (mm Hg) • Blood urea nitrogen (mg/dL) • SCr (mg/dL) • LVH severity

Momeni 2014 *(Continued)*

	• Diastolic dysfunction severity • Presence of pericardial effusion
Notes	• Funding: Shahrekord University of Medical Sciences

Risk of bias

Bias	Authors' judgement	Support for judgement
Random sequence generation (selection bias)	Unclear risk	Insufficient information to permit judgement
Allocation concealment (selection bias)	Unclear risk	Insufficient information to permit judgement
Blinding of participants and personnel (performance bias) All outcomes	High risk	No blinding
Blinding of outcome assessment (detection bias) Objective outcomes	Low risk	No blinding of outcome assessment (or not reported), but the outcome measurement is not likely to be influenced by lack of blinding
Blinding of outcome assessment (detection bias) Subjective outcomes	Low risk	No patient-reported outcome
Incomplete outcome data (attrition bias) All outcomes	Low risk	No missing outcome data
Selective reporting (reporting bias)	Unclear risk	Insufficient information to permit judgement
Other bias	Unclear risk	Insufficient information to permit judgement

Mortazavi 2013

Study characteristics

Methods	• Study design: parallel RCT • Study duration: not reported • Study follow-up period: 16 weeks
Participants	• Country: Iran • Setting: HD unit • Inclusion criteria: HD for at least 3 months; dialysis at least 3 times/week; presence of RLS; ferritin > 100 ng/mL; transferrin saturation rate > 20% • Number: exercise group (13); control group (13) • Mean age ± SD (years): exercise group (32.3 ± 6.7); control group (47.1 ± 13.1) • Sex (M/F): 18/8

Mortazavi 2013 *(Continued)*

	• Exclusion criteria: musculoskeletal disorders which incapacitated them from physical activity; history of ischaemic heart disease (recent MI or unstable angina); any catabolic process such as malignancies opportunistic infections, and infections needing antibiotic therapy during the last 3 months
Interventions	Duration of intervention • 16 weeks Exercise group • Type: aerobic • Description: stationary cycling • Position: not reported • Material: ergometer • Location: HD unit • Duration of training sessions: 20 minutes • Duration of warm-up/cool-down: 5/5 minutes • Frequency: 3 times/week • Timing in relation to dialysis treatments: during • Intensity: 10 to 12 on RPE • Supervised by: not reported • Mode of delivery: not reported • Tailoring: individualised intensity • Modifications/progression: not reported • Strategies to enhance adherence: not reported • Adherence to intervention: not reported • Co-intervention: none Control group • Usual care
Outcomes	• RLS questionnaire • QoL
Notes	• Funding: not reported

Risk of bias

Bias	Authors' judgement	Support for judgement
Random sequence generation (selection bias)	Unclear risk	Insufficient information to permit judgement
Allocation concealment (selection bias)	Unclear risk	Insufficient information to permit judgement
Blinding of participants and personnel (performance bias) All outcomes	High risk	No blinding
Blinding of outcome assessment (detection bias) Objective outcomes	Low risk	No objective outcomes

Mortazavi 2013 *(Continued)*

Blinding of outcome assessment (detection bias) Subjective outcomes	High risk	No blinding of outcome assessment, and the outcome measurement is likely to be influenced by lack of blinding
Incomplete outcome data (attrition bias) All outcomes	Unclear risk	Insufficient information to permit judgement
Selective reporting (reporting bias)	Low risk	Pre-specified outcomes (of interest to this review) were reported
Other bias	Unclear risk	Insufficient information to permit judgement

Olvera-Soto 2016

Study characteristics	
Methods	• Study design: parallel RCT • Study duration: 6 months • Study follow-up period: 12 weeks
Participants	• Country: Mexico • Setting: HD unit • Inclusion criteria: > 18 years; on HD for at least 3 months, residents of Mexico City • Number: exercise group (30); control group (31) • Median age, IQR (years): exercise group (28.5, 23 to 46.5); control group (29, 19 to 38) • Sex (M/F): exercise group (14/16); control group (19/12) • Median HD vintage, IQR (years): exercise group (12, 5.75 to 37.75); control group (18, 8 to 39) • Mean BMI ± SD (kg/m^2): exercise group (21.8 ± 3.1); control group (21.1 ± 2.7) • Exclusion criteria: not reported
Interventions	Duration of intervention • 12 weeks Exercise group • Type: resistance • Description: upper and lower limbs exercises • Position: seated • Material: weights and resistance bands • Location: HD unit • Duration of training sessions: 50 minutes • Duration of warm-up/cool-down: not reported • Frequency: 2 times/week • Timing in relation to dialysis treatments: during • Intensity: not reported • Supervised by: supervised not further defined • Mode of delivery: face-to-face • Tailoring: not reported • Modifications/progression: weights added on 3rd sessions • Strategies to enhance adherence: performed in groups • Adherence to intervention: not reported

Olvera-Soto 2016 *(Continued)*

	• Co-intervention: none Control group • Usual care
Outcomes	• Body fat (%) • Dietary energy intake • Dietary protein intake • Arm muscle circumference (mm) • Arm muscular area • Handgrip strength (kg)
Notes	• Funding: not reported

Risk of bias

Bias	Authors' judgement	Support for judgement
Random sequence generation (selection bias)	Low risk	Computer random number generator
Allocation concealment (selection bias)	Unclear risk	Insufficient information to permit judgement
Blinding of participants and personnel (performance bias) All outcomes	High risk	No blinding
Blinding of outcome assessment (detection bias) Objective outcomes	Low risk	No blinding of outcome assessment (or not reported), but the outcome measurement is not likely to be influenced by lack of blinding
Blinding of outcome assessment (detection bias) Subjective outcomes	Low risk	No patient-reported outcome
Incomplete outcome data (attrition bias) All outcomes	Low risk	Missing outcome data balanced in numbers across intervention groups
Selective reporting (reporting bias)	High risk	The study report fails to include results for key outcomes that would be expected to have been reported for such a study
Other bias	Unclear risk	Insufficient information to permit judgement

Ouzouni 2009

Study characteristics

Methods	• Study design: parallel RCT • Study duration: 6 months • Study follow-up period: 43 weeks
Participants	• Country: Greece

Ouzouni 2009 *(Continued)*

- Setting: not reported
- Inclusion criteria: on maintenance HD 3 days/ week, 4 hours/session for at least 6 months prior to the study
- Number (randomised/analysed): exercise group (20/19); control group (15/14)
- Mean age ± SD (years): exercise group (47 ± 16); control group (51 ± 12)
- Sex (M/F): exercise group (14/5); control group (13/1)
- HD vintage ± SD (years): exercise group (7.7 ± 7.0); control group (8.6 ± 6.0)
- Exclusion criteria: unstable hypertension; heart failure (NYHA class > II); cardiac arrhythmias (> III according to Lown); recent MI or unstable angina; DM; active liver disease or orthopaedic problems limiting exercise

Interventions	Duration of intervention • 43.4 weeks Exercise group • Type: combined • Description: stationary cycling + abdominal and lower limbs exercises • Position: not reported • Material: ergometer, weights and resistance bands • Location: HD unit • Duration of training sessions: 20 min aerobic + varied for resistance minutes • Duration of warm-up/cool-down: 5/5 minutes • Frequency: 3 times/week • Timing in relation to dialysis treatments: during • Intensity: 13 to 14 on RPE (6 to 20) • Supervised by: physician and exercise physiologist • Mode of delivery: face-to-face • Tailoring: individualised intensity • Modifications/progression: increasing duration, number of repetitions and weights added • Strategies to enhance adherence: not reported • Adherence to intervention: not reported • Co-intervention: none Control group • Usual care
Outcomes	• HRQoL • VO_2 peak • Exercise time • Metabolic equivalents • HR maximum • BP • Depression • Double product • Maximum pulmonary ventilation
Notes	• Funding: not reported

Risk of bias

Bias	Authors' judgement	Support for judgement

Ouzouni 2009 *(Continued)*

Random sequence generation (selection bias)	Unclear risk	Insufficient information to permit judgement
Allocation concealment (selection bias)	Unclear risk	Insufficient information to permit judgement
Blinding of participants and personnel (performance bias) All outcomes	High risk	No blinding
Blinding of outcome assessment (detection bias) Objective outcomes	Low risk	No blinding of outcome assessment (or not reported), but the outcome measurement is not likely to be influenced by lack of blinding
Blinding of outcome assessment (detection bias) Subjective outcomes	High risk	No blinding of outcome assessment, and the outcome measurement is likely to be influenced by lack of blinding
Incomplete outcome data (attrition bias) All outcomes	Low risk	Missing outcome data balanced in numbers across intervention groups
Selective reporting (reporting bias)	Low risk	Pre-specified outcomes (of interest to this review) were reported
Other bias	Unclear risk	Insufficient information to permit judgement

Painter 2002a

Study characteristics	
Methods	• Study design: factorial RCT (4 arms); stratified by age (< 50 years versus ≥ 50 years) • Study duration: not reported • Study follow-up period: 5 months

Participants	• Country: USA
	• Setting: 5 HD units
	• Inclusion criteria: ≥ 18 years; treated with HD for at least 3 months; mean HCT of 30% ± 3% for 4 weeks before study enrolment
	  ○ Exercise group 1: usual care HCT (30% to 33%) + exercise
	  ○ Exercise group 2: normalised HCT (40% to 42%) + exercise
	• Number: exercise group 1 (10); exercise group 2 (12); control group 1 (14); control group 2 (12)
	• Mean age ± SD (years): exercise group 1 (47.6 ± 11.9); exercise group 2 (43.5 ± 10.5); control group 1 (43.3 ± 9.8); control group 2 (50.1 ± 13.8)
	• Sex (M/F): exercise group 1 (5/5); exercise group 2 (5/7); control group 1 (6/8); control group 2 (5/7)
	• Mean HD vintage ± SD (months): exercise group 1 (23.1 ± 24.6); exercise group 2 (60.4 ± 80.0); control group 1 (61.8 ± 72.9); control group 2 (67.8 ± 54.4)
	• Exclusion criteria: unstable hypertension; heart failure (NYHA class > II); cardiac arrhythmias (> III according to Lown); recent MI or unstable angina; DM; active liver disease or orthopaedic problems limiting exercise

Interventions	Duration of intervention • 21.7 weeks

Painter 2002a *(Continued)*

	Exercise groups • Type: aerobic • Description: stationary cycling • Position: not reported • Material: ergometer • Location: HD unit • Duration of training sessions: 10 to 30 minutes • Duration of warm-up/cool-down: 10/not reported minutes • Frequency: 3 times/week • Timing in relation to dialysis treatments: during • Intensity: 14 to 17 on RPE or 70% max HR • Supervised by: study staff • Mode of delivery: face-to-face • Tailoring: individualised intensity • Modifications/progression: increasing duration, addition of more intense intervals once 20 min was reached • Strategies to enhance adherence: not reported • Adherence to intervention: not reported • Co-intervention: none Control group • Usual care or normalized HCT (factorial RCT)
Outcomes	• VO_2 peak • Physical functioning • HRQoL • HR maximum • HCT • Hb • EPO dose • Respiratory exchange ratio • BP maximum
Notes	• The published article does not provide the results for HRQoL. The authors were contacted but could not provide the missing results • Funding: Amgen

Risk of bias

Bias	Authors' judgement	Support for judgement
Random sequence generation (selection bias)	Low risk	Stratified by age. Assumed computer-generated
Allocation concealment (selection bias)	Low risk	Sealed envelopes
Blinding of participants and personnel (performance bias) All outcomes	High risk	No blinding
Blinding of outcome assessment (detection bias)	Low risk	No blinding of outcome assessment (or not reported), but the outcome measurement is not likely to be influenced by lack of blinding

Painter 2002a *(Continued)*

Objective outcomes		
Blinding of outcome assessment (detection bias) Subjective outcomes	High risk	No blinding of outcome assessment, and the outcome measurement is likely to be influenced by lack of blinding
Incomplete outcome data (attrition bias) All outcomes	Low risk	Missing outcome data balanced in numbers across intervention groups, with similar reasons for missing data across groups
Selective reporting (reporting bias)	High risk	One or more outcomes of interest in the review are reported incompletely so that they cannot be entered in a meta-analysis
Other bias	High risk	Private funding. Funder's involvement not specified

Paluchamy 2018

Study characteristics	
Methods	• Study design: parallel RCT • Study duration: 2 months • Study follow-up period: not reported
Participants	• Country: India • Setting: HD unit • Inclusion criteria: undergoing HD • Number: exercise group (10); control group (10) • Age range: 51 to 70 years • Sex (M/F): exercise group (9/1); control group (9/1) • Exclusion criteria: symptomatic cardiovascular disease such as unstable angina, recent MI, congestive cardiac failure Grade II; body temperature more than 101°F; persistent hyperkalaemia before dialysis; active liver disease; musculoskeletal limitations; severe peripheral polyneuropathy; dementia or other mental disorders; on another exercise program; haemodynamically unstable during the dialysis treatment; lower limb amputation
Interventions	Duration of intervention • 12 weeks Exercise group • Type: aerobic • Description: stationary cycling • Position: recumbent • Material: ergometer • Location: HD unit • Duration of training sessions: 10 to 15 minutes • Duration of warm-up/cool-down: 5/not reported minutes • Frequency: 3 times/week • Timing in relation to dialysis treatments: during • Intensity: not reported • Supervised by: not reported • Mode of delivery: not reported • Tailoring: individualised intensity and duration

Paluchamy 2018 *(Continued)*

	• Modifications/progression: not reported • Strategies to enhance adherence: not reported • Adherence to intervention: not reported • Co-intervention: none Control group • Usual care
Outcomes	• Kt/V • SBP • DBP • Weight • SCr • blood urea • Calcium • Phosphate • Potassium • Hb • QoL (KDQOL-SF)
Notes	• Unpublished results were provided by the authors • The results for the individual domains of KDQOL-SF could not be included in the meta-analysis because they were not rescaled from 0 to 100 • Funding: not reported

Risk of bias

Bias	Authors' judgement	Support for judgement
Random sequence generation (selection bias)	Unclear risk	Insufficient information to permit judgement
Allocation concealment (selection bias)	Unclear risk	Insufficient information to permit judgement
Blinding of participants and personnel (performance bias) All outcomes	High risk	No blinding
Blinding of outcome assessment (detection bias) Objective outcomes	Low risk	No blinding of outcome assessment (or not reported), but the outcome measurement is not likely to be influenced by lack of blinding
Blinding of outcome assessment (detection bias) Subjective outcomes	High risk	No blinding of outcome assessment, and the outcome measurement is likely to be influenced by lack of blinding
Incomplete outcome data (attrition bias) All outcomes	Unclear risk	Insufficient information to permit judgement
Selective reporting (reporting bias)	Unclear risk	Insufficient information to permit judgement

Paluchamy 2018 *(Continued)*

Other bias	Unclear risk	Insufficient information to permit judgement

Parsons 2004

Study characteristics	
Methods	• Study design: parallel RCT • Study duration: 2 months • Study follow-up period: not reported
Participants	• Country: Canada • Setting: HD unit • Inclusion criteria: undergoing HD treatments • Number: exercise group (6); control group (7) • Mean age ± SD (years): exercise group (60 ± 17); control group (49 ± 25) • Sex (M/F): exercise group (3/3); control group (4/3) • Mean HD vintage ± SD (months): exercise group (25 ± 25); control group (49 ± 26) • Exclusion criteria: cardiovascular, neurological or orthopaedic impairment which would preclude the ability to exercise during the 8-week protocol
Interventions	Duration of intervention • 12 weeks Exercise group • Type: aerobic • Description: stationary cycling • Position: not reported • Material: ergometer • Location: HD unit • Duration of training sessions: 45 minutes • Duration of warm-up/cool-down: not reported • Frequency: 3 times/week • Timing in relation to dialysis treatments: during • Intensity: 405 to 50% of maximum load • Supervised by: not reported • Mode of delivery: not reported • Tailoring: individualised intensity • Modifications/progression: increased intensity at week 4 if improvement in Wmax • Strategies to enhance adherence: not reported • Adherence to intervention: not reported • Co-intervention: none Control group • Usual care
Outcomes	• Maximal work capacity • Resting BP • HRQoL • Blood urea clearance

Parsons 2004 *(Continued)*

	• Dialysate urea clearance

Notes	• Missing data: resting SBP and DBP post exercise training intervention for both the exercise group and the control group
	• Funding
	  ○ Kidney Foundation of Canada
	  ○ John Bedal Foundation at Kingston General Hospital

Risk of bias

Bias	Authors' judgement	Support for judgement
Random sequence generation (selection bias)	Low risk	Stratified on multiple characteristics. Assumed computer-generated
Allocation concealment (selection bias)	Unclear risk	Insufficient information to permit judgement
Blinding of participants and personnel (performance bias) All outcomes	High risk	No blinding
Blinding of outcome assessment (detection bias) Objective outcomes	Low risk	No blinding of outcome assessment (or not reported), but the outcome measurement is not likely to be influenced by lack of blinding
Blinding of outcome assessment (detection bias) Subjective outcomes	High risk	No blinding of outcome assessment, and the outcome measurement is likely to be influenced by lack of blinding
Incomplete outcome data (attrition bias) All outcomes	Low risk	Missing outcome data balanced in numbers across intervention groups
Selective reporting (reporting bias)	Low risk	Pre-specified outcomes (of interest to this review) were reported
Other bias	Low risk	Study appears free of other biases

PEAK 2006

Study characteristics

Methods	• Study design: parallel RCT • Study duration: 57 months • Study follow-up period: 12 weeks
Participants	• Country: Australia • Setting: HD unit • Inclusion criteria: > 18 years; on HD for > 3 months; without acute or chronic medical conditions precluding the intervention or collection of outcome measures; independent ambulation with or without an assistive device for > 50 min; adequately dialysed (Kt/V > 1.2) and stable during dialysis; cognition and English language sufficient to understand research procedures and provide written informed consent; willingness to be randomised and to undergo study protocols

PEAK 2006 *(Continued)*

- Number: exercise group (24); control group (25)
- Mean age ± SD (years): exercise group (60.2 ± 15.2); control group (66.3 ± 13.5)
- Sex (M/F): exercise group (9/4); control group (12/6)
- Median HD vintage, IQR (years): exercise group (3.9, 0.3 to 16.7); control group (1.2, 0.6 to 8.3)
- Mean BMI ± SD (kg/m^2): exercise group (27.9 ± 6.7); control group (27.3 ± 5.3)
- Exclusion criteria: cardiac instability; aortic stenosis; unstable cerebral aneurysms; psychological disorder/dementia; active malignancy; proliferative diabetic retinopathy; emphysema; multiple hernias; unstable HD; non-compliance to HD; hemiparesis

Interventions	Duration of intervention • 12 weeks Exercise group • Type: resistance • Description: upper and lower limbs exercises • Position: seated or supine • Material: ankle and free-weights dumbbells • Location: HD unit • Duration of training sessions: 45 minutes • Duration of warm-up/cool-down: not reported • Frequency: 3 times/week • Timing in relation to dialysis treatments: prior and during • Intensity: 15 to 17 on RPE • Supervised by: exercise physiologist • Mode of delivery: face-to-face • Tailoring: individualised intensity • Modifications/progression: not reported • Strategies to enhance adherence: not reported • Adherence to intervention (sessions attended): 75.9% • Co-intervention: none Control group • Usual care
Outcomes	• BMI (kg/m^2) • Body weight (kg) • Regional fat estimates: subcutaneous mid-thigh fat (cm^2) • Regional fat estimates: total mid-thigh fat (cm^2) • Waist circumference (cm) • Serum albumin • CRP • IL-10b (pg/mL) • IL-12a (pg/mL) • IL-1 a (pg/mL) • IL-6b (pg/mL) • IL-8b (pg/mL) • Lymphocytes (x 10^9/L) • Tumour necrosis factor a (pg/mL) • WBC count (x 10^9) • SCr (mol/L) • Adherence to exercise sessions

PEAK 2006 *(Continued)*

- Energy intake (20) (kcal/kg/day)
- Mini-nutritional assessment (19) (0 to 30)
- Protein catabolic rate (g/kg/day)
- Protein intake (20) (g/kg/day)
- Physical activity scale
- 6MWT
- Muscle attenuation (Hounsfield unit)
- Mid-arm circumference (cm)
- Mid-calf circumference (cm)
- Mid-thigh circumference (cm)
- Muscle cross-sectional area (cm^2)
- Total strength (kg)
- Geriatric depression scale
- QoL
- Dialysis adequacy (Kt/V)

Notes	Funding • University of Sydney Healthy Ageing Research Program • Australian Kidney Foundation • National Health and Medical Research Council of Australia • equipment donations from the Australian Barbell Company and SIMBEX Corporation

Risk of bias

Bias	Authors' judgement	Support for judgement
Random sequence generation (selection bias)	Low risk	Computer random number generator
Allocation concealment (selection bias)	Low risk	Randomisation process independent from study team and use of opaque sealed envelopes
Blinding of participants and personnel (performance bias) All outcomes	High risk	No blinding
Blinding of outcome assessment (detection bias) Objective outcomes	Low risk	Blinding of outcome assessment ensured, and unlikely that the blinding could have been broken
Blinding of outcome assessment (detection bias) Subjective outcomes	High risk	No blinding of outcome assessment, and the outcome measurement is likely to be influenced by lack of blinding
Incomplete outcome data (attrition bias) All outcomes	Unclear risk	Insufficient information to permit judgement
Selective reporting (reporting bias)	High risk	Not all of the study's pre-specified outcomes have been reported. One or more outcomes of interest in the review are reported incompletely so that they cannot be entered in a meta-analysis.
Other bias	High risk	Private funding. Funder's involvement not specified

Pellizzaro 2013

Study characteristics	
Methods	• Study design: parallel RCT (3 arms*) • Study duration: 3 months • Study follow-up period: 10 weeks
Participants	• Country: Brazil • Setting: HD unit • Inclusion criteria: 18 and 70 years; on dialysis > 3 months; agree to participate by signing an informed consent form • Number: exercise group (15); control group (15) • Mean age ± SD (years): exercise group (48.9 ± 10.1); control group (51.9 ± 11.6) • Sex (M/F): exercise group (7/7); control group (8/6) • Mean BMI ± SD (kg/m^2): exercise group (23.1 ± 2.6); control group (24.1 ± 3.6) • Median HD vintage, IQR (months): exercise group (54.0, 10.7 to 120); control group (54.0, 12 to 78) • Exclusion criteria: unstable angina; uncontrolled cardiac arrhythmia; decompensated heart failure; SBP > 200 mm Hg, DBP > 120 mm Hg; acute pericarditis or myocarditis; decompensated DM (fasting serum glucose > 300 mg/dL); severe untreated mitral or aortic insufficiency/stenosis, severe lung conditions; acute systemic infection; severe bone disease; lower limb amputations; cognitive disorders; unable to perform the proposed tests due to disabling musculoskeletal, bone, or joint disorders
Interventions	Duration of intervention • 10 weeks Exercise group • Type: resistance • Description: knee extensions • Position: seated • Material: free leg weights • Location: HD unit • Duration of training sessions: varied minutes • Duration of warm-up/cool-down: not reported • Frequency: 3 times/week • Timing in relation to dialysis treatments: during • Intensity: 50% of 1-RM • Supervised by: not reported • Mode of delivery: not reported • Tailoring: individualised intensity • Modifications/progression: training load adjusted on 30th day • Strategies to enhance adherence: not reported • Adherence to intervention: not reported • Co-intervention: none Control group • Usual care
Outcomes	• Serum albumin • Hb • Phosphorus • Potassium

Pellizzaro 2013 *(Continued)*

	• hs-CRP • Urea • Kt/V • Post-intervention FVC (L) • Post-intervention PEmax (cmH_2O) • Post-intervention PImax (cmH_2O) • 6MWT • QoL
Notes	• *Respiratory muscle training group no included in this review • Funding: Research Funding of Hospital de Clínicas de Porto Alegre (FIPE/HCPA)

Risk of bias

Bias	Authors' judgement	Support for judgement
Random sequence generation (selection bias)	Unclear risk	Insufficient information to permit judgement
Allocation concealment (selection bias)	Unclear risk	Insufficient information to permit judgement
Blinding of participants and personnel (performance bias) All outcomes	High risk	No blinding
Blinding of outcome assessment (detection bias) Objective outcomes	Low risk	No blinding of outcome assessment (or not reported), but the outcome measurement is not likely to be influenced by lack of blinding
Blinding of outcome assessment (detection bias) Subjective outcomes	High risk	No blinding of outcome assessment, and the outcome measurement is likely to be influenced by lack of blinding
Incomplete outcome data (attrition bias) All outcomes	High risk	Reason for missing outcome data likely to be related to true outcome, with either imbalance in numbers or reasons for missing data across intervention groups
Selective reporting (reporting bias)	High risk	One or more primary outcomes is reported using measurements, analysis methods or subsets of the data (e.g. sub-scales) that were not pre-specified. The study report fails to include results for a key outcome that would be expected to have been reported for such a study.
Other bias	Low risk	The study appears to be free of other sources of bias

Rahimimoghadam 2017

Study characteristics

Methods	• Study design: parallel RCT • Study duration: 3 months • Study follow-up period: 8 weeks

Rahimimoghadam 2017 *(Continued)*

Participants	• Country: Iran • Setting: Hospital gym • Inclusion criteria: 18 to 65 years; history of HD treatment 2 to 3 times/week for at least 6 months; physical ability to perform basic daily activities; Nephrologist's permission to practice the exercise • Number: exercise group (25); control group (25) • Mean age ± SD (years): exercise group (39.1 ± 2.2); control group (38.4 ± 1.8) • Sex (M/F): exercise group (21/4); control group (20/5) • Mean HD vintage ± SD (months): exercise group (32.2 ± 28.2); control group (45.5 ± 49.5) • Exclusion criteria: 3 or more sessions of absence in exercises; being a habitual Pilates practitioner; detection of reduced exercise tolerance, including tachycardia, shortness of breath, and feeling too tired or weak; PD during the study; other concurrent clinical conditions, such as cardio-respiratory problems reported by physician and/or patients
Interventions	Duration of intervention • 8 weeks Exercise group • Type: resistance • Description: modified Pilates • Position: not applicable • Material: not reported • Location: hospital gym • Duration of training sessions: 45 minutes • Duration of warm-up/cool-down: not reported • Frequency: 3 times/week • Timing in relation to dialysis treatments: on non-HD days • Intensity: not reported • Supervised by: qualified Pilates professionals • Mode of delivery: face-to-face • Tailoring: not reported • Modifications/progression: not reported • Strategies to enhance adherence: not reported • Adherence to intervention: not reported • Co-intervention: none Control group • Usual care
Outcomes	• Anxiety • Depression • Physical symptoms • Social dysfunction • Total score of general health
Notes	• Funding: Kashan University of Medical Sciences

Risk of bias

Bias	Authors' judgement	Support for judgement
Random sequence generation (selection bias)	Low risk	Bloc randomisation. Assumed computer-generated

Rahimimoghadam 2017 *(Continued)*

Allocation concealment (selection bias)	Unclear risk	Insufficient information to permit judgement
Blinding of participants and personnel (performance bias) All outcomes	High risk	No blinding
Blinding of outcome assessment (detection bias) Objective outcomes	Low risk	No objective outcomes
Blinding of outcome assessment (detection bias) Subjective outcomes	High risk	No blinding of outcome assessment, and the outcome measurement is likely to be influenced by lack of blinding
Incomplete outcome data (attrition bias) All outcomes	Low risk	No missing outcome data
Selective reporting (reporting bias)	Low risk	Pre-specified outcomes (of interest to this review) were reported
Other bias	Low risk	The study appears to be free of other sources of bias

Reboredo 2010

Study characteristics	
Methods	• Study design: parallel RCT • Study duration: not reported • Study follow-up period: 12 weeks
Participants	• Country: Brazil • Setting: HD unit • Inclusion criteria: adults undergoing HD who did not exercise on a regular basis for at least 6 months • Number: exercise group (14); control group (14) • Mean age ± SD (years): exercise group (49.6 ± 10.6); control group (43.5 ± 12.8) • Sex (M/F): exercise group (4/7); control group (4/7) • Mean HD vintage ± SD (months): exercise group (41.9 ± 42.4); control group (60.1 ± 54.4) • Mean BMI ± SD (kg/m^2): exercise group (22.6 ± 2.3); control group (22.9 ± 4.1) • Exclusion criteria: DM; unstable angina; uncontrolled arterial hypertension (SBP ≥ 200 mm Hg and/or DBP ≥ 120 mm Hg); use of antiarrhythmic drugs; severe pneumopathies; acute systemic infection; severe renal osteodystrophy; disabling neurological and muscle-skeletal disorders
Interventions	Duration of intervention • 12 weeks Exercise group • Type: aerobic • Description: stationary cycling • Position: not reported • Material: horizontal ergometer

Reboredo 2010 *(Continued)*

- Location: HD unit
- Duration of training sessions: 35 minutes
- Duration of warm-up/cool-down: 15/3 minutes
- Frequency: 3 times/week
- Timing in relation to dialysis treatments: during
- Intensity: 4 to 6 on RPE (1 to 10)
- Supervised by: supervised not further defined
- Mode of delivery: not reported
- Tailoring: individualised intensity
- Modifications/progression: not reported
- Strategies to enhance adherence: not reported
- Adherence to intervention (mean ± SD sessions attended): 75.3% ± 15.2%
- Co-intervention: none

Control group

- Usual care

Outcomes	• Serum albumin • Hb • Calcium (mg/dL) • Phosphorus (mg/dL) • Potassium (mEq/L) • End systolic volume (mL) • End diastolic volume (mL) • LVMI (g/m^2) • Ejection fraction (%) • Systolic volume (mL) • HF (ms^2) • LF (ms^2) • LF/HF • pNN50 (%) • RMSSD (ms) • SDNN index (ms) • SCr (mg/dL) • Adherence to exercise sessions • Kt/V
Notes	Funding • Fundação de Amparo à Pesquisa do Estado de Minas Gerais • Coordenação de Aperfeiçoamento de Pessoal de Nível Superior • IMEPEN Foundation

Risk of bias

Bias	Authors' judgement	Support for judgement
Random sequence generation (selection bias)	Unclear risk	Insufficient information to permit judgement
Allocation concealment (selection bias)	Unclear risk	Insufficient information to permit judgement

Reboredo 2010 *(Continued)*

Blinding of participants and personnel (performance bias) All outcomes	High risk	No blinding
Blinding of outcome assessment (detection bias) Objective outcomes	Low risk	Blinding of outcome assessment ensured, and unlikely that the blinding could have been broken
Blinding of outcome assessment (detection bias) Subjective outcomes	Low risk	No patient-reported outcome
Incomplete outcome data (attrition bias) All outcomes	High risk	Reason for missing outcome data likely to be related to true outcome, with either imbalance in numbers or reasons for missing data across intervention groups
Selective reporting (reporting bias)	Low risk	Pre-specified outcomes (of interest to this review) were reported
Other bias	Low risk	The study appears to be free of other sources of bias

Rezaei 2015

Study characteristics	
Methods	• Study design: parallel RCT • Study duration: not reported • Study follow-up period: 10 weeks
Participants	• Country: Iran • Setting: HD unit • Inclusion criteria: aged 15 to 65 years, under treatment of HD for at least 3 months • Number: exercise group (25); control group (26) • Mean age ± SD (years): exercise group (44.0 ± 7.9); control group (42.6 ± 12.7) • Sex (M/F): exercise group (21/4); control group (14/12) • Mean HD vintage ± SD (months): exercise group (42.7 ± 38.9); control group (35.5 ± 27.0) • Exclusion criteria: progressive cardiovascular or respiratory diseases; restricting musculoskeletal disorder; lacking the physical power to exercise; using any medicine or other procedures for treating depression; not being under treatment of HD 2 or 3 times/week, not performing the exercise program for 3 times continuously or 5 times alternatively; dissatisfaction for continuing collaboration; problematic haemodynamic instability.
Interventions	Duration of intervention • 10 weeks Exercise group • Type: range of movement • Description: joints warming actions, stretching exercises, motions of lower back muscles and abdomen, and deep breathing exercises. • Position: not reported • Material: not reported • Location: home

Rezaei 2015 *(Continued)*

- Duration of training sessions: 35 minutes
- Duration of warm-up/cool-down: not reported
- Frequency: 3 times/week
- Timing in relation to dialysis treatments: not during, home-based
- Intensity: not reported bur described as less than moderate
- Supervised by: unsupervised
- Mode of delivery: posters
- Tailoring: not reported
- Modifications/progression: not reported
- Strategies to enhance adherence: phone calls and visits in dialysis
- Adherence to intervention: not reported
- Co-intervention: none

Control group

- Usual care

Outcomes	• Depression (BDI)
Notes	• Funding: not reported

Risk of bias

Bias	Authors' judgement	Support for judgement
Random sequence generation (selection bias)	Unclear risk	Insufficient information to permit judgement
Allocation concealment (selection bias)	Unclear risk	Insufficient information to permit judgement
Blinding of participants and personnel (performance bias) All outcomes	High risk	No blinding
Blinding of outcome assessment (detection bias) Objective outcomes	Low risk	No objective outcomes
Blinding of outcome assessment (detection bias) Subjective outcomes	High risk	No blinding of outcome assessment, and the outcome measurement is likely to be influenced by lack of blinding
Incomplete outcome data (attrition bias) All outcomes	High risk	Reason for missing outcome data likely to be related to true outcome, with either imbalance in numbers or reasons for missing data across intervention groups
Selective reporting (reporting bias)	High risk	The study report fails to include results for key outcomes that would be expected to have been reported for such a study.
Other bias	Unclear risk	Insufficient information to permit judgement

Rosa 2018

Study characteristics	
Methods	• Study design: parallel RCT • Study duration: 21 months • Study follow-up period: 12 weeks
Participants	• Country: Brazil • Setting: HD unit • Inclusion criteria: > 18 years; HD > 3 months; permission of the attending Nephrologist; independent ambulation for > 50 metres with or without an assistive device; cognition and willingness to be randomly assigned into groups and to undergo the study protocols • Number: exercise group (30); control group (29) • Mean age ± SD (years): exercise group (54.49 ± 11.97); control group (57.10 ± 16.20) • Sex (M/F): exercise group (20/8); control group (15/9) • Mean BMI ± SD (kg/m^2): exercise group (26.36 ± 4.48); control group (25.54 ± 3.95) • Mean HD vintage ± SD (years): exercise group (1.54 ± 1.26); control group (2.35 ± 1.66) • Exclusion criteria: acute or chronic medical conditions that would preclude exercise or the collection of the outcome measure data
Interventions	Duration of intervention • 12 weeks Exercise group • Type: resistance • Description: upper and lower limbs exercises • Position: not reported • Material: weights and resistance bands • Location: HD unit • Duration of training sessions: 40 to 50 minutes • Duration of warm-up/cool-down: not reported • Frequency: 3 times/week • Timing in relation to dialysis treatments: prior and during • Intensity: not reported • Supervised by: clinical exercise physiologists • Mode of delivery: face-to-face • Tailoring: individualised resistance level • Modifications/progression: increasing resistance level to maintain N of repetitions • Strategies to enhance adherence: not reported • Adherence to intervention (mean ± SD sessions attended): upper limbs (67% ± 18%); lower limbs (83% ± 9%) • Co-intervention: none Control group • Very low-intensity exercise without load and progression and a breathing exercise
Outcomes	• BMI (kg/m^2) • Bone mineral content (kg) • Total LBM (kg) • Trunk lean mass (kg) • Arm lean mass (kg) • Leg lean mass (kg) • Total fat mass (kg)

Rosa 2018 *(Continued)*

	• Total mass (kg) • 6MWT (m) • Sit-to-stand test (rep) • Handgrip strength (kg/strength) • Flexibility (cm) • QoL
Notes	• Funding: nil

Risk of bias

Bias	Authors' judgement	Support for judgement
Random sequence generation (selection bias)	Low risk	Computer random number generator
Allocation concealment (selection bias)	Low risk	Allocation concealment performed by researcher not involved in recruitment or assessment
Blinding of participants and personnel (performance bias) All outcomes	Low risk	Sham exercise in the control arm
Blinding of outcome assessment (detection bias) Objective outcomes	Low risk	No blinding of outcome assessment (or not reported), but the outcome measurement is not likely to be influenced by lack of blinding
Blinding of outcome assessment (detection bias) Subjective outcomes	Low risk	Sham exercise in the control arm
Incomplete outcome data (attrition bias) All outcomes	Low risk	Missing outcome data balanced in numbers across intervention groups
Selective reporting (reporting bias)	Low risk	Pre-specified outcomes (of interest to this review) were reported
Other bias	Low risk	The study appears to be free of other sources of bias

Rouchon 2016

Study characteristics

Methods	• Study design: parallel RCT • Study duration: not reported • Study follow-up period: 12 weeks
Participants	• Country: France • Setting: not reported • Inclusion criteria: undergoing PD treatments • Number: exercise group (9); control group (9) • Loss to follow-up: exercise group (1); control group (5)

Rouchon 2016 *(Continued)*

- Mean age ± SD (years): exercise group (66.94 ± 2.89); control group (57.80 ± 3,30)
- Sex M/F: exercise group (4/4); control group (0/4)
- Mean BMI ± SD (kg/m^2): exercise group (31.12 ± 1.90); control group (26.01 ± 1.59)
- Mean HD vintage ± SD (years): exercise group (1.94 ± 0.46); control group (2.1± 0.8)
- Exclusion criteria: not reported

Interventions	Duration of intervention • 12 weeks Exercise group • Type: combined • Description: bicycle-HIIT sessions + upper and lower limbs exercises • Position: not reported • Material: ergometer, weights • Location: not reported • Duration of training sessions: 20 minutes • Duration of warm-up/cool-down: not reported/15 minutes • Frequency: 2 times/week • Timing in relation to dialysis treatments: PD patients only • Intensity: not reported • Supervised by: not reported • Mode of delivery: not reported • Tailoring: not reported • Modifications/progression: not reported • Strategies to enhance adherence: not reported • Adherence to intervention: not reported • Co-intervention: none Control group • Usual care
Outcomes	• 6MWT • VO_2 peak
Notes	• Abstract-only publication: unpublished results were provided by the authors • Funding: not reported

Risk of bias

Bias	Authors' judgement	Support for judgement
Random sequence generation (selection bias)	Low risk	Drawing of lots (provided by author)
Allocation concealment (selection bias)	Unclear risk	Insufficient information to permit judgement
Blinding of participants and personnel (performance bias) All outcomes	High risk	No blinding

Rouchon 2016 *(Continued)*

Blinding of outcome assessment (detection bias) Objective outcomes	Low risk	No blinding of outcome assessment (or not reported), but the outcome measurement is not likely to be influenced by lack of blinding
Blinding of outcome assessment (detection bias) Subjective outcomes	Low risk	No patient-reported outcome
Incomplete outcome data (attrition bias) All outcomes	High risk	Reason for missing outcome data likely to be related to true outcome, with either imbalance in numbers or reasons for missing data across intervention groups
Selective reporting (reporting bias)	Unclear risk	Insufficient information to permit judgement
Other bias	Unclear risk	Insufficient information to permit judgement

Samara 2016

Study characteristics	
Methods	• Study design: parallel RCT • Study duration: not reported • Study follow-up period: 16 weeks
Participants	• Country: Greece • Setting: outside the HD unit • Inclusion criteria: HD 3 days/week, 4 hours/session for at least 6 months prior to the study • Number: exercise group (16); control group (13) • Mean age ± SD (years): exercise group (48.0 ± 11.3); control group (48.6 ± 15.4) • Sex (M/F): exercise group (13/2); control group (11/1) • Mean BMI ± SD (kg/m^2): exercise group (24.23 ± 2.81); control group (25.46 ± 5.14) • Exclusion criteria: no acute or chronic medical conditions that would affect the measured data; recent MI (within 6 weeks); malignant arrhythmias; unstable angina; Hb < 10 g/dL or inconstant throughout the study; receiving beta-blockers or other antiarrhythmic medication
Interventions	Duration of intervention • 16 weeks Exercise group • Type: aerobic • Description: swimming (freestyle, breaststroke, and backstroke) • Position: not applicable • Material: pool, foam tubes, buoyancy belts, paddles • Location: pool • Duration of training sessions: 20 to 40 minutes • Duration of warm-up/cool-down: 10/10 minutes • Frequency: 3 times/week • Timing in relation to dialysis treatments: on non-HD days • Intensity: 13 to 14 on RPE (6 to 20) • Supervised by: specialised exercise trainer • Mode of delivery: face-to-face

Samara 2016 *(Continued)*

	• Tailoring: individualised intensity • Modifications/progression: increasing intensity • Strategies to enhance adherence: not reported • Adherence to intervention: not reported • Co-intervention: none Control group • Usual care
Outcomes	• 6MWT • Sit and reach (cm) • Time up and go • Handgrip (kg) • Sit-to-stand test • QoL
Notes	• Funding: not reported

Risk of bias

Bias	Authors' judgement	Support for judgement
Random sequence generation (selection bias)	Low risk	Drawing of lots
Allocation concealment (selection bias)	Unclear risk	Insufficient information to permit judgement
Blinding of participants and personnel (performance bias) All outcomes	High risk	No blinding
Blinding of outcome assessment (detection bias) Objective outcomes	Low risk	No blinding of outcome assessment (or not reported), but the outcome measurement is not likely to be influenced by lack of blinding
Blinding of outcome assessment (detection bias) Subjective outcomes	High risk	No blinding of outcome assessment, and the outcome measurement is likely to be influenced by lack of blinding
Incomplete outcome data (attrition bias) All outcomes	Low risk	Missing outcome data balanced in numbers across intervention groups
Selective reporting (reporting bias)	Low risk	Pre-specified outcomes (of interest to this review) were reported
Other bias	Unclear risk	Insufficient information to permit judgement

Segura-Orti 2009

Study characteristics

Segura-Orti 2009 *(Continued)*

Methods	• Study design: parallel RCT • Study duration: 18 months • Study follow-up period: 24 weeks
Participants	• Country: Spain • Setting: HD clinics • Inclusion criteria: stable condition under their medication and undertaking HD sessions for at least 3 months • Number: exercise group (19); control group (8) • Mean age ± SD (years): exercise group (53.5 ± 18.0); control group (60.1 ± 16.9) • Sex (M/F): exercise group (11/6); control group (7/1) • Mean BMI ± SD (kg/m^2): exercise group (24.6 ± 2.6); control group (24.9 ± 2.2) • Mean HD vintage ± SD (months): exercise group (37.3 ± 34.9); control group (53.7 ± 42.0) • Exclusion criteria: recent MI (6 weeks); uncontrolled hypertension; malignant arrhythmias; unstable angina and any disorder that could be exacerbated by activity
Interventions	Duration of intervention • 24 weeks Exercise group • Type: resistance • Description: lower limbs isotonic and isometric exercises • Position: not reported • Material: ankle weights • Location: HD unit • Duration of training sessions: 25 minutes • Duration of warm-up/cool-down: 5/5 minutes • Frequency: 3 times/week • Timing in relation to dialysis treatments: during • Intensity: 12 to 14 on RPE • Supervised by: physiotherapist • Mode of delivery: face-to-face • Tailoring: not reported • Modifications/progression: progressive not further defined • Strategies to enhance adherence: not reported • Adherence to intervention: not reported • Co-intervention: none Control group • Cycling on the minimum possible workload
Outcomes	• Sit-to-stand test (10 seconds) • Sit-to-stand test (60 repetitions) • 6MWT • HRQoL
Notes	• Funding: Universidad CEU Cardenal Herrera

Risk of bias

Bias	Authors' judgement	Support for judgement

Segura-Orti 2009 *(Continued)*

Random sequence generation (selection bias)	Low risk	Random numbers table
Allocation concealment (selection bias)	Unclear risk	Insufficient information to permit judgement
Blinding of participants and personnel (performance bias) All outcomes	Low risk	Sham exercise in the control arm
Blinding of outcome assessment (detection bias) Objective outcomes	Low risk	Blinding of outcome assessment ensured, and unlikely that the blinding could have been broken
Blinding of outcome assessment (detection bias) Subjective outcomes	Low risk	Sham exercise in the control arm
Incomplete outcome data (attrition bias) All outcomes	Low risk	Missing outcome data balanced in numbers across intervention groups, with similar reasons for missing data across groups
Selective reporting (reporting bias)	Low risk	Pre-specified outcomes (of interest to this review) were reported
Other bias	Low risk	The study appears to be free of other sources of bias

Sheshadri 2020

Study characteristics	
Methods	• Study design: parallel RCT • Study duration: not reported • Study follow-up period: 24 weeks
Participants	• Country: USA • Setting: HD units • Inclusion criteria: ≥ 18 years; receiving in-centre HD or any form of PD; having telephone access; being ambulatory • Number: exercise group (30), control group (30) • Median age, IQR (years): exercise group (60, 53 to 66); control group (56, 51 to 65) • Sex (M/F): exercise group (28/2); control group (19/11) • Median BMI, IQR (kg/m^2): exercise group (26.9, 25.3 to 32.9); control group (31.6, 26.7 to 34.6) • Median HD vintage, IQR (months): exercise group (3.7, 1.5 to 7.2); control group (1.9, 0.95 to 4.7) • Exclusion criteria: patients using wheelchairs or scooters
Interventions	Duration of intervention • 12 weeks Exercise group • Type: aerobic • Description: walking and weekly steps goal

Sheshadri 2020 *(Continued)*

- Position: not applicable
- Material: pedometer
- Location: not reported
- Duration of training sessions: not applicable
- Duration of warm-up/cool-down: not applicable
- Frequency: not applicable
- Timing in relation to dialysis treatments: outside treatments
- Intensity: not reported
- Supervised by: unsupervised
- Mode of delivery: weekly phone counselling session
- Tailoring: based on baseline daily steps
- Modifications/progression: 10% of the previous week target
- Strategies to enhance adherence: weekly phone counselling
- Adherence to intervention: not reported
- Co-intervention: none

Control group

- Usual care and received a pedometer

Outcomes	• Physical function (SF-36 physical function scores, short physical performance battery) • Endothelial function (reactive hyperemia index with peripheral arterial tonometry) • HR variability (SDNN, LF/HF) • Dialysis symptoms index • SF-36 physical functioning and vitality score • Centers for Epidemiologic Studies Depression Scale
Notes	Funding • American Kidney Fund Clinical Scientist in Nephrology Fellowship • Ruth L. Kirschstein National Research Service Award Individual Postdoctoral Fellowship • International Society of Nephrology fellowship

Risk of bias

Bias	Authors' judgement	Support for judgement
Random sequence generation (selection bias)	Low risk	Block randomisation using computer generated program
Allocation concealment (selection bias)	Low risk	Sealed, opaque envelopes used to perform allocation concealment
Blinding of participants and personnel (performance bias) All outcomes	High risk	Nil blinding performed
Blinding of outcome assessment (detection bias) Objective outcomes	Low risk	No blinding of outcome assessment (or not reported), but the outcome measurement is not likely to be influenced by lack of blinding
Blinding of outcome assessment (detection bias) Subjective outcomes	High risk	No blinding of outcome assessment, and the outcome measurement is likely to be influenced by lack of blinding

Sheshadri 2020 *(Continued)*

Incomplete outcome data (attrition bias) All outcomes	Low risk	Low and equal rates of drop-out in both arms of treatment, unlikely to affect outcome
Selective reporting (reporting bias)	Low risk	All pre-specified outcome variables reported in body of text or supplementary material
Other bias	Low risk	Study appears to be free from other sources of bias

Soliman 2015

Study characteristics	
Methods	• Study design: parallel RCT • Study duration: 5 months • Study follow-up period: 8 weeks
Participants	• Country: Egypt • Setting: HD unit • Inclusion criteria: aged > 18 years; minimum HD vintage of 3 months, receiving HD 3 times/week, for 3 or 4 hours/session; stable on HD, Kt/V > 1.2; bicarbonate dialysis solution; unintentional low dietary protein intake < 1 g/kg of ideal weight/day for at least 2 months; unintentional low dietary energy intake < 30 kcal/kg of ideal weight/day for at least 2 months • Number: exercise group (18); control group (12) • Age: exercise group (61% between 40 and 60); control group (58% between 40 and 60) • Sex (M/F): exercise group (8/10); control group (6/6) • Mean BMI ± SD (kg/m^2): exercise group (25.6 ± 4.3); control group (27.2 ± 5.7) • Exclusion criteria: any acute or chronic medical conditions that would make exercise training potentially hazardous or primary outcomes impossible to assess; problematic AV fistula; uncontrolled hypertension; congestive heart failure; arrhythmia requiring treatment; unstable angina; major valvular heart disease; MI; significant arteriosclerosis; a risk of fracture; musculoskeletal disorders; change in the resting ECG; severe aortic stenosis; suspected or known dissecting aneurysm; myocarditis; participation in another trial; inadequate dialysis Kt/V < 1.2; Hb < 10 g/dL; unstable on dialysis
Interventions	Duration of intervention • 8 weeks Exercise group • Type: range of movement • Description: range of motion exercises • Position: not reported • Material: not reported • Location: HD unit • Duration of training sessions: 15 minutes • Duration of warm-up/cool-down: not reported • Frequency: 3 times/week • Timing in relation to dialysis treatments: during • Intensity: not reported • Supervised by: not reported • Mode of delivery: face-to-face and booklet • Tailoring: not reported • Modifications/progression: not reported

Soliman 2015 *(Continued)*

	• Strategies to enhance adherence: not reported • Adherence to intervention: not reported • Co-intervention: none Control group • Usual care
Outcomes	• Fatigue (Iowa Fatigue Scale) • Potassium • Calcium • Phosphate • Hb • Resting BP
Notes	• Funding: not reported

Risk of bias

Bias	Authors' judgement	Support for judgement
Random sequence generation (selection bias)	Unclear risk	Insufficient information to permit judgement
Allocation concealment (selection bias)	Unclear risk	Insufficient information to permit judgement
Blinding of participants and personnel (performance bias) All outcomes	High risk	No blinding
Blinding of outcome assessment (detection bias) Objective outcomes	Low risk	No blinding of outcome assessment (or not reported), but the outcome measurement is not likely to be influenced by lack of blinding
Blinding of outcome assessment (detection bias) Subjective outcomes	High risk	No blinding of outcome assessment, and the outcome measurement is likely to be influenced by lack of blinding
Incomplete outcome data (attrition bias) All outcomes	High risk	Reason for missing outcome data likely to be related to true outcome, with either imbalance in numbers or reasons for missing data across intervention groups
Selective reporting (reporting bias)	Low risk	Pre-specified outcomes (of interest to this review) were reported
Other bias	Unclear risk	Insufficient information to permit judgement

Song 2012a

Study characteristics

Methods	• Study design: parallel RCT • Study duration: not reported

Song 2012a *(Continued)*

	• Study follow-up period: 12 weeks
Participants	• Country: Korea • Setting: outpatient clinic • Inclusion criteria: ≥ 18 years; on HD > 3 months; under the permission of their Nephrologist; ability to maintain a seated position; independent ambulation of 50 m or more, with or without an assistive device; adequately dialysed (most recent Kt/V = 1.2); stable during dialysis • Number: exercise group (22); control group (22) • Mean age ± SD (years): exercise group (52.1 ± 12.4); control group (54.6 ± 10.1) • Sex (M/F): exercise group (8/12); control group (12/8) • Mean HD vintage ± SD (months): exercise group (38.9 ± 26.1); control group (45.9 ± 56.2) • Exclusion criteria: not reported
Interventions	Duration of intervention • 12 weeks Exercise group • Type: resistance • Description: upper and lower limbs exercises • Position: seated • Material: ankle weights and resistance bands • Location: conference room adjacent to HD unit • Duration of training sessions: 20 minutes • Duration of warm-up/cool-down: 5/5 minutes • Frequency: 3 times/week • Timing in relation to dialysis treatments: not during • Intensity: 11 to 15 on RPE • Supervised by: investigator and research assistant • Mode of delivery: face-to-face • Tailoring: individualised resistance level • Modifications/progression: ankle weights added at week 4 • Strategies to enhance adherence: not reported • Adherence to intervention: not reported • Co-intervention: none Control group • Usual care
Outcomes	• Body fat rate (%) • Visceral fat area (cm^2) • Skeletal muscle mass (kg) • Waist circumference (cm) • HDL cholesterol (mg/dL) • LDL cholesterol (mg/dL) • Total cholesterol (mg/dL) • Triglyceride (mg/dL) • Balance (sec) • Shoulder flexibility (cm) • Waist flexibility (cm) • Arm muscle circumference (mm) • Grip strength (kg) • Leg muscle strength (kg)

Song 2012a *(Continued)*

	• Sit-to-stand test • QoL
Notes	• Funding: not reported

Risk of bias

Bias	Authors' judgement	Support for judgement
Random sequence generation (selection bias)	Unclear risk	Insufficient information to permit judgement
Allocation concealment (selection bias)	Unclear risk	Insufficient information to permit judgement
Blinding of participants and personnel (performance bias) All outcomes	High risk	No blinding
Blinding of outcome assessment (detection bias) Objective outcomes	Low risk	Blinding of outcome assessment ensured, and unlikely that the blinding could have been broken
Blinding of outcome assessment (detection bias) Subjective outcomes	High risk	No blinding of outcome assessment, and the outcome measurement is likely to be influenced by lack of blinding
Incomplete outcome data (attrition bias) All outcomes	Low risk	Missing outcome data balanced in numbers across intervention groups, with similar reasons for missing data across groups
Selective reporting (reporting bias)	Low risk	Pre-specified outcomes (of interest to this review) were reported
Other bias	Unclear risk	Insufficient information to permit judgement

Suhardjono 2019

Study characteristics

Methods	• Study design: parallel RCT (3 arms) • Study duration: 3 months • Study follow-up period: 12 weeks
Participants	• Country: Indonesia • Setting: not reported • Inclusion criteria: ≥ 18 years; given their consent to participate in the study; maintenance dialysis for at least 3 months • Number: aerobic group (42); combined group (40); control group (41) • Mean age ± SD (years): aerobic group (49.78 ± 11.65); combined group (46.38 ± 14.19); control group (50.54 ± 10.83) • Sex (M/F): aerobic group (28/14); combined group (21/18); control group (18/21) • Median HD vintage, range (months): aerobic group (48, 4 to 192); combined group (48, 6 to 204); control group (60, 5 to 240)

Suhardjono 2019 *(Continued)*

- Exclusion criteria: travelling on dialysis; being hospitalised for any reason within the past 3 months; having arrhythmias; being on dialysis for less than 2-week intervals; having a limited range of motion of extremities; being immobilized

Interventions	Duration of intervention • 12 weeks Aerobic exercise group • Type: aerobic • Description: stationary cycling • Position: not reported • Material: ergometer • Location: HD unit • Duration of training sessions: 30 minutes • Duration of warm-up/cool-down: not reported • Frequency: 2 times/week • Timing in relation to dialysis treatments: during • Intensity: 40% to 60%, and then 60% to 80% of max HR • Supervised by: nephrologist, sports medicine doctor • Mode of delivery: face-to-face • Tailoring: individualised intensity • Modifications/progression: increasing intensity • Strategies to enhance adherence: not reported • Adherence to intervention: not reported • Co-intervention: none Combined aerobic + resistance exercise group • Type: combined • Description: stationary cycling + ankle weightlifting • Position: not reported • Material: ankle weights • Location: HD unit • Duration of training sessions: not reported • Duration of warm-up/cool-down: not reported • Frequency: 2 times/week • Timing in relation to dialysis treatments: during • Intensity: 11 to 13 on RPE • Supervised by: nephrologist, sports medicine doctor • Mode of delivery: face-to-face • Tailoring: individualised intensity • Modifications/progression: not reported • Strategies to enhance adherence: not reported • Adherence to intervention: not reported • Co-intervention: none Control group • Usual care
Outcomes	• Skeletal muscle index (kg/m^2), • Handgrip strength (kg) • Gait speed (m/sec)

Suhardjono 2019 *(Continued)*

	• Right lower extremity muscle strength (kg) • Left lower extremity muscle strength (kg) • CRP (g/dL) • Malnutrition-inflammation score • QoL
Notes	• The results for CRP were not included in the meta-analysis because the reported numbers and unit of measure were implausible • Funding: Universitas Indonesia

Risk of bias

Bias	Authors' judgement	Support for judgement
Random sequence generation (selection bias)	Low risk	Block randomisation. Assumed computer-generated
Allocation concealment (selection bias)	Unclear risk	Insufficient information to permit judgement
Blinding of participants and personnel (performance bias) All outcomes	High risk	No blinding
Blinding of outcome assessment (detection bias) Objective outcomes	Low risk	No blinding of outcome assessment (or not reported), but the outcome measurement is not likely to be influenced by lack of blinding
Blinding of outcome assessment (detection bias) Subjective outcomes	High risk	No blinding of outcome assessment, and the outcome measurement is likely to be influenced by lack of blinding
Incomplete outcome data (attrition bias) All outcomes	Low risk	Missing outcome data balanced in numbers across intervention groups, with similar reasons for missing data across groups
Selective reporting (reporting bias)	Low risk	Pre-specified outcomes (of interest to this review) were reported
Other bias	Low risk	The study appears to be free of other sources of bias

Toussaint 2008

Study characteristics

Methods	• Study design: cross-over RCT • Study duration: not reported • Study follow-up period: 24 weeks
Participants	• Country: Australia • Setting: satellite HD unit • Inclusion criteria: HD > 3 months; able to give informed consent; able and willing to commit to exercise regularly for 3 months • Number: exercise group (9); control group (10)

Toussaint 2008 *(Continued)*

- Median age, range (years): exercise group (67, 60 to 83); control group (70, 28 to 77)
- Sex (M/F): exercise group (5/4); control group (4/6)
- Mean HD vintage ± SD (months): exercise group (35 ± 31); control group (72 ± 56)
- Mean BMI ± SD (kg/m^2): exercise group (27 ± 4); control group (24 ± 4)
- Exclusion criteria: active or symptomatic cardiovascular or respiratory disease; musculoskeletal abnormalities that limited exercise ability

Interventions	Duration of intervention • 12 weeks Exercise group • Type: aerobic • Description: stationary cycling • Position: not reported • Material: ergometer • Location: HD unit • Duration of training sessions: 30 minutes • Duration of warm-up/cool-down: not reported • Frequency: 3 times/week • Timing in relation to dialysis treatments: during • Intensity: no target • Supervised by: unsupervised • Mode of delivery: not reported • Tailoring: not reported • Modifications/progression: not reported • Strategies to enhance adherence: not reported • Adherence to intervention (sessions attended); 88% • Co-intervention: none Control group • Usual care
Outcomes	• CRP • Hb • Calcium × phosphate product • PTH • Beta-2-microglobulin • Homocysteine • BP • Albumin • Augmentation index • Brain-natriuretic peptide • Pulse pressure • Pulse wave velocity
Notes	• We only included the results at 3 months as we felt that the 1-month washout period was insufficient to eliminate the carry-over effect. • Funding: National Health and Medical Research Grant

Risk of bias

Bias	Authors' judgement	Support for judgement

Toussaint 2008 *(Continued)*

Random sequence generation (selection bias)	Unclear risk	Insufficient information to permit judgement
Allocation concealment (selection bias)	Low risk	Sealed envelops
Blinding of participants and personnel (performance bias) All outcomes	High risk	No blinding
Blinding of outcome assessment (detection bias) Objective outcomes	Low risk	No blinding of outcome assessment (or not reported), but the outcome measurement is not likely to be influenced by lack of blinding
Blinding of outcome assessment (detection bias) Subjective outcomes	Low risk	No patient-reported outcome
Incomplete outcome data (attrition bias) All outcomes	Low risk	Missing outcome data balanced in numbers across intervention groups
Selective reporting (reporting bias)	Low risk	Pre-specified outcomes (of interest to this review) were reported
Other bias	Low risk	The study appears to be free of other sources of bias

Tsuyuki 2003

Study characteristics	
Methods	• Study design: parallel RCT • Study duration: not reported • Study follow-up period: 5 months
Participants	• Country: Japan • Setting: not reported • Inclusion criteria: receiving regular HD • Number: exercise group (17); control group (12) • Mean age ± SD (years): exercise group (40.1 ± 11.9); control group (39.7 ± 10.7) • Sex (M/F): exercise group (9/8); control group (5/7) • Mean HD vintage ± SD (years): exercise group (2.1 ± 2.5); control group (2.7 ± 2.6) • Exclusion criteria: hypertension (> 170/110 mm Hg); anaemia (HCT < 18%); weight gain (< 3.0 kg); heart disease; liver dysfunction; DM; chronic obstructive pulmonary disease
Interventions	Duration of intervention • 20 weeks Exercise group • Type: aerobic • Description: cycling, walking and jogging • Position: not reported

Tsuyuki 2003 *(Continued)*

- Material: ergometer
- Location: not reported
- Duration of training sessions: 30 minutes
- Duration of warm-up/cool-down: not reported
- Frequency: 2 to 3 times/week
- Timing in relation to dialysis treatments: on non-HD days
- Intensity: 50% to 60% of max HR
- Supervised by: medical supervision
- Mode of delivery: not reported
- Tailoring: individualised intensity
- Modifications/progression: not reported
- Strategies to enhance adherence: not reported
- Adherence to intervention: not reported
- Co-intervention: none

Control group

- Usual care

Outcomes	• VO_2 peak • HR • BP • Minute ventilation • Carbon dioxide output • Respiratory ratio • Tidal volume • Anaerobic threshold • Hb • HCT
Notes	• The authors were contacted during the previous version of this review for clarification on the methods, but without result. • Funding: not reported

Risk of bias

Bias	Authors' judgement	Support for judgement
Random sequence generation (selection bias)	Unclear risk	Insufficient information to permit judgement
Allocation concealment (selection bias)	Unclear risk	Insufficient information to permit judgement
Blinding of participants and personnel (performance bias) All outcomes	High risk	No blinding
Blinding of outcome assessment (detection bias) Objective outcomes	Low risk	No blinding of outcome assessment (or not reported), but the outcome measurement is not likely to be influenced by lack of blinding
Blinding of outcome assessment (detection bias)	Low risk	No patient-reported outcome

Tsuyuki 2003 *(Continued)*

Subjective outcomes		
Incomplete outcome data (attrition bias) All outcomes	Unclear risk	Insufficient information to permit judgement
Selective reporting (reporting bias)	Low risk	Pre-specified outcomes (of interest to this review) were reported
Other bias	Unclear risk	Insufficient information to permit judgement

Uchiyama 2019

Study characteristics	
Methods	• Study design: parallel RCT • Study duration: 17 months • Study follow-up period: 3 months
Participants	• Country: Japan • Setting: not reported • Inclusion criteria: stable PD patients aged 20–90 years who had started with and undergone PD for at least 3 months • Number: exercise group (24); control group (23) • Mean age ± SD (years): exercise group (64.9 ± 9.2); control group (63.2 ± 9.5) • Sex (M/F): exercise group (19/5); control group (16/7) • Mean BMI ± SD (kg/m^2): exercise group (22.70 ± 3.50); control group (24.60 ± 4.10) • Mean PD vintage ± SD (years): exercise group (3.6 ± 2.7); control group (4.0 ± 2.8) • Exclusion criteria: uncontrolled hypertension (BP > 180/110 mm Hg); severe anaemia (Hb < 7 mg/dL); active and proliferative diabetic retinopathy; symptomatic coronary artery disease or cerebrovascular disease within 3 months before study recruitment; current heart failure (NYHA classes III and IV); symptomatic and fatal arrhythmia; significant valvular heart disease; difficulty walking without a walking aid owing to orthopaedic problems; a history of cerebrovascular disease; a history of peripheral artery disease
Interventions	Duration of intervention • 12 weeks Exercise group • Type: combined • Description: walking, upper and lower limbs exercises • Position: not applicable • Material: resistance bands • Location: home • Duration of training sessions: 20 to 30 minutes • Duration of warm-up/cool-down: not reported • Frequency: 3 times/week • Timing in relation to dialysis treatments: PD patients only • Intensity: aerobic (40% to 60% of the peak HR and 11 to 13 on the Borg RPE); resistance (70% of 1RM) • Supervised by: unsupervised • Mode of delivery: face-to-face • Tailoring: individualised intensity

Uchiyama 2019 *(Continued)*

	• Modifications/progression: increasing duration • Strategies to enhance adherence: weekly postcard • Adherence to intervention: mean (SD) number of sessions attended: aerobic: 52% (40); resistance: 76% (37) • Co-intervention: none Control group • Usual care
Outcomes	• Incremental shuttle walking test (m) • HR-QoL (KDQOL-SF) • Handgrip strength (kg) • Quadriceps strength (kg) • BMI (kg/m^2) • Waist circumference (cm) • Leg circumference (cm) • Skeletal muscle mass index (kg/m^2) • Albumin (g/L) • nPCR (g/kg/day) • HbA1c (%) • Total cholesterol (mmol/L) • HDL cholesterol (mg/dL) • Triglyceride (mg/dL) • Homeostasis model assessment of insulin resistance • Renal Kt/V • Ultrafiltration (mL/day) • PD Kt/V • CRP (mg/L) • ANP (pg/mL) • Brachial-ankle pulse wave velocity
Notes	• Funding: not reported

Risk of bias

Bias	Authors' judgement	Support for judgement
Random sequence generation (selection bias)	Low risk	Computer random number generator
Allocation concealment (selection bias)	Low risk	External to the investigators
Blinding of participants and personnel (performance bias) All outcomes	High risk	No blinding
Blinding of outcome assessment (detection bias) Objective outcomes	Low risk	No blinding of outcome assessment (or not reported), but the outcome measurement is not likely to be influenced by lack of blinding
Blinding of outcome assessment (detection bias)	High risk	No blinding of outcome assessment, and the outcome measurement is likely to be influenced by lack of blinding

Uchiyama 2019 *(Continued)*

Subjective outcomes		
Incomplete outcome data (attrition bias) All outcomes	Low risk	No missing outcome data
Selective reporting (reporting bias)	Low risk	Pre-specified outcomes (of interest to this review) were reported
Other bias	Unclear risk	Insufficient information to permit judgement

van Vilsteren 2005

Study characteristics	
Methods	• Study design: parallel RCT • Study duration: not reported • Study follow-up period: 12 weeks
Participants	• Country: Netherlands • Setting: single centre • Inclusion criteria: prevalent HD patients • Number (randomised/analysed): exercise group (60/53); control group (43/43) • Mean age ± SD (years): exercise group (52 ± 15); control group (58 ± 16) • Sex (M/F): exercise group (38/22); control group (30/13) • Mean HD vintage ± SD (years): exercise group (3.22 ± 4.08); control group (3.90 ± 4.41) • Exclusion criteria: severe cardiovascular disease; use of beta-blockers; unstable angina pectoris; orthopaedic complaints
Interventions	Duration of intervention • 12 weeks Exercise group • Type: combined • Description: callisthenics, steps, flexibility and low weight resistance exercises + stationary cycling • Position: not reported • Material: multitrainer • Location: HD unit • Duration of training sessions: 20 to 30 minutes • Duration of warm-up/cool-down: 20/5 to 10 minutes • Frequency: 3 times/week • Timing in relation to dialysis treatments: during and prior to HD • Intensity: 60% of max HR • Supervised by: not reported • Mode of delivery: not reported • Tailoring: individualised intensity • Modifications/progression: not reported • Strategies to enhance adherence: not reported • Adherence to intervention: not reported • Co-intervention: none Control group

van Vilsteren 2005 *(Continued)*

	• Usual care
Outcomes	• Muscle strength • Physical functioning • VO_2 peak • HRQoL • BP • HR • Cholesterol • Depression • Kt/V • HCT • Hb • Behavioural change • Mean body weight
Notes	• The results for VO_2 max could not be included in the meta-analysis because the number of participants in each group was not provided. The authors were contacted to obtain the missing information • Funding: not reported

Risk of bias

Bias	Authors' judgement	Support for judgement
Random sequence generation (selection bias)	Unclear risk	Insufficient information to permit judgement
Allocation concealment (selection bias)	Unclear risk	Insufficient information to permit judgement
Blinding of participants and personnel (performance bias) All outcomes	High risk	No blinding
Blinding of outcome assessment (detection bias) Objective outcomes	Low risk	No blinding of outcome assessment (or not reported), but the outcome measurement is not likely to be influenced by lack of blinding
Blinding of outcome assessment (detection bias) Subjective outcomes	High risk	No blinding of outcome assessment, and the outcome measurement is likely to be influenced by lack of blinding
Incomplete outcome data (attrition bias) All outcomes	Low risk	Missing outcome data balanced in numbers across intervention groups
Selective reporting (reporting bias)	Low risk	Pre-specified outcomes (of interest to this review) were reported
Other bias	Unclear risk	Insufficient information to permit judgement

Wilund 2010

Study characteristics	
Methods	• Study design: parallel RCT • Study duration: not reported • Study follow-up period: 16 weeks
Participants	• Country: USA • Setting: HD unit • Inclusion criteria: HD patients; 30 to 70 years, non-smoking; BMI < 35 kg/m^2 • Number: exercise group (8); control group (9) • Mean age ± SD (years): exercise group (60.8 ± 3.2); control group (59.0 ± 4.9) • Sex (M/F): exercise group (3/4); control group (3/5) • Mean HD vintage ± SD (months): exercise group (63.3 ± 8.7); control group (44.6 ± 12.2) • BMI ± SD (kg/m^2): exercise group (30.10 ± 2.40); control group (29.00 ± 2.00) • Exclusion criteria: orthopaedic problems that prevented cycling during dialysis; chronic obstructive pulmonary disease, coronary heart failure or cardiovascular surgery (e.g. coronary bypass, valve replacement or angioplasty) in the past 6 months; did not get medical clearance from a primary care physician; participation in intradialytic exercise training for 6 months prior to recruitment in the study
Interventions	Duration of intervention • 16 weeks Exercise group • Type: aerobic • Description: stationary cycling • Position: not reported • Material: ergometer • Location: HD unit • Duration of training sessions: 5 to 45 minutes • Duration of warm-up/cool-down: not reported • Frequency: 3 times/week • Timing in relation to dialysis treatments: during • Intensity: 12 to 14 on RPE • Supervised by: study staff • Mode of delivery: face-to-face • Tailoring: individualised intensity and duration • Modifications/progression: increasing duration 5 to 10 min/session • Strategies to enhance adherence: not reported • Adherence to intervention: not reported • Co-intervention: none Control group • Usual care
Outcomes	• BMI (kg/m^2) • Serum albumin • HCT • ALP • Calcium × phosphorous product • Calcium (mg/dL) • Phosphorous (mg/dL) • Potassium (mEq/L)

Wilund 2010 *(Continued)*

- DBP
- SBP
- Epicardial fat thickness
- Left atrial volume index
- LVMI (g/m^2)
- Myocardial performance index
- Relative wall thickness
- Cholesterol (mg/dL)
- CRP (mg/L)
- IL-6 (pg/mL)
- Fetuin-A (ng/mL)
- Blood urea nitrogen/creatinine ratio
- Thiobarbituric acid reactive substances (µmol/L)
- Shuttle walk distance

Notes	• Funding: College of Medicine, University of Illinois at Urbana–Champaign

Risk of bias

Bias	Authors' judgement	Support for judgement
Random sequence generation (selection bias)	Unclear risk	Insufficient information to permit judgement
Allocation concealment (selection bias)	Unclear risk	Insufficient information to permit judgement
Blinding of participants and personnel (performance bias) All outcomes	High risk	No blinding
Blinding of outcome assessment (detection bias) Objective outcomes	Low risk	No blinding of outcome assessment (or not reported), but the outcome measurement is not likely to be influenced by lack of blinding
Blinding of outcome assessment (detection bias) Subjective outcomes	Low risk	No patient-reported outcome
Incomplete outcome data (attrition bias) All outcomes	Low risk	Missing outcome data balanced in numbers across intervention groups, with similar reasons for missing data across groups
Selective reporting (reporting bias)	Low risk	Pre-specified outcomes (of interest to this review) were reported
Other bias	Low risk	The study appears to be free of other sources of bias

Wu 2014d

Study characteristics

Methods	• Study design: parallel RCT

Wu 2014d *(Continued)*

	• Study duration: not reported • Study follow-up period: 12 weeks
Participants	• Country: China • Setting: HD unit • Inclusion criteria: relatively stable disease; good compliance and co-operation with the doctor; no apparent cardiovascular complications (such as heart failure, severe arrhythmia, angina or cerebrovascular disease) or infection; no orthopaedic problems that would prevent cycling during dialysis; BP < 180/100 mm Hg; HD duration > 3 months • Number: exercise group (34); control group (35) • Median age, IQR (years): exercise group (45, 37 to 48); control group (44, 41 to 50) • Sex (M/F): exercise group (27/5); control group (28/5) • Mean HD vintage ± SD (months): exercise group (55.5 ± 37.3); control group (39.8 ± 29.7) • Exclusion criteria: any chronic diseases not under control; retinal laser treatment; history of acute MI; joint replacement or fracture of the lower limb within the previous 6 months; severe cognitive disturbance
Interventions	Duration of intervention • 12 weeks Exercise group • Type: aerobic • Description: stationary cycling • Position: recumbent • Material: ergometer • Location: HD unit • Duration of training sessions: 10 to 15 minutes • Duration of warm-up/cool-down: 5 minutes/not reported • Frequency: 3 times/week • Timing in relation to dialysis treatments: during • Intensity: 12 to 16 on RPE • Supervised by: not reported • Mode of delivery: not reported • Tailoring: individualised intensity and duration • Modifications/progression: increasing intensity • Strategies to enhance adherence: encouragements by study staff • Adherence to intervention: not reported • Co-intervention: none Control group • Stretching exercises
Outcomes	• 6MWT • Time to walk up and go test • Grip strength • Sit-to-stand test • Time to perform 10 sit-to-stand manoeuvres • QoL
Notes	• Funding: nil
Risk of bias	

Wu 2014d *(Continued)*

Bias	Authors' judgement	Support for judgement
Random sequence generation (selection bias)	Low risk	Computer random number generator
Allocation concealment (selection bias)	Unclear risk	Insufficient information to permit judgement
Blinding of participants and personnel (performance bias) All outcomes	High risk	No blinding
Blinding of outcome assessment (detection bias) Objective outcomes	Low risk	No objective outcomes
Blinding of outcome assessment (detection bias) Subjective outcomes	High risk	No blinding of outcome assessment, and the outcome measurement is likely to be influenced by lack of blinding
Incomplete outcome data (attrition bias) All outcomes	Low risk	Missing outcome data balanced in numbers across intervention groups, with similar reasons for missing data across groups
Selective reporting (reporting bias)	Low risk	Pre-specified outcomes (of interest to this review) were reported
Other bias	Low risk	The study appears to be free of other sources of bias

Yurtkuran 2007

Study characteristics	
Methods	• Study design: parallel RCT • Study duration: not reported • Study follow-up period: 12 weeks
Participants	• Country: Turkey • Setting: single centre • Inclusion criteria: prevalent HD patients • Number (randomised/analysed): exercise group (20/19); control group (20/18) • Mean age ± SD (years): exercise group (38 ± 14); control group (41 ± 10) • Sex (M/F): exercise group (9/11); control group (7/3) • Median/mean HD vintage ± SD (months): 10.5/21.9 ± 14.2 (for all 40 patients) • Exclusion criteria: unstable hypertension; arrhythmia or cardiac angina after 10 min of fast pedalling; ischaemic cardiac pain; unstable angina; congestive heart failure grade II; significant cardiac valve disease; conduction abnormalities on the ECG; cerebrovascular disease; electrolyte imbalance; persistent hyperkalaemia before dialysis; DM; active liver disease; arthritic or orthopaedic problems limiting exercise: peripheral vascular disease; 'undisciplined patients'
Interventions	Duration of intervention • 12 weeks

Yurtkuran 2007 *(Continued)*

	Exercise group • Type: yoga • Description: modified yoga exercise • Position: seated, supine and standing • Material: not reported • Location: not reported • Duration of training sessions: 30 minutes • Duration of warm-up/cool-down: not reported • Frequency: 2 times/week • Timing in relation to dialysis treatments: not reported • Intensity: not reported • Supervised by: not reported • Mode of delivery: not reported • Tailoring: postures adapted • Modifications/progression: increasing intensity and duration • Strategies to enhance adherence: not reported • Adherence to intervention: not reported • Co-intervention: none Control group • Usual care
Outcomes	• Grip strength • HDL cholesterol • Triglyceride • Pain • Fatigue • Sleep disturbance • Urea • SCr • Calcium • ALP • Phosphorus • Erythrocyte • HCT
Notes	• 3 patients that missed 3 sessions and adhered poorly to the exercise instructions were excluded from the analyses • Funding: not reported

Risk of bias

Bias	Authors' judgement	Support for judgement
Random sequence generation (selection bias)	Low risk	Computer random number generator
Allocation concealment (selection bias)	Low risk	Concealed from the investigators
Blinding of participants and personnel (performance bias)	High risk	No blinding

Yurtkuran 2007 *(Continued)*

All outcomes		
Blinding of outcome assessment (detection bias) Objective outcomes	Low risk	Blinding of outcome assessment ensured, and unlikely that the blinding could have been broken
Blinding of outcome assessment (detection bias) Subjective outcomes	High risk	No blinding of outcome assessment, and the outcome measurement is likely to be influenced by lack of blinding
Incomplete outcome data (attrition bias) All outcomes	Low risk	Missing outcome data balanced in numbers across intervention groups, with similar reasons for missing data across groups
Selective reporting (reporting bias)	Low risk	Pre-specified outcomes (of interest to this review) were reported
Other bias	Unclear risk	Insufficient information to permit judgement

Zhao 2017

Study characteristics	
Methods	• Study design: parallel RCT (3 arms*) • Study duration: not reported • Study follow-up period: 18 weeks
Participants	• Country: China • Setting: HD unit • Inclusion criteria: HD had been performed for at least 3 months or at least 3 times within 1 week; ability to ride a bicycle • Number: aerobic exercise + escitalopram group (63); aerobic exercise only group (63); escitalopram only control group (63) • Median age, IQR (years): aerobic exercise + escitalopram group (52.9, 43.9 to 65.8); aerobic exercise only group (53.6, 44.5 to 66.3); escitalopram only control group (54.1, 42.3 to 68.7) • Sex (M/F): aerobic exercise + escitalopram group (39/24); aerobic exercise only group (41/22); escitalopram only control group (40/23) • Median HD vintage, IQR (months): aerobic exercise + escitalopram group (24.9, 13.8 to 35.7); aerobic exercise only group (25.3, 14.9 to 34.2); escitalopram only control group (24.7, 15.6 to 36.1) • Exclusion criteria: opportunistic infections; medical therapy for other diseases during the last 3 months; SBP > 160 mm Hg and/or DBP > 110 mm Hg before and after HD and/or at hours 2 and 3 during HD; symptoms for interrupting the exercises, such as chest pain, dyspnoea, body temperature 38°C and cardiac arrhythmias; signs of neurological vertigo and/or imbalance; non-adherence to the exercise program and instability in haemodynamic parameters after exercises
Interventions	Duration of intervention • 12 weeks Exercise group • Type: yoga • Description: modified yoga exercise • Position: seated, supine and standing • Material: not reported

Zhao 2017 *(Continued)*

	• Location: not reported • Duration of training sessions: 30 minutes • Duration of warm-up/cool-down: not reported • Frequency: 2 times/week • Timing in relation to dialysis treatments: not reported • Intensity: not reported • Supervised by: not reported • Mode of delivery: not reported • Tailoring: postures adapted • Modifications/progression: increasing intensity and duration • Strategies to enhance adherence: not reported • Adherence to intervention: not reported • Co-intervention: none Control group • Escitalopram: 20 mg/day
Outcomes	• IL-18 (pg/mL) • IL-6 (pg/mL) • QoL
Notes	• *Aerobic exercise only not included in our meta-analyses • Funding: not reported

Risk of bias

Bias	Authors' judgement	Support for judgement
Random sequence generation (selection bias)	Unclear risk	Insufficient information to permit judgement
Allocation concealment (selection bias)	Unclear risk	Insufficient information to permit judgement
Blinding of participants and personnel (performance bias) All outcomes	High risk	No blinding
Blinding of outcome assessment (detection bias) Objective outcomes	Low risk	No blinding of outcome assessment (or not reported), but the outcome measurement is not likely to be influenced by lack of blinding
Blinding of outcome assessment (detection bias) Subjective outcomes	High risk	No blinding of outcome assessment, and the outcome measurement is likely to be influenced by lack of blinding
Incomplete outcome data (attrition bias) All outcomes	Unclear risk	Insufficient information to permit judgement
Selective reporting (reporting bias)	Unclear risk	Insufficient information to permit judgement
Other bias	Unclear risk	Insufficient information to permit judgement

1RM - 1-repetition maximum test; 6MWT - 6 minute walk test; AIDS - acquired immune deficiency syndrome; ALP - alkaline phosphatase; AV - arteriovenous; BCM - body composition monitor; BDI - Beck Depression Index; BMD - bone mineral density; BMI - body mass index; BP - blood pressure; bpm - beats per minute; CAPD - continuous ambulatory peritoneal dialysis; COP - centre of foot pressure; CRP- C-reactive protein; DBP - diastolic blood pressure; DM - diabetes mellitus; ECG - echocardiograph; EPO - erythropoietin; ESKD - end-stage kidney disease; FEV - forced expiratory volume; FIM - functional independence measure; FM - fat mass; FTI - fat tissue index; FVC - forced vital capacity; Hb - haemoglobin; HCT - haematocrit; HD - haemodialysis; HDL - high-density lipoprotein; IL - Interleukin; iPTH - intact parathyroid hormone; HR - heart rate; IQR - interquartile range; LBM - lean body mass; LDL - low-density lipoprotein; LTI - lean tissue index; LVEF - left ventricular ejection fraction; LVMI - left ventricular mass index; MAP - mean arterial pressure; MI - myocardial infarction; MRI - magnetic resonance imaging; NSRI - North Staffordshire Royal Infirmary; NYHA - New York Heart Association; PD - peritoneal dialysis; PEW - protein-energy wasting; (HR)QoL - (health-related) quality of life; RCT- randomised controlled trial; RLS - restless leg syndrome; RPE - rating of perceived exertion; SBP - systolic blood pressure; SCr - serum creatinine; SD - standard deviation; SDNN - standard deviation of normal to normal R-R intervals; TUG - timed up-and-go; URR - urea reduction ratio; VO_2 max - maximum rate of oxygen consumption; WBC - white blood cell

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

Study	Reason for exclusion
Al-Ali 2018a	Wrong comparator: control group also performing exercise
Aliasgharpour 2016	Wrong intervention: intervention was stretching only
Alvares 2017	Wrong intervention duration: lasted less than 8 weeks (acute effects of exercise)
Bogataj 2020	Wrong comparator: control group also performing exercise
Bohm 2014	Wrong comparator: control group also performing exercise
Bohm 2017	Wrong intervention duration: lasted less than 8 weeks (acute effects of exercise)
Brown 2018	Wrong intervention duration: lasted less than 8 weeks (acute effects of exercise)
Campos 2018	Wrong intervention: intervention was not exercise training
Castellino 1987	Wrong intervention duration: lasted less than 8 weeks (acute effects of exercise)
Chagolla 2018	Wrong intervention duration: lasted less than 8 weeks (acute effects of exercise)
CTRI/2018/02/012021	Wrong intervention duration: lasted less than 8 weeks (acute effects of exercise)
De Villar 2016	Wrong comparator: control group also performing exercise
Dias 2020	No control group not performing exercise; comparing exercise with and without blood flow restriction
Dungey 2013	Wrong intervention duration: lasted less than 8 weeks (acute effects of exercise)
Dungey 2015	Wrong intervention duration: lasted less than 8 weeks (acute effects of exercise)
Dziubek 2016	Wrong comparator: control group also performing exercise
Fontsere 2016	Wrong intervention duration: lasted less than 8 weeks (acute effects of exercise)
Frih 2017	Wrong intervention: intervention was not exercise training
Frih 2018	Wrong comparator: control group also performing exercise

Study	Reason for exclusion
Fuhro 2018	Wrong intervention duration: lasted less than 8 weeks (acute effects of exercise)
Garcia Testal 2019	Wrong comparator: control group also performing exercise
Giannaki 2015	Wrong intervention: intervention was not exercise training
Hamad 2016	Wrong comparator: control group also performing exercise
Jeong 2018	Wrong intervention duration: lasted less than 8 weeks (acute effects of exercise)
Kirkman 2013	Wrong intervention duration: lasted less than 8 weeks (acute effects of exercise)
Krase 2020	Wrong intervention duration: intervention for only 180 min; study aimed to investigate the thermoregulatory responses of cold dialysis and exercise
Maheshwari 2012	Wrong intervention duration: lasted less than 8 weeks (acute effects of exercise)
Majchrzak 2008	Wrong intervention duration: lasted less than 8 weeks (acute effects of exercise)
Miura 2016	Wrong population: not chronic HD or PD
Molsted 2013	Wrong intervention: intervention was not exercise training
Mora 2007	Wrong intervention duration: lasted less than 8 weeks (acute effects of exercise)
Moug 2004	Wrong intervention duration: lasted less than 8 weeks (acute effects of exercise)
Orcy 2012	Wrong intervention duration: lasted less than 8 weeks (acute effects of exercise)
Orcy 2014	Wrong intervention duration: lasted less than 8 weeks (acute effects of exercise)
Pinto 2015	Wrong comparator: control group also performing exercise
Ribeiro 2019	Wrong intervention duration: less than 8 weeks (during HD session)
Rossum 2019	Wrong intervention duration: less than 8 weeks (4 weeks)
Stray-Gundersen 2016	Wrong intervention: intervention was not exercise training
Sun 2002	Wrong intervention duration: lasted less than 8 weeks (acute effects of exercise)
Tao 2015	Wrong comparator: control group also performing exercise
Vrakas 2017	Co-intervention other than exercise that was not offered to the control group

HD - haemodialysis; PD - peritoneal dialysis

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

Assawasaksakul 2018

Methods	• Study design: parallel RCT • Study duration: unclear • Study follow-up period: unclear

Assawasaksakul 2018 *(Continued)*

Participants	• Country: unclear • Setting: HD unit • Inclusion criteria: HD patients • Number:12 (number per group not reported) • Mean age ± SD: 53.1 ± 14.4 years • Sex (M/F): not reported • Dialysis vintage: not reported • BMI: 23.23 ± 5.5 kg/m^2 • Exclusion criteria: not reported
Interventions	Intradialytic exercise group • Trained with the customized exercise program to exercise, initiated by a multidisciplinary team, on a cycle ergometer within the first hour of HD • Physical activity was measured in terms of the number of daily steps counted by a wrist-worn wearable triaxial accelerometer Control group • Not reported
Outcomes	• Muscle mass • Physical activity • Hb • Albumin • Phosphate
Notes	• Abstract-only publication

Bennett 2019

Methods	• Study design: parallel RCT • Study duration: not reported • Study follow-up period: not reported
Participants	• Country: USA • Setting: single centre • Inclusion criteria: PD patients • Number (randomised/analysed): exercise group (18/13); control group (18/13) • Age: not reported • Sex: not reported • Dialysis vintage: not reported • BMI: not reported • Exclusion criteria: not reported
Interventions	Exercise group • Monthly exercise physiologist consultation; exercise prescription (resistance and aerobic exercise program using exercise bands) and four phone calls over 12 weeks Control group • Normal care

Bennett 2019 *(Continued)*

Outcomes	• Physical function measured • QoL • Adverse events
Notes	• Abstract-only publication

Dong 2019

Methods	• Study design: parallel RCT • Study duration: May 2017 to July 2017 • Study follow-up period: 12 weeks
Participants	• Country: China • Setting: HD unit • Inclusion criteria: HD patients with sarcopenia; aged 18 to 80 years; stable dialysis time ≥ 3 months; no central system disease; can walk independently, no physical disability, muscle strength ≥ III; can communicate normally • Number (randomised/analysed): exercise group (23/21); control group (22/20) • Mean age, range (years): exercise group (59, 32.5 to 66.5); control group (62.5, 50.5 to 70.0) • Sex (M/F): exercise group (9/12); control group (12/8) • BMI: exercise group (19.96 ± 308); control group (20.49 ± 3.41) • Exclusion criteria: pregnant woman; 3 months of bleeding or infection records; cannot perform BIA test, such as cardiovascular stent implantation, pacemaker installation, artificial joint replacement or amputation surgery; had other serious complications such as heart failure, serious infection, malignant tumours; patients with cognitive impairment and mental illness
Interventions	Exercise group • "In the first week, the ankle weight was 0 kg, and quadriceps training board was used to assist the patient in low intensity resistance training. According to the patient's tolerance, the ankle weight of + 0.5 kg (single foot) per week until it was +5 kg (one foot), with the angle of the training board reduced gradually (150°–90°) until it was removed. In the meantime, the untreated hand was holding the elastic ball for 10 × 10 performing each step of the upper limb resistance exercise. During the exercise, patients performed a 5-min warm-up followed by a 1–2 h bout of intradialytic resistance exercise: for the one-leg raise-and-down exercise, and upper limb bouncing ball movement which exerted pressure on the elastic ball and maximally maintained for 3–5 s for one cycle and then release it, both complete 10 × 10 cycles repeatedly" Control group • Usual care
Outcomes	• Maximum grip strength • Daily pace • Physical activity level • Hb • SCr • Kt/V • Albumin • Protein decomposition rate • CRP • IL-6 • IL-10

Dong 2019 *(Continued)*

Notes	• Funding source: nil

IMPCT 2020

Methods	• Study design: parallel block RCT; randomised by sex, race and dialysis centre • Study duration: unclear • Study follow-up period: unclear
Participants	• Country: USA • Setting: multicentre (13 sites) • Inclusion criteria: adults ≥ 18 years; ESKD patients undergoing HD 2 to 3 times/week; within 3 months to 3 years of initiating HD • Number: 200, ~ 50 per group • Exclusion criteria: pregnancy; angina pectoris; chronic lung disease requiring oxygen; musculoskeletal conditions; amputation; orthopaedic disorders exacerbated by physical activity; a femoral AV access; legally blind; hepatitis B infection requiring medical isolation, or current incarceration; inability to recognize numbers and letters
Interventions	• Exercise training • Cognitive training • Exercise + cognitive training • Standard care
Outcomes	• Change in executive function • Secondary measures of cognitive function • ESKD-specific clinical functions (physical function, falls, hospitalisation, death, return to work) • Patient-centred outcomes (e.g. HRQoL measures)
Notes	• Computer-based allocation system

Lopes 2019

Methods	• Study design: parallel RCT (3 arms) • Study duration: unclear • Study follow-up period: 12 weeks
Participants	• Country: Brazil • Setting: unclear • Inclusion criteria: HD patients aged 30 to 75 years, HD for at least 3 months, AV fistula. Kt/V ≥ 1.2; no mobility issues; medical consent from a nephrologist • Number: ML group (16); HL group (14); control group (20) • Mean age ± SD (years): ML group (56.2 ± 12.5); HL group (48.1 ± 10.8); control group (56.9 ± 12.4) • Sex (M/F): ML group (9/7); HL group (8/6); control group (13/7) • Mean dialysis vintage ± SD (months): ML group (72.1 ± 50.3); HL group (45.7 ± 39.3); control group (53.2 ± 44.1) • Mean BMI ± SD (kg/m^2): ML group (25.5 ± 5.1); HL group (24.5 ± 4.7); control group (26.3 ± 3.7) • Exclusion criteria: undergoing regular exercise program; physical disability or severe orthopaedic problems; the history of a stroke in the past 6 months; a recent hospitalisation (< 3 months); diagnosis of acquired immunodeficiency syndrome

Lopes 2019 *(Continued)*

Interventions	• Resistance training
	  ○ Moderate-load intradialytic group (ML)
	  ○ High-load intradialytic group (HL)
	• Stretching exercise (control)

Outcomes	• Body composition • Functional capacity • Inflammatory markers
Notes	

Maynard 2019

Methods	• Study design: parallel RCT • Study duration: unclear • Study follow-up period: 12 weeks
Participants	• Country: Brazil • Setting: private HD centre • Inclusion criteria: sedentary adults (≥ 18 years); on HD by AV fistula 3 times/week for at least 3 months • Number (randomised/analysed): treatment group (22/20); control group (23/20) • Mean age ± SD (years): treatment group (49 ± 15.2); control group (43.9 ± 11.7) • Sex: treatment group (12/8); control group (10/10) • Mean dialysis vintage ± SD (months): treatment group (62.7 ± 34.2); control group (55.95 ± 38.87) • Mean BMI ± SD (kg/m^2): treatment group (25.5 ± 5); control group (24.5 ± 4.5) • Exclusion criteria: haemodynamic instability; diagnosed respiratory disorder; visual impairment, or musculoskeletal and/or neurological limitations that compromised the ability to perform the proposed exercises; absence from two consecutive sessions; withdrawal; or death were excluded from the final analysis
Interventions	• Wii Sports (2006) and Wii Fit Plus (2009) • Control group
Outcomes	• HRQoL (KDQOL) • Physical function • Mental health • Clinical parameters
Notes	

PEDAL 2021

Methods	• Study design: parallel RCT • Study duration: unclear • Study follow-up period: not reported
Participants	• Country: UK • Setting: dialysis centres (10 sites)

PEDAL 2021 *(Continued)*

	• Inclusion criteria: adult patients > 18 years, treated as outpatients, undergoing in-centre (hospital unit, satellite unit) maintenance HD > 3 months • Number: ~115 per group • Age: > 18 years • Sex: males and females • Exclusion criteria: expected survival on dialysis < 6 months; dialysis withdrawal was being considered; likely to receive a live-donor transplant or transfer to PD in the period of time; patients deemed to be clinically unstable by their treating physician; bilateral lower-limb amputations; dementia or severe cognitive impairment; unable to give informed consent; psychiatric disorders; pregnant
Interventions	• Resistance training with progression • Usual care
Outcomes	• Change in KDQOL-SF 1.3 physical capacity score (disease-specific QOL measure) • Peak aerobic capacity • Physical performance tests • Anthropometric measures • Cardiovascular risk • Physical function questionnaires • Biochemistry • Medication • Safety of intervention
Notes	• Protocol only

Stringuetta Belik 2018

Methods	• Study design: parallel RCT • Study duration: unclear • Study follow-up period: 4 months
Participants	• Country: Brazil • Setting: HD centre • Inclusion criteria: > 18 years; maintenance HD for at least 3 months; stable medication; did not present contraindications for physical exercises • Number: intervention group (15); control group (15) • Mean age ± SD (years): intervention group (50 ± 17.2); control group (58 ± 15.0) • Sex (M/F): intervention group (7/8); control group (8/7) • Mean dialysis vintage ± SD (months): intervention group (26.0 ± 14.58); control group (21.0 ± 27.1) • Mean BMI ± SD: intervention group (25.7 ± 3.58); control group (26.7 ± 4.6) • Exclusion criteria: already physically active; previous diagnosis of coronary artery disease or a positive treadmill exercise test for coronary arterial disease; previous stroke; cancer; liver failure; infection inactivity; BP > 160 × 100 mm Hg at a treadmill test; inclusion in another concurrent trial
Interventions	• Aerobic training • Usual care
Outcomes	• Physical activity • Biochemistry • Cardiovascular outcomes

Stringuetta Belik 2018 *(Continued)*

Notes

AV - arteriovenous BIA - bioelectrical impedance analysis; BMI - body mass index; BP - blood pressure; CRP - C-reactive protein; ESKD - end-stage kidney disease; Hb - haemoglobin; HD - haemodialysis; HRQoL - health-related quality of life; Kt/V - dialysis capacity; M/F - male/female; PD - peritoneal dialysis; QoL - quality of life; RCT - randomised controlled trial; SCr - serum creatinine

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

ACTRN12618000724279

Study name	Evaluation of the effectiveness of home-based physical training in patients undergoing haemodialysis
Methods	• Study design: parallel RCT • Study duration: unclear • Study follow-up period: 26 weeks
Participants	• Country: Poland • Setting: home • Exclusion criteria: lack of logical contact with the patient
Interventions	Exercise group • Type: aerobic • Description: stationary ergometric bicycle training • Duration: 30 to 35 minutes • Warm-up: 5 minutes • Cool-down: 5 minutes • Frequency: 3 times/week on non-dialysis days • Intensity: 40% to 60% HR • Supervised: partially Control group • Not reported, assumed usual care
Outcomes	• Exercise tolerance • Functional fitness • QoL
Starting date	10th August 2015
Contact information	
Notes	Trial registration information only

Cardoso 2019

Study name	Effects of continuous moderate exercise with partial blood flow restriction during hemodialysis: a protocol for a randomized clinical trial
Methods	• Study design: parallel RCT (3 arms) • Study duration: unclear

Cardoso 2019 *(Continued)*

	• Study follow-up period: 13 weeks
Participants	• Country: Brazil • Setting: HD unit • Exclusion criteria: diagnosis of coronary artery disease, presence of active infection or cancer; presence of musculoskeletal limitations preventing exercise performance; cognitive alterations making it impossible to understand the instructions of the exercises; SBP > 180 mm Hg or DBP > 105 mm Hg at rest; resting HR > 120 bpm
Interventions	Exercise group • Type: aerobic • Description: stationary bicycle performed in the first 2 hours of HD • Duration: min • Warm-up: min • Cool-down: min • Frequency: times/week • Intensity: weeks 1 to 6: HR between 60% and 63% of HRmax or 10 to 11 in the perceived subjective exertion (ranges from 6 to 20) • Weeks 5 to 8: HR between 64% and 76% of HRmax or 12 to 13 in the subjective perception of effort scale • Supervised: unclear Control group • Not reported, no exercise assumed
Outcomes	• IL-6 • IL-10 • CRP • Femoral quadriceps muscle thickness • Catalase activity • Superoxide dismutase activity • Glutathione peroxidase activity • Ankle-arm index • Functional test • Strength • QoL
Starting date	Unknown
Contact information	rafaelorcy@gmail.com
Notes	Protocol published

Chan 2019

Study name	A randomized controlled trial of exercise to prevent muscle mass and functional loss in elderly hemodialysis patients: rationale, study design, and baseline sample
Methods	• Study design: parallel RCT • Study duration: unclear • Study follow-up period: weeks

Chan 2019 *(Continued)*

Participants	• Country: USA • Setting: HD units • Exclusion criteria: temporary vascular access; uncontrolled DM; active autoimmune disease; malignancy, severe obesity (BMI > 35); alcoholism or other recreational drug use; unstable cardiac disease (abnormal exercise test, angina, uncontrolled arrhythmias or MI within 3 months); peripheral vascular disease (claudication with exercise); medically unstable; currently active (> 2 hours/week of moderate-intensity exercise); have received anabolic, catabolic or cytotoxic medications in the past 3 months
Interventions	Exercise group • Type: aerobic and resistance • Description: 12-week individualized exercise program combining supervised and home-based monitored exercise • Duration: 45 minutes • Frequency: 7 times/week • Intensity: 70% to 80% of HR reserve and 12 to 14 on the Borg perceived exertion scale • Supervised: partially
Outcomes	• VO_2 max • Chair raise test • 6MWT • Handgrip strength • Body composition • HRQoL: measured using SF-36 • Beeson cognitive test
Starting date	
Contact information	knchan@stanford.edu
Notes	

Clarkson 2017

Study name	Efficacy of blood flow restriction exercise during dialysis for end stage kidney disease patients: protocol of a randomised controlled trial
Methods	• Study design: parallel RCT (3 arms) • Study duration: unclear • Study follow-up period: 12 Weeks
Participants	• Country: Australia • Setting: HD Unit • Exclusion criteria: do not understand English and are unable to complete or comprehend the surveys or study documents; within the previous 12 weeks they have participated in regular physical activity or sport (> 150 min/week) of moderate or greater intensity, or structured resistance training (> 1 session/week) • symptomatic peripheral vascular disease; limb ischaemia; untreated symptomatic cardiovascular disease • any other absolute contraindications to exercise training (such as musculoskeletal factors or neurological conditions) that may affect their ability to perform physical assessments or exercise training protocols in the present study; currently smokers; pregnancy; have required hospitalisa-

Clarkson 2017 *(Continued)*

	tion for non-dialysis reasons in the 4 weeks prior to the study's commencement; also be deemed unable to exercise during individual dialysis sessions if they present with fluid overload (> 5% above dialysis base weight);, SBP > 180 mm Hg, DBP < 90 mm Hg
Interventions	Blood flow restriction group • Type: aerobic • Description: stationary bicycle performed in the first 2 hours of HD • Duration: 10 minutes of exercise, followed by 20 minutes of rest and a subsequent 10 minutes of exercise (20 minutes exercise in total) • Warm-up: unclear • Cool-down: unclear • Frequency: unclear • Intensity: 15 RPE, 60% of age-adjusted HRmax • Supervised: yes • Co-Intervention: automated tourniquet system applied to patient thighs during exercise Non-blood flow restriction group • Type: aerobic • Description: stationary bicycle performed in the first 2 hours of HD • Duration: 20 minutes • Warm-up: unclear • Cool-down: unclear • Frequency: unclear • Intensity: 12 RPE, 50% of age-adjusted HRmax • Supervised: yes • Co-Intervention: no Control group • Usual care, given exercise advice at end of study only
Outcomes	• Lower limb muscle strength: 3RM • Sit-to-stand in 30 seconds • TUG • 6MWT • Muscle cross-sectional area • Body composition • Hb • Albumin • Potassium • PTH • Phosphate • URR • Physical activity level • POS-S questionnaire for symptom-related QoL
Starting date	
Contact information	stuart.warmington@deakin.edu.au
Notes	Protocol Published

NCT01721551

Study name	Sleep and training aspects in dialysis fatigue - exercise intervention (StandFirm)
Methods	• Study design: parallel RCT • Study duration: 32 months • Study follow-up period: 39 Weeks
Participants	• Country: Greece • Setting: unclear • Exclusion criteria: unable to give informed consent; opportunistic infection in the last 3 months; malignancy; infection requiring intravenous antibiotics within 2 months prior to enrolment; myoskeletal contraindication to exercise; requirement for systemic anticoagulation; participating or participated in an investigational drug or medical device study within 30 days or 5 half-lives; pregnant or breastfeeding; female of childbearing potential who does not agree to remain abstinent or to use an acceptable contraceptive regimen; LDH > 300U/L; prolonged QT interval (as defined by QTc > 460 msec in males and > 470 msec in females) in screening ECG; known current alcohol or drug abuse; known or suspected hypersensitivity to the study medication or any of its ingredients
Interventions	Exercise group • Type: aerobic • Description: recumbent cycle training during dialysis session • Duration: 45 to 60 minutes • Warm-up: unclear • Cool-down: unclear • Frequency: unclear • Intensity: progressive from 30% to 40% of maximum exercise power to 60% to 70% of maximum exercise power • Supervised: unclear Control group • Assumed usual care, stated that patients will not participate in any type of systematic exercise training Co-Intervention • No
Outcomes	• Fatigue • Body composition • Muscle functionality
Starting date	November 2012
Contact information	
Notes	Trial Registry Document

6MWT - 6 minute walk test; BMI - body mass index; bpm - beats per minute; CRP - C-reactive protein; DBP - diastolic blood pressure; DM- diabetes mellitus; ECG - electrocardiograph; Hb - haemoglobin; HD - haemodialysis; HR - heart rate; IL - interleukin; MI - myocardial infarction; PTH - parathyroid hormone; (HR)QoL - (health-related) quality of life; RCT - randomised controlled trial; RPE - rating of perceived exertion; SBP - systolic blood pressure; TUG - timed up-and-go; URR - urea reduction ratio VO_2 max - maximum rate of oxygen consumption

DATA AND ANALYSES

Comparison 1. Any exercise versus control (no exercise/placebo exercise)

Outcome or subgroup title	No. of studies	No. of participants	Statistical method	Effect size
1.1 Death	1	296	Risk Ratio (M-H, Random, 95% CI)	0.95 [0.56, 1.62]
1.2 Fatigue	6		Std. Mean Difference (IV, Random, 95% CI)	Totals not selected
1.3 HRQoL: Summary component scores	17		Mean Difference (IV, Random, 95% CI)	Subtotals only
1.3.1 Physical Component Score	17	656	Mean Difference (IV, Random, 95% CI)	-4.12 [-6.37, -1.88]
1.3.2 Mental Component Score	17	656	Mean Difference (IV, Random, 95% CI)	-2.53 [-5.47, 0.40]
1.4 HRQoL: Individual domains	20		Mean Difference (IV, Random, 95% CI)	Subtotals only
1.4.1 Physical Functioning	18	1040	Mean Difference (IV, Random, 95% CI)	-4.70 [-8.94, -0.47]
1.4.2 Role-physical	13	809	Mean Difference (IV, Random, 95% CI)	-3.75 [-13.73, 6.23]
1.4.3 Pain	15	872	Mean Difference (IV, Random, 95% CI)	-5.28 [-10.69, 0.12]
1.4.4 General health perceptions	14	834	Mean Difference (IV, Random, 95% CI)	-3.86 [-7.39, -0.33]
1.4.5 Emotional well-being	13	789	Mean Difference (IV, Random, 95% CI)	-4.24 [-8.00, -0.47]
1.4.6 Role-emotional	14	833	Mean Difference (IV, Random, 95% CI)	-8.08 [-11.26, -4.90]
1.4.7 Vitality	16	940	Mean Difference (IV, Random, 95% CI)	-4.47 [-8.15, -0.79]
1.4.8 Social function	15	851	Mean Difference (IV, Random, 95% CI)	-0.80 [-4.56, 2.96]
1.4.9 Symptoms	7	533	Mean Difference (IV, Random, 95% CI)	-6.07 [-12.07, -0.08]
1.4.10 Effects of kidney disease	5	409	Mean Difference (IV, Random, 95% CI)	-4.01 [-6.47, -1.55]
1.4.11 Burden of kidney disease	5	409	Mean Difference (IV, Random, 95% CI)	-0.06 [-2.64, 2.51]
1.4.12 Work status	4	362	Mean Difference (IV, Random, 95% CI)	-0.36 [-3.75, 3.03]
1.4.13 Cognitive function	5	409	Mean Difference (IV, Random, 95% CI)	-2.66 [-7.57, 2.25]
1.4.14 Quality of social interactions	5	409	Mean Difference (IV, Random, 95% CI)	-4.92 [-8.32, -1.51]

Outcome or subgroup title	No. of studies	No. of participants	Statistical method	Effect size
1.4.15 Sexual function	4	362	Mean Difference (IV, Random, 95% CI)	-3.60 [-11.16, 3.96]
1.4.16 Sleep	6	437	Mean Difference (IV, Random, 95% CI)	-6.58 [-12.57, -0.60]
1.4.17 Social support	5	409	Mean Difference (IV, Random, 95% CI)	-3.98 [-7.07, -0.89]
1.4.18 Dialysis staff encouragement	5	409	Mean Difference (IV, Random, 95% CI)	-3.75 [-8.40, 0.90]
1.4.19 Patient satisfaction	5	409	Mean Difference (IV, Random, 95% CI)	-4.58 [-10.23, 1.06]
1.5 Depression	10	441	Std. Mean Difference (IV, Random, 95% CI)	0.65 [0.22, 1.07]
1.5.1 4 months or less	6	311	Std. Mean Difference (IV, Random, 95% CI)	0.30 [-0.14, 0.74]
1.5.2 More than 4 months	4	130	Std. Mean Difference (IV, Random, 95% CI)	1.26 [0.72, 1.80]
1.6 6MWT	19	827	Mean Difference (IV, Random, 95% CI)	-49.91 [-62.59, -37.22]
1.7 Sit-To-Stand test [N reps/30 sec]	12	478	Mean Difference (IV, Random, 95% CI)	-2.36 [-2.98, -1.73]
1.8 Sit-To-Stand test [sit to 5 reps]	8	508	Mean Difference (IV, Random, 95% CI)	1.74 [1.22, 2.25]
1.9 Systolic blood pressure	20		Mean Difference (IV, Random, 95% CI)	Subtotals only
1.9.1 Aerobic	13	394	Mean Difference (IV, Random, 95% CI)	3.99 [-1.80, 9.78]
1.9.2 Combined aerobic and resistance	7	282	Mean Difference (IV, Random, 95% CI)	8.69 [3.69, 13.69]
1.9.3 Others	1	30	Mean Difference (IV, Random, 95% CI)	25.55 [14.95, 36.15]
1.10 Diastolic blood pressure	20		Mean Difference (IV, Random, 95% CI)	Subtotals only
1.10.1 Aerobic	13	394	Mean Difference (IV, Random, 95% CI)	-0.72 [-3.69, 2.24]
1.10.2 Combined aerobic and resistance	7	282	Mean Difference (IV, Random, 95% CI)	4.45 [2.91, 5.98]
1.10.3 Others	1	30	Mean Difference (IV, Random, 95% CI)	13.42 [7.46, 19.38]
1.11 Aerobic capacity (VO max or peak)	14	407	Mean Difference (IV, Random, 95% CI)	-3.30 [-4.33, -2.28]
1.12 Albumin	23	767	Mean Difference (IV, Random, 95% CI)	-0.39 [-1.25, 0.47]
1.13 Blood lipids	12		Mean Difference (IV, Random, 95% CI)	Subtotals only

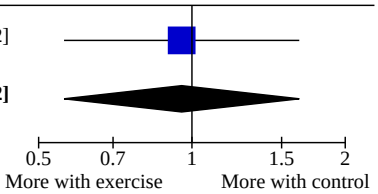
Outcome or subgroup title	No. of studies	No. of participants	Statistical method	Effect size
1.13.1 Total cholesterol [mmol/L]	12	439	Mean Difference (IV, Random, 95% CI)	0.22 [0.04, 0.39]
1.13.2 LDL cholesterol [mmol/L]	6	180	Mean Difference (IV, Random, 95% CI)	0.24 [-0.02, 0.51]
1.13.3 HDL cholesterol [mmol/L]	8	264	Mean Difference (IV, Random, 95% CI)	-0.07 [-0.18, 0.04]
1.13.4 Triglycerides [mmol/L]	8	264	Mean Difference (IV, Random, 95% CI)	0.09 [-0.25, 0.44]
1.14 Body composition	10		Mean Difference (IV, Random, 95% CI)	Subtotals only
1.14.1 Fat mass [kg]	9	384	Mean Difference (IV, Random, 95% CI)	-0.04 [-0.10, 0.02]
1.14.2 Lean mass [kg]	7	313	Mean Difference (IV, Random, 95% CI)	-0.37 [-2.74, 1.99]
1.15 Body mass index	16	590	Mean Difference (IV, Random, 95% CI)	-0.12 [-0.55, 0.31]
1.16 Calcium	17	592	Mean Difference (IV, Random, 95% CI)	0.03 [-0.00, 0.06]
1.17 C-reactive protein	14	421	Mean Difference (IV, Random, 95% CI)	0.31 [-0.13, 0.74]
1.18 Dialysis adequacy: Kt/V	11	382	Mean Difference (IV, Random, 95% CI)	-0.08 [-0.16, 0.00]
1.19 Energy intake	7	316	Mean Difference (IV, Random, 95% CI)	-0.09 [-1.58, 1.40]
1.20 Haemoglobin	29	975	Mean Difference (IV, Random, 95% CI)	-0.06 [-0.18, 0.06]
1.21 Left ventricular ejection fraction	6	222	Mean Difference (IV, Random, 95% CI)	-1.45 [-3.60, 0.70]
1.22 Left ventricular mass index	6	215	Mean Difference (IV, Random, 95% CI)	-9.85 [-20.50, 0.80]
1.23 Maximum heart rate	8	275	Mean Difference (IV, Random, 95% CI)	-6.14 [-10.05, -2.24]
1.24 Muscular strength	16		Mean Difference (IV, Random, 95% CI)	Subtotals only
1.24.1 Knee extension	8	316	Mean Difference (IV, Random, 95% CI)	-5.06 [-8.58, -1.54]
1.24.2 Handgrip	10	410	Mean Difference (IV, Random, 95% CI)	-4.16 [-6.61, -1.71]
1.25 Phosphate	20	672	Mean Difference (IV, Random, 95% CI)	0.05 [-0.07, 0.16]
1.26 Potassium	18	610	Mean Difference (IV, Random, 95% CI)	0.23 [-0.06, 0.51]
1.27 Protein intake	7	316	Mean Difference (IV, Random, 95% CI)	-0.02 [-0.10, 0.07]
1.28 Parathyroid hormone	5	129	Mean Difference (IV, Random, 95% CI)	0.39 [-10.90, 11.68]

Outcome or subgroup title	No. of studies	No. of participants	Statistical method	Effect size
1.29 Resting heart rate	11	405	Mean Difference (IV, Random, 95% CI)	3.72 [1.89, 5.56]
1.30 Timed up-and-go test	6	285	Mean Difference (IV, Random, 95% CI)	1.63 [0.90, 2.36]

Analysis 1.1. Comparison 1: Any exercise versus control (no exercise/placebo exercise), Outcome 1: Death

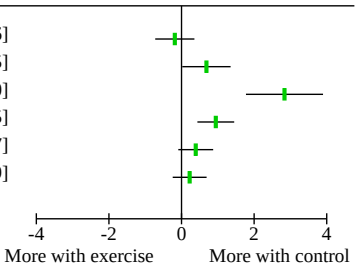
Study or Subgroup	Control Events	Control Total	Exercise Events	Exercise Total	Weight	Risk Ratio M-H, Random, 95% CI
EXCITE 2014	22	145	24	151	100.0%	0.95 [0.56 , 1.62]
Total (95% CI)		**145**		**151**	**100.0%**	**0.95 [0.56 , 1.62]**
Total events:	22		24			

Heterogeneity: Not applicable
Test for overall effect: Z = 0.17 (P = 0.86)
Test for subgroup differences: Not applicable



Analysis 1.2. Comparison 1: Any exercise versus control (no exercise/placebo exercise), Outcome 2: Fatigue

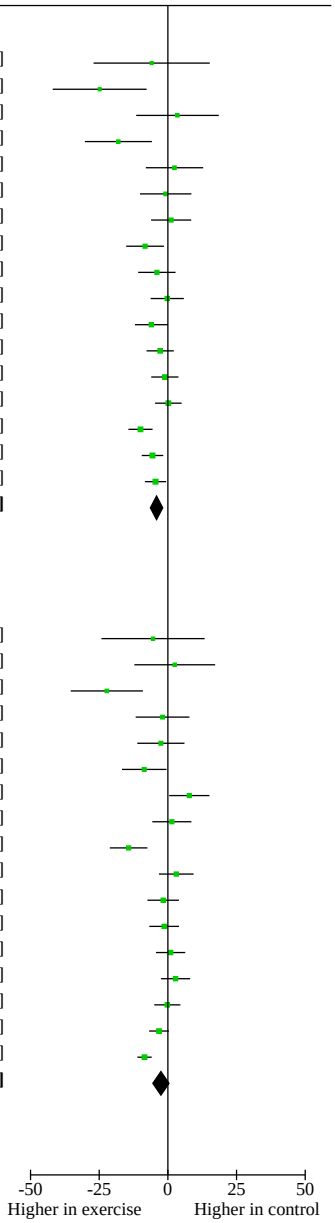
Study or Subgroup	Control Mean	Control SD	Control Total	Exercise Mean	Exercise SD	Exercise Total	Std. Mean Difference IV, Random, 95% CI
Sheshadri 2020	2	1.6	26	2.3	1.6	27	-0.18 [-0.72 , 0.36]
Yurtkuran 2007	6.9	7.2	18	3.3	1.5	19	0.69 [0.02 , 1.35]
Soliman 2015 (1)	29.75	5.19	12	14.44	5.29	18	2.84 [1.78 , 3.90]
Amini 2016	6.2	2.15	35	4.37	1.62	32	0.94 [0.44 , 1.45]
Johansen 2006 (2)	8.95	4.71	33	7.07	4.78	35	0.39 [-0.09 , 0.87]
Chang 2010	45.5	19.66	35	41	20.09	36	0.22 [-0.24 , 0.69]



Footnotes
(1) data has been verified
(2) Factorial design, two intervention arms pooled together in the exercise group and two control arms pooled together in the control group

Analysis 1.3. Comparison 1: Any exercise versus control (no exercise/ placebo exercise), Outcome 3: HRQoL: Summary component scores

Study or Subgroup	Control Mean	Control SD	Control Total	Exercise Mean	Exercise SD	Exercise Total	Weight	Mean Difference IV, Random, 95% CI
1.3.1 Physical Component Score								
Giannaki 2013a	70.5	26.5	7	76.4	15.6	15	1.0%	-5.90 [-27.06 , 15.26]
ACTINUT 2013	59.87	21.37	9	84.7	13.32	7	1.5%	-24.83 [-41.93 , -7.73]
Koh 2009 (1)	55	25	15	51.5	22.71	30	1.9%	3.50 [-11.54 , 18.54]
CHAIR 2015 (2)	33.58	18.05	11	51.6	7.41	6	2.7%	-18.02 [-30.22 , -5.82]
Rosa 2018	74.43	18.07	24	72.02	20.36	28	3.5%	2.41 [-8.04 , 12.86]
Molsted 2004 (3)	44.95	10.99	7	45.75	7.44	10	4.1%	-0.80 [-10.16 , 8.56]
Segura-Orti 2009	45.9	8.7	8	44.7	8.7	17	5.6%	1.20 [-6.11 , 8.51]
Song 2012a	64.2	12.2	20	72.5	9.8	20	6.0%	-8.30 [-15.16 , -1.44]
Chen 2010	50	11	22	54	12	22	6.1%	-4.00 [-10.80 , 2.80]
DIALY-SIZE 2016 (4)	3.4	7.3	8	3.64	8.1	23	6.9%	-0.24 [-6.29 , 5.81]
Samara 2016	43.9	8.8	12	49.9	6.6	15	7.0%	-6.00 [-12.00 , -0.00]
Uchiyama 2019	38.2	9.2	23	41	8.1	24	8.3%	-2.80 [-7.76 , 2.16]
Dobsak 2012	50.6	6.8	10	51.7	4.4	11	8.3%	-1.10 [-6.05 , 3.85]
IHOPE 2019	38.9	9.42	38	38.72	10.4	29	8.5%	0.18 [-4.65 , 5.01]
Suhardjono 2019 (5)	-3.45	12.45	38	6.52	8.32	73	9.1%	-9.97 [-14.36 , -5.58]
Ouzouni 2009	38.9	5.8	14	44.5	5.5	19	9.8%	-5.60 [-9.52 , -1.68]
Frih 2017a	51	7	20	55.5	5.5	21	9.8%	-4.50 [-8.37 , -0.63]
Subtotal (95% CI)			**286**			**370**	**100.0%**	**-4.12 [-6.37 , -1.88]**
Heterogeneity: Tau² = 9.41; Chi² = 31.17, df = 16 (P = 0.01); I² = 49%								
Test for overall effect: Z = 3.61 (P = 0.0003)								
1.3.2 Mental Component Score								
Giannaki 2013a	65	21.9	7	70.4	18.7	15	1.9%	-5.40 [-24.18 , 13.38]
Koh 2009 (1)	64	25	15	61.5	20.96	30	2.8%	2.50 [-12.21 , 17.21]
ACTINUT 2013	52.07	16.11	9	74.3	10.61	7	3.2%	-22.23 [-35.37 , -9.09]
Rosa 2018	76.08	19.15	24	78.02	16.44	28	4.6%	-1.94 [-11.73 , 7.85]
Molsted 2004 (3)	51.55	10.26	7	54.1	6.47	10	5.2%	-2.55 [-11.14 , 6.04]
Song 2012a	60.8	12.4	20	69.4	13.7	20	5.4%	-8.60 [-16.70 , -0.50]
Segura-Orti 2009	54.3	5.1	8	46.5	13.5	17	5.9%	7.80 [0.47 , 15.13]
CHAIR 2015	53.05	6.65	11	51.6	7.41	6	6.0%	1.45 [-5.66 , 8.56]
Samara 2016	39	10.4	12	53.3	6.9	15	6.2%	-14.30 [-21.14 , -7.46]
DIALY-SIZE 2016 (4)	0.7	7.5	8	-2.36	8.75	23	6.5%	3.06 [-3.25 , 9.37]
Ouzouni 2009	40.1	6.8	14	41.8	10	19	6.8%	-1.70 [-7.44 , 4.04]
IHOPE 2019	50.7	11.63	38	52.05	10.81	29	7.1%	-1.35 [-6.75 , 4.05]
Chen 2010	38	9	22	37	9	22	7.1%	1.00 [-4.32 , 6.32]
Uchiyama 2019	52.6	9	23	49.8	9.6	24	7.1%	2.80 [-2.52 , 8.12]
Dobsak 2012	59.3	5.6	10	59.5	5.5	11	7.5%	-0.20 [-4.96 , 4.56]
Suhardjono 2019	-0.56	9.224	38	2.67	9.05	73	8.1%	-3.23 [-6.82 , 0.36]
Frih 2017a	42.5	4.5	20	51	4	21	8.6%	-8.50 [-11.11 , -5.89]
Subtotal (95% CI)			**286**			**370**	**100.0%**	**-2.53 [-5.47 , 0.40]**
Heterogeneity: Tau² = 24.15; Chi² = 59.95, df = 16 (P < 0.00001); I² = 73%								
Test for overall effect: Z = 1.69 (P = 0.09)								



Footnotes

(1) two intervention arms pooled together in the exercise group
(2) mean and standard deviation estimated from the median and range
(3) mean and standard deviation estimated from the median and the range
(4) three intervention arms pooled together in the exercise group
(5) mean and standard deviation estimated from the median and range and both intervention arms pooled together

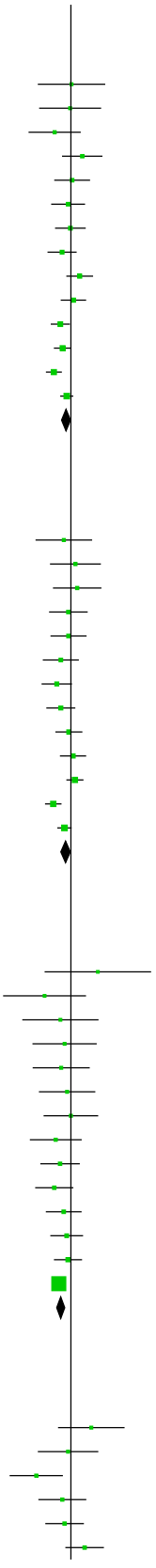
Analysis 1.4. Comparison 1: Any exercise versus control (no exercise/placebo exercise), Outcome 4: HRQoL: Individual domains

Study or Subgroup	Control Mean	Control SD	Control Total	Exercise Mean	Exercise SD	Exercise Total	Weight	Mean Difference IV, Random, 95% CI
1.4.1 Physical Functioning								
Parsons 2004	65.7	27.1	7	68.3	30.6	6	1.5%	-2.60 [-34.26 , 29.06]
Matsumoto 2007	48	36.0572	32	43	27.2293	17	3.6%	5.00 [-12.99 , 22.99]
Martins do Valle 2020	63.1	24.5	12	72.5	20.2	12	3.6%	-9.40 [-27.37 , 8.57]
Molsted 2004 (1)	70	21.99	7	82.5	9.41	11	3.8%	-12.50 [-29.71 , 4.71]
Zhao 2017	64.2	55.464	56	68.8	30.7879	59	4.0%	-4.60 [-21.11 , 11.91]
Koh 2009 (2)	70	26	15	67.5	25.04	30	4.2%	2.50 [-13.42 , 18.42]
Martin-Alemany 2016	59.7	26.4	19	71.3	22.3	17	4.2%	-11.60 [-27.51 , 4.31]
AVANTE-HEMO 2020	84.44	22.7	13	76.79	14.02	21	5.0%	7.65 [-6.07 , 21.37]
Johansen 2006 (3)	56.58	26.72	33	59.12	30.37	35	5.1%	-2.54 [-16.12 , 11.04]
Sheshadri 2020	63.7	24.3	26	60.2	25.4	27	5.1%	3.50 [-9.88 , 16.88]
van Vilsteren 2005	60.2	34.5	43	62.5	28	53	5.4%	-2.30 [-15.07 , 10.47]
Jong 2004	2.35	10.62	17	7.42	17.17	19	7.0%	-5.07 [-14.29 , 4.15]
Abreu 2017	85	13	19	87	18	25	7.1%	-2.00 [-11.16 , 7.16]
Uchiyama 2019	73.2	13.9	23	76	15.7	24	7.4%	-2.80 [-11.27 , 5.67]
PEAK 2006	-1.8	17.6	25	7.6	11.8	24	7.5%	-9.40 [-17.76 , -1.04]
Dobsak 2012	53.1	10	10	54.1	7.9	11	7.8%	-1.00 [-8.76 , 6.76]
EXCITE 2014	-2.7	27.4518	123	1.5	21.0824	104	8.5%	-4.20 [-10.52 , 2.12]
Wu 2014d	60.6	12.9	33	82.1	10	32	8.9%	-21.50 [-27.10 , -15.90]
Subtotal (95% CI)			**513**			**527**	**100.0%**	**-4.70 [-8.94 , -0.47]**
Heterogeneity: Tau² = 44.10; Chi² = 43.01, df = 17 (P = 0.0005); I² = 60%								
Test for overall effect: Z = 2.18 (P = 0.03)								
1.4.2 Role-physical								
Molsted 2004 (1)	62.5	36.64	7	62.5	32.33	10	5.0%	0.00 [-33.74 , 33.74]
Parsons 2004	90.5	25.2	7	77.7	34.5	6	5.0%	12.80 [-20.52 , 46.12]
Martin-Alemany 2016	68.8	41.2	19	65.6	40.7	17	6.3%	3.20 [-23.59 , 29.99]
Koh 2009 (2)	48	44	15	37	39.82	30	6.3%	11.00 [-15.44 , 37.44]
Matsumoto 2007	40	58.2462	32	44	35.0091	17	6.4%	-4.00 [-30.16 , 22.16]
AVANTE-HEMO 2020	88.89	33.3	13	77.8	41.77	21	6.6%	11.09 [-14.34 , 36.52]
Zhao 2017	54.4	65.3044	56	63.2	62.9545	59	7.0%	-8.80 [-32.26 , 14.66]
van Vilsteren 2005	54.5	45.7	43	50	43	53	8.4%	4.50 [-13.41 , 22.41]
Abreu 2017	63	27	19	79	27	25	8.8%	-16.00 [-32.11 , 0.11]
Uchiyama 2019	62.2	26.9	23	71.9	22	24	9.3%	-9.70 [-23.78 , 4.38]
EXCITE 2014	-9.2	53.2229	123	0.2	47.821	104	9.5%	-9.40 [-22.55 , 3.75]
Dobsak 2012	51.3	8.9	10	44.1	10.6	11	10.6%	7.20 [-1.15 , 15.55]
Wu 2014d	26.3	11.5	33	54.6	15.4	32	10.9%	-28.30 [-34.92 , -21.68]
Subtotal (95% CI)			**400**			**409**	**100.0%**	**-3.75 [-13.73 , 6.23]**
Heterogeneity: Tau² = 227.13; Chi² = 57.02, df = 12 (P < 0.00001); I² = 79%								
Test for overall effect: Z = 0.74 (P = 0.46)								
1.4.3 Pain								
Martins do Valle 2020	60	32.9	12	53.4	26.1	12	3.6%	6.60 [-17.16 , 30.36]
Parsons 2004	86.6	13.2	7	79.5	23.9	6	4.1%	7.10 [-14.38 , 28.58]
Zhao 2017	52.7	54.6641	56	64.6	59.4176	59	4.3%	-11.90 [-32.75 , 8.95]
Koh 2009 (2)	57	31	15	62.5	29.98	30	4.8%	-5.50 [-24.51 , 13.51]
Martin-Alemany 2016	65.4	34.7	19	77.3	21.2	17	5.0%	-11.90 [-30.47 , 6.67]
Matsumoto 2007	47	36.0572	32	46	23.3394	17	5.6%	1.00 [-15.71 , 17.71]
AVANTE-HEMO 2020	85	18.3	13	78.27	24.79	21	6.4%	6.73 [-7.81 , 21.27]
Abreu 2017	82	23	19	85	19	25	7.2%	-3.00 [-15.74 , 9.74]
Uchiyama 2019	67.5	24.4	23	73	19.1	24	7.3%	-5.50 [-18.06 , 7.06]
Molsted 2004 (1)	82.5	13.92	7	90.5	11.93	11	7.3%	-8.00 [-20.49 , 4.49]
Pellizzaro 2013	-15.5	16.7741	14	24	16.7741	14	7.3%	-39.50 [-51.93 , -27.07]
van Vilsteren 2005	76.1	25.5	43	76.9	21	53	8.7%	-0.80 [-10.29 , 8.69]
Dobsak 2012	55.7	10.7	10	57.6	10.9	11	8.8%	-1.90 [-11.15 , 7.35]
EXCITE 2014	-3.2	34.1747	123	-1.1	30.8523	104	9.2%	-2.10 [-10.56 , 6.36]
Wu 2014d	59	12.7	43	63	13.4	32	10.4%	-4.00 [-10.00 , 2.00]
Subtotal (95% CI)			**436**			**436**	**100.0%**	**-5.28 [-10.69 , 0.12]**
Heterogeneity: Tau² = 63.78; Chi² = 37.76, df = 14 (P = 0.0006); I² = 63%								
Test for overall effect: Z = 1.91 (P = 0.06)								
1.4.4 General health perceptions								

Analysis 1.4. (Continued)

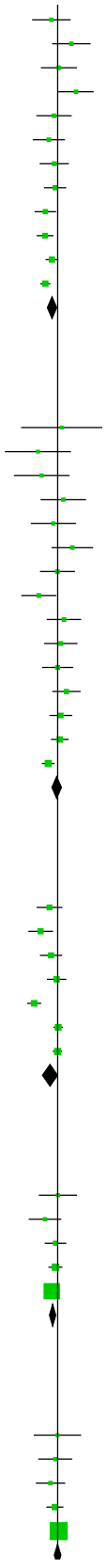
Test for overall effect: Z = 1.91 (P = 0.06)

1.4.4 General health perceptions								
Molsted 2004 (1)	59	30.05	7	58.5	25.11	11	1.6%	0.50 [-26.25 , 27.25]
Parsons 2004	50.1	22.4	7	50.7	22.7	6	1.9%	-0.60 [-25.20 , 24.00]
Zhao 2017	52.2	50.9911	56	65.1	62.0354	59	2.6%	-12.90 [-33.61 , 7.81]
Koh 2009 (2)	48	27	15	39	23.42	30	4.0%	9.00 [-7.03 , 25.03]
Matsumoto 2007	44	33.2836	32	43	17.5045	17	4.9%	1.00 [-13.22 , 15.22]
Martins do Valle 2020	50.5	13.3	12	52.7	19.7	12	5.3%	-2.20 [-15.65 , 11.25]
AVANTE-HEMO 2020	53.33	17.5	13	53.73	17.76	21	6.1%	-0.40 [-12.57 , 11.77]
Abreu 2017	71	21	19	78	17	25	6.6%	-7.00 [-18.56 , 4.56]
Martin-Alemany 2016	51	14.1	19	44	17.9	17	7.4%	7.00 [-3.61 , 17.61]
Uchiyama 2019	45.7	17.4	23	43.7	17.9	24	8.0%	2.00 [-8.09 , 12.09]
Dobsak 2012	42.5	9	10	50.9	8.7	11	11.1%	-8.40 [-15.99 , -0.81]
van Vilsteren 2005	45.2	18.1	43	51.8	15.9	53	12.2%	-6.60 [-13.50 , 0.30]
Wu 2014d	34.6	9.3	33	48.1	15.8	32	13.1%	-13.50 [-19.83 , -7.17]
EXCITE 2014	-2.5	20.1687	123	0.8	19.5398	104	15.2%	-3.30 [-8.48 , 1.88]
Subtotal (95% CI)			**412**			**422**	**100.0%**	**-3.86 [-7.39 , -0.33]**
Heterogeneity: Tau² = 14.33; Chi² = 20.32, df = 13 (P = 0.09); I² = 36%								
Test for overall effect: Z = 2.14 (P = 0.03)								
1.4.5 Emotional well-being								
Zhao 2017	55.3	61.2787	56	60.9	61.5759	59	2.5%	-5.60 [-28.06 , 16.86]
Parsons 2004	84.3	16.9	7	80.7	19.8	6	3.0%	3.60 [-16.59 , 23.79]
Martins do Valle 2020	70	16.7	12	65	29.6	12	3.3%	5.00 [-14.23 , 24.23]
Matsumoto 2007	52	30.5099	32	54	23.3394	17	4.9%	-2.00 [-17.32 , 13.32]
AVANTE-HEMO 2020	75.11	24.7	13	76.98	11.65	21	5.4%	-1.87 [-16.19 , 12.45]
Molsted 2004 (1)	76	17.59	7	84	10.04	11	5.4%	-8.00 [-22.32 , 6.32]
Martin-Alemany 2016	65.6	17.3	19	76.8	19.4	17	7.0%	-11.20 [-23.26 , 0.86]
Abreu 2017	78	22	19	86	15	25	7.5%	-8.00 [-19.51 , 3.51]
Dobsak 2012	63.4	14.9	10	65	9.2	11	8.3%	-1.60 [-12.32 , 9.12]
Uchiyama 2019	73.2	17.6	23	71.5	18.8	24	8.6%	1.70 [-8.71 , 12.11]
van Vilsteren 2005	79.4	15	43	76.2	18.9	53	13.8%	3.20 [-3.58 , 9.98]
Wu 2014d	54.2	14.1	33	68.2	12.8	32	14.3%	-14.00 [-20.54 , -7.46]
EXCITE 2014	-3.9	24.0904	123	1.2	19.5398	104	16.0%	-5.10 [-10.78 , 0.58]
Subtotal (95% CI)			**397**			**392**	**100.0%**	**-4.24 [-8.00 , -0.47]**
Heterogeneity: Tau² = 14.68; Chi² = 18.30, df = 12 (P = 0.11); I² = 34%								
Test for overall effect: Z = 2.21 (P = 0.03)								
1.4.6 Role-emotional								
Parsons 2004	71.4	30.4	7	50	44.7	6	0.6%	21.40 [-20.87 , 63.67]
Martins do Valle 2020	54.1	43.3	12	75	38.8	12	0.9%	-20.90 [-53.80 , 12.00]
Molsted 2004 (1)	75	36.64	7	83.33	21.55	10	1.1%	-8.33 [-38.58 , 21.92]
Koh 2009 (2)	69	41	15	74	41.43	30	1.6%	-5.00 [-30.50 , 20.50]
Zhao 2017	54.1	52.7802	56	61.8	70.3068	59	2.0%	-7.70 [-30.35 , 14.95]
Matsumoto 2007	47	52.699	32	50	27.2293	17	2.0%	-3.00 [-25.38 , 19.38]
Abreu 2017	76	35	19	76	38	25	2.2%	0.00 [-21.67 , 21.67]
Martin-Alemany 2016	73.4	33.3	19	85.4	29.7	17	2.4%	-12.00 [-32.58 , 8.58]
van Vilsteren 2005	70.2	41.9	43	78.8	35	53	4.1%	-8.60 [-24.27 , 7.07]
Uchiyama 2019	64.3	31.8	23	77.5	19.4	24	4.4%	-13.20 [-28.34 , 1.94]
EXCITE 2014	-7.5	57.1446	123	-1.8	51.9278	104	5.0%	-5.70 [-19.90 , 8.50]
AVANTE-HEMO 2020	92.59	22.2	13	95.92	11.32	21	6.0%	-3.33 [-16.33 , 9.67]
Dobsak 2012	57	14.7	10	59.3	10.9	11	8.1%	-2.30 [-13.46 , 8.86]
Wu 2014d	30.4	7.4	33	40	9.4	32	59.6%	-9.60 [-13.72 , -5.48]
Subtotal (95% CI)			**412**			**421**	**100.0%**	**-8.08 [-11.26 , -4.90]**
Heterogeneity: Tau² = 0.00; Chi² = 6.00, df = 13 (P = 0.95); I² = 0%								
Test for overall effect: Z = 4.98 (P < 0.00001)								
1.4.7 Vitality								
Parsons 2004	62.9	14.1	7	46.7	30.3	6	1.7%	16.20 [-10.20 , 42.60]
Molsted 2004 (1)	69	29.32	7	71.25	17.26	11	2.1%	-2.25 [-26.25 , 21.75]
Pellizzaro 2013	-10	28.5212	14	17.5	28.5212	14	2.6%	-27.50 [-48.63 , -6.37]
Zhao 2017	50.4	58.47	56	57.2	44.2067	59	3.1%	-6.80 [-25.82 , 12.22]
Matsumoto 2007	47	30.5099	32	52	23.3394	17	4.3%	-5.00 [-20.32 , 10.32]
Martin-Alemany 2016	68.1	20	19	57.2	26	17	4.3%	10.90 [-4.38 , 26.18]



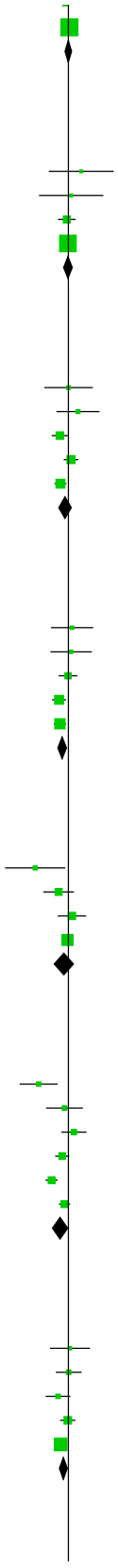
Analysis 1.4. (Continued)

Matsumoto 2007	47	30.5099	32	52	23.3394	17	4.3%	-5.00 [-20.32 , 10.32]
Martin-Alemany 2016	68.1	20	19	57.2	26	17	4.3%	10.90 [-4.38 , 26.18]
Koh 2009 (2)	52	23	15	51	23.31	30	4.8%	1.00 [-13.32 , 15.32]
AVANTE-HEMO 2020	72.78	22.6	13	58.22	15.91	21	4.9%	14.56 [0.52 , 28.60]
Sheshadri 2020	52.7	26.3	26	55.6	25.8	27	4.9%	-2.90 [-16.93 , 11.13]
Abreu 2017	67	21	19	74	22	25	5.6%	-7.00 [-19.79 , 5.79]
Uchiyama 2019	54.8	20.3	23	57.5	20.3	24	6.3%	-2.70 [-14.31 , 8.91]
Dobsak 2012	50.2	13.3	10	52.2	5.1	11	8.6%	-2.00 [-10.78 , 6.78]
PEAK 2006	-7	14.1	25	2.8	16.3	24	8.9%	-9.80 [-18.35 , -1.25]
van Vilsteren 2005	56.1	17.4	43	66.1	15.3	53	11.0%	-10.00 [-16.63 , -3.37]
EXCITE 2014	-3.7	25.2109	123	0.8	13.3693	104	12.8%	-4.50 [-9.64 , 0.64]
Wu 2014d	42.5	7.8	33	52.3	8.5	32	14.2%	-9.80 [-13.77 , -5.83]
Subtotal (95% CI)			**465**			**475**	**100.0%**	**-4.47 [-8.15 , -0.79]**
Heterogeneity: Tau² = 20.75; Chi² = 27.95, df = 15 (P = 0.02); I² = 46%								
Test for overall effect: Z = 2.38 (P = 0.02)								
1.4.8 Social function								
Parsons 2004	80.3	20.3	7	77.1	35.7	6	1.3%	3.20 [-29.08 , 35.48]
Martins do Valle 2020	64	35.6	12	79.7	29.8	12	1.9%	-15.70 [-41.97 , 10.57]
Zhao 2017	53.7	66.1989	56	66.4	53.764	59	2.6%	-12.70 [-34.81 , 9.41]
Koh 2009 (2)	73	30	15	68.5	27.42	30	3.7%	4.50 [-13.58 , 22.58]
Martin-Alemany 2016	76.4	25.5	19	79.8	29	17	3.8%	-3.40 [-21.33 , 14.53]
CHAIR 2015 (4)	41.68	14.78	11	30.01	17.5	6	4.4%	11.67 [-4.83 , 28.17]
AVANTE-HEMO 2020	90.28	19.5	13	90.44	21	21	5.8%	-0.16 [-14.05 , 13.73]
Abreu 2017	76	26	19	91	19	25	5.8%	-15.00 [-28.86 , -1.14]
Dobsak 2012	66.5	17.6	10	61.5	14	11	5.9%	5.00 [-8.69 , 18.69]
Uchiyama 2019	74.3	26	23	71.8	19.6	24	6.3%	2.50 [-10.71 , 15.71]
Molsted 2004 (1)	90.63	13.74	7	90.63	11.77	11	7.0%	0.00 [-12.33 , 12.33]
Matsumoto 2007	59	13.8681	32	52	21.3944	17	8.0%	7.00 [-4.25 , 18.25]
van Vilsteren 2005	74.1	25	43	71.6	19	53	10.7%	2.50 [-6.56 , 11.56]
EXCITE 2014	-0.8	22.9699	123	-2.5	29.8239	104	14.2%	1.70 [-5.32 , 8.72]
Wu 2014d	37	8.9	33	44.5	11.7	32	18.6%	-7.50 [-12.56 , -2.44]
Subtotal (95% CI)			**423**			**428**	**100.0%**	**-0.80 [-4.56 , 2.96]**
Heterogeneity: Tau² = 13.12; Chi² = 19.17, df = 14 (P = 0.16); I² = 27%								
Test for overall effect: Z = 0.42 (P = 0.68)								
1.4.9 Symptoms								
Martin-Alemany 2016	70.1	16.6	19	76.6	14.8	17	11.8%	-6.50 [-16.76 , 3.76]
Pellizzaro 2013	0	13.2288	14	13.5	13.2288	14	12.2%	-13.50 [-23.30 , -3.70]
AVANTE-HEMO 2020	76.87	13.4	13	82.12	11.85	21	12.9%	-5.25 [-14.12 , 3.62]
Uchiyama 2019	78.7	15.2	23	79.5	11.4	24	13.9%	-0.80 [-8.51 , 6.91]
Wu 2014d	43.5	8.8	33	62.2	13.6	32	15.6%	-18.70 [-24.29 , -13.11]
van Vilsteren 2005	23.9	9.5	43	23.5	9.1	53	16.8%	0.40 [-3.35 , 4.15]
EXCITE 2014	-0.8	15.6868	123	-0.6	12.3409	104	16.9%	-0.20 [-3.85 , 3.45]
Subtotal (95% CI)			**268**			**265**	**100.0%**	**-6.07 [-12.07 , -0.08]**
Heterogeneity: Tau² = 51.93; Chi² = 40.59, df = 6 (P < 0.00001); I² = 85%								
Test for overall effect: Z = 1.99 (P = 0.05)								
1.4.10 Effects of kidney disease								
Martin-Alemany 2016	70.2	21.1	19	70	25	17	2.6%	0.20 [-15.01 , 15.41]
AVANTE-HEMO 2020	64.59	18.1	13	74.65	19.73	21	3.6%	-10.06 [-23.02 , 2.90]
Uchiyama 2019	78.1	15.6	23	79.8	14.3	24	8.2%	-1.70 [-10.27 , 6.87]
EXCITE 2014	-0.3	20.7289	123	1.5	21.5966	104	19.7%	-1.80 [-7.34 , 3.74]
Wu 2014d	34.6	5.7	33	39.4	6.7	32	65.9%	-4.80 [-7.83 , -1.77]
Subtotal (95% CI)			**211**			**198**	**100.0%**	**-4.01 [-6.47 , -1.55]**
Heterogeneity: Tau² = 0.00; Chi² = 2.28, df = 4 (P = 0.68); I² = 0%								
Test for overall effect: Z = 3.20 (P = 0.001)								
1.4.11 Burden of kidney disease								
Martin-Alemany 2016	44.3	26.4	19	44.5	30.8	17	1.9%	-0.20 [-19.05 , 18.65]
AVANTE-HEMO 2020	56.96	19.6	13	58.88	19.33	21	3.6%	-1.92 [-15.41 , 11.57]
Uchiyama 2019	42.4	19.2	23	48.1	21.7	24	4.8%	-5.70 [-17.40 , 6.00]
EXCITE 2014	0.4	28.0121	123	2.6	24.1676	104	14.4%	-2.20 [-8.99 , 4.59]
Wu 2014d	27.6	5.91	33	26.8	6.29	32	75.2%	0.80 [-2.17 , 3.77]
Subtotal (95% CI)			**211**			**198**	**100.0%**	**-0.06 [-2.64 , 2.51]**



Analysis 1.4. (Continued)

Wu 2014d	27.6	5.91	33	26.8	6.29	32	75.2%	0.80 [-2.17 , 3.77]
Subtotal (95% CI)			**211**			**198**	**100.0%**	**-0.06 [-2.64 , 2.51]**
Heterogeneity: Tau² = 0.00; Chi² = 1.67, df = 4 (P = 0.80); I² = 0%								
Test for overall effect: Z = 0.05 (P = 0.96)								
1.4.12 Work status								
AVANTE-HEMO 2020	50	35.4	13	39.8	39.5	21	1.8%	10.20 [-15.41 , 35.81]
Martin-Alemany 2016	27.5	41.2	19	25.3	36.7	17	1.8%	2.20 [-23.25 , 27.65]
EXCITE 2014	-0.9	31.3735	123	0.3	22.1108	104	23.5%	-1.20 [-8.19 , 5.79]
Wu 2014d	29.3	8.97	33	29.7	7.29	32	72.9%	-0.40 [-4.37 , 3.57]
Subtotal (95% CI)			**188**			**174**	**100.0%**	**-0.36 [-3.75 , 3.03]**
Heterogeneity: Tau² = 0.00; Chi² = 0.75, df = 3 (P = 0.86); I² = 0%								
Test for overall effect: Z = 0.21 (P = 0.84)								
1.4.13 Cognitive function								
AVANTE-HEMO 2020	24.46	27.3	13	24.29	28.42	21	5.7%	0.17 [-19.01 , 19.35]
Martin-Alemany 2016	33	20.5	19	25.4	30	17	7.1%	7.60 [-9.38 , 24.58]
EXCITE 2014	-6.4	30.8133	123	0.3	17.9972	104	25.9%	-6.70 [-13.15 , -0.25]
Uchiyama 2019	92.4	9.5	23	90.3	10.7	24	28.4%	2.10 [-3.68 , 7.88]
Wu 2014d	70.4	9.19	33	76.7	10.13	32	32.8%	-6.30 [-11.01 , -1.59]
Subtotal (95% CI)			**211**			**198**	**100.0%**	**-2.66 [-7.57 , 2.25]**
Heterogeneity: Tau² = 13.38; Chi² = 7.69, df = 4 (P = 0.10); I² = 48%								
Test for overall effect: Z = 1.06 (P = 0.29)								
1.4.14 Quality of social interactions								
AVANTE-HEMO 2020	25.92	25.3	13	22.99	21.91	21	4.1%	2.93 [-13.71 , 19.57]
Martin-Alemany 2016	33	22	19	30.8	27.3	17	4.3%	2.20 [-14.12 , 18.52]
Uchiyama 2019	88.1	14.9	23	88.4	10.6	24	19.3%	-0.30 [-7.72 , 7.12]
Wu 2014d	66.5	11.5	33	73.9	11.25	32	32.5%	-7.40 [-12.93 , -1.87]
EXCITE 2014	-4.6	20.7289	123	2.1	16.9688	104	39.8%	-6.70 [-11.60 , -1.80]
Subtotal (95% CI)			**211**			**198**	**100.0%**	**-4.92 [-8.32 , -1.51]**
Heterogeneity: Tau² = 1.31; Chi² = 4.34, df = 4 (P = 0.36); I² = 8%								
Test for overall effect: Z = 2.83 (P = 0.005)								
1.4.15 Sexual function								
AVANTE-HEMO 2020	8.33	25	13	34.57	45.49	21	8.5%	-26.24 [-49.97 , -2.51]
Martin-Alemany 2016	88.3	23.3	19	96	12.7	17	22.6%	-7.70 [-19.79 , 4.39]
EXCITE 2014	-2.1	46.5	123	-4.9	39.5938	104	24.7%	2.80 [-8.40 , 14.00]
Wu 2014d	15	10.37	33	15.7	9.39	32	44.2%	-0.70 [-5.51 , 4.11]
Subtotal (95% CI)			**188**			**174**	**100.0%**	**-3.60 [-11.16 , 3.96]**
Heterogeneity: Tau² = 27.68; Chi² = 5.84, df = 3 (P = 0.12); I² = 49%								
Test for overall effect: Z = 0.93 (P = 0.35)								
1.4.16 Sleep								
Pellizzaro 2013	-15	20.2665	14	8.5	20.2665	14	9.8%	-23.50 [-38.51 , -8.49]
Martin-Alemany 2016	63.9	25	19	67	19.5	17	10.1%	-3.10 [-17.67 , 11.47]
Uchiyama 2019	60.9	18.1	23	56.6	16.7	24	14.9%	4.30 [-5.67 , 14.27]
AVANTE-HEMO 2020	69.72	6.9	13	74.64	9.54	21	20.9%	-4.92 [-10.46 , 0.62]
Wu 2014d	36.4	7.54	33	49.7	11.6	32	21.9%	-13.30 [-18.07 , -8.53]
EXCITE 2014	0.7	19.0482	123	3.7	14.9119	104	22.3%	-3.00 [-7.42 , 1.42]
Subtotal (95% CI)			**225**			**212**	**100.0%**	**-6.58 [-12.57 , -0.60]**
Heterogeneity: Tau² = 36.63; Chi² = 20.16, df = 5 (P = 0.001); I² = 75%								
Test for overall effect: Z = 2.16 (P = 0.03)								
1.4.17 Social support								
Martin-Alemany 2016	70	21.3	19	68.7	26.4	17	3.8%	1.30 [-14.49 , 17.09]
Uchiyama 2019	81	16.9	23	80.7	18.7	24	9.1%	0.30 [-9.88 , 10.48]
AVANTE-HEMO 2020	68.53	10	13	76.7	19.08	21	9.9%	-8.17 [-17.98 , 1.64]
EXCITE 2014	-2	24.0904	123	-1.5	22.1108	104	25.8%	-0.50 [-6.52 , 5.52]
Wu 2014d	75.27	7.86	33	81.36	9.41	32	51.3%	-6.09 [-10.31 , -1.87]
Subtotal (95% CI)			**211**			**198**	**100.0%**	**-3.98 [-7.07 , -0.89]**
Heterogeneity: Tau² = 0.21; Chi² = 4.05, df = 4 (P = 0.40); I² = 1%								
Test for overall effect: Z = 2.53 (P = 0.01)								
1.4.18 Dialysis staff encouragement								



Analysis 1.4. (Continued)

Test for overall effect: Z = 2.53 (P = 0.01)

1.4.18 Dialysis staff encouragement

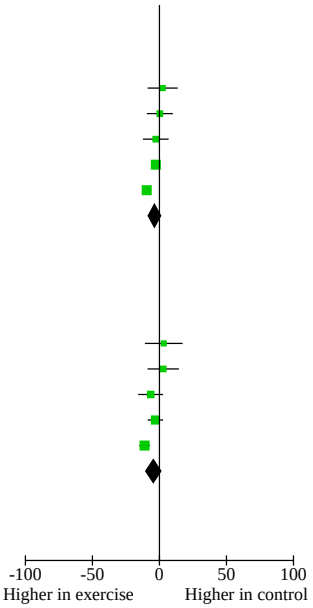
Uchiyama 2019	83	17.4	23	80.6	21.7	24	11.6%	2.40 [-8.82 , 13.62]
Martin-Alemany 2016	80	17.4	19	79.7	12	17	14.0%	0.30 [-9.38 , 9.98]
AVANTE-HEMO 2020	80.56	12.6	13	83.29	15.65	21	14.2%	-2.73 [-12.31 , 6.85]
EXCITE 2014	-1.6	17.9277	123	1.1	4.1136	104	30.1%	-2.70 [-5.97 , 0.57]
Wu 2014d	81.1	7.7	33	90.6	5.4	32	30.2%	-9.50 [-12.73 , -6.27]
Subtotal (95% CI)			**211**			**198**	**100.0%**	**-3.75 [-8.40 , 0.90]**

Heterogeneity: Tau² = 15.94; Chi² = 12.32, df = 4 (P = 0.02); I² = 68%
Test for overall effect: Z = 1.58 (P = 0.11)

1.4.19 Patient satisfaction

Martin-Alemany 2016	66.7	21.7	19	63.5	21.3	17	11.1%	3.20 [-10.86 , 17.26]
Uchiyama 2019	78	22.8	23	75.2	17.6	24	14.2%	2.80 [-8.88 , 14.48]
AVANTE-HEMO 2020	52.22	13.4	13	58.77	13.49	21	18.2%	-6.55 [-15.84 , 2.74]
EXCITE 2014	-4.6	25.2109	123	-1.6	18.5114	104	26.3%	-3.00 [-8.70 , 2.70]
Wu 2014d	74.8	8.6	33	85.9	8.16	32	30.2%	-11.10 [-15.17 , -7.03]
Subtotal (95% CI)			**211**			**198**	**100.0%**	**-4.58 [-10.23 , 1.06]**

Heterogeneity: Tau² = 23.13; Chi² = 10.51, df = 4 (P = 0.03); I² = 62%
Test for overall effect: Z = 1.59 (P = 0.11)

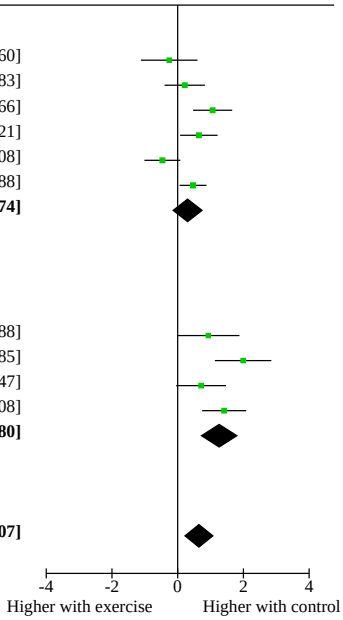


Footnotes

(1) mean and standard deviation estimated from the median and the range
(2) two intervention arms polled together in the exercise group
(3) Factorial design, two intervention arms pooled together in the exercise group and two control arms pooled together in the control group
(4) mean and standard deviation estimated from the median and range

Analysis 1.5. Comparison 1: Any exercise versus control (no exercise/placebo exercise), Outcome 5: Depression

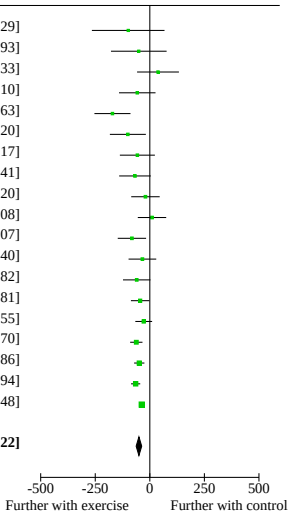
Study or Subgroup	Control Mean	Control SD	Control Total	Exercise Mean	Exercise SD	Exercise Total	Weight	Std. Mean Difference IV, Random, 95% CI
1.5.1 4 months or less								
Carmack 1995	5	5	11	6.8	8.2	10	8.7%	-0.26 [-1.12 , 0.60]
Frih 2017a	13	25.64	20	8.5	14.28	21	10.5%	0.21 [-0.40 , 0.83]
Rezaei 2015	26.11	13.72	25	12.64	11.07	25	10.7%	1.06 [0.47 , 1.66]
Rahimimoghadam 2017	10.4	2.4	25	8.6	3.06	25	10.9%	0.64 [0.07 , 1.21]
Sheshadri 2020	6.6	6.5	26	11.3	12.4	27	11.0%	-0.47 [-1.01 , 0.08]
van Vilsteren 2005	41.4	9.6	43	37.2	8.3	53	12.0%	0.47 [0.06 , 0.88]
Subtotal (95% CI)			**150**			**161**	**63.7%**	**0.30 [-0.14 , 0.74]**
Heterogeneity: Tau² = 0.21; Chi² = 17.50, df = 5 (P = 0.004); I² = 71%								
Test for overall effect: Z = 1.34 (P = 0.18)								
1.5.2 More than 4 months								
Giannaki 2013a	43.71	11.17	7	35.84	6.38	15	8.1%	0.93 [-0.01 , 1.88]
Ouzouni 2009	19.4	4	14	11.7	3.6	19	8.7%	1.99 [1.13 , 2.85]
Kouidi 1997	21.3	11.9	11	13.7	9.5	20	9.4%	0.71 [-0.05 , 1.47]
Kouidi 2010	22.1	6.24	20	14.61	4.15	24	10.1%	1.41 [0.74 , 2.08]
Subtotal (95% CI)			**52**			**78**	**36.3%**	**1.26 [0.72 , 1.80]**
Heterogeneity: Tau² = 0.13; Chi² = 5.44, df = 3 (P = 0.14); I² = 45%								
Test for overall effect: Z = 4.60 (P < 0.00001)								
Total (95% CI)			**202**			**239**	**100.0%**	**0.65 [0.22 , 1.07]**
Heterogeneity: Tau² = 0.35; Chi² = 38.89, df = 9 (P < 0.0001); I² = 77%								
Test for overall effect: Z = 2.99 (P = 0.003)								
Test for subgroup differences: Chi² = 7.34, df = 1 (P = 0.007), I² = 86.4%								



Analysis 1.6. Comparison 1: Any exercise versus control (no exercise/placebo exercise), Outcome 6: 6MWT

Study or Subgroup	Control Mean [metres]	Control SD [metres]	Control Total	Exercise Mean [metres]	Exercise SD [metres]	Exercise Total	Weight	Mean Difference IV, Random, 95% CI [metres]
Marchesan 2016 (1)	399.43	164	8	498.5	164	7	0.6%	-99.07 [-265.43 , 67.29]
ACTINUT 2013	295.77	121.07	9	346.28	134.88	7	0.9%	-50.51 [-177.95 , 76.93]
Martins do Valle 2020	494.8	66.9	12	457.3	155.6	12	1.6%	37.50 [-58.33 , 133.33]
Koh 2009 (2)	452	144	16	509.5	121.07	28	2.1%	-57.50 [-141.10 , 26.10]
Samara 2016	454.4	90.4	12	625.6	128.1	15	2.1%	-171.20 [-253.77 , -88.63]
PEAK 2006	414.3	127.3	25	514.9	163.9	24	2.1%	-100.60 [-183.00 , -18.20]
Rosa 2018	469.42	162.93	24	526.45	126.15	28	2.2%	-57.03 [-137.23 , 23.17]
Pellizzaro 2013	407	116.7	14	475	74.1	14	2.7%	-68.00 [-140.41 , 4.41]
Rouchon 2016	400	65.99	4	420	11.96	8	3.2%	-20.00 [-85.20 , 45.20]
CHAIR 2015 (3)	317.5	81.6	11	307.5	54.62	6	3.2%	10.00 [-55.08 , 75.08]
Wu 2014d	359	132	33	441	135	32	3.2%	-82.00 [-146.93 , -17.07]
DePaul 2002	430	80	14	464	94	15	3.4%	-34.00 [-97.40 , 29.40]
Liao 2016	290	64.1	20	350	128.2	20	3.4%	-60.00 [-122.82 , 2.82]
DIALY-SIZE 2016 (4)	0.8	44	8	44.99	72.01	23	6.3%	-44.19 [-86.57 , -1.81]
Segura-Orti 2009	20.6	36.6	8	48.5	60.8	17	7.3%	-27.90 [-66.35 , 10.55]
Fernandes 2019	325	59.8	19	386.9	19.38	20	10.5%	-61.90 [-90.10 , -33.70]
Cho 2018 (5)	-26	41	13	22.39	22.16	33	12.4%	-48.39 [-71.92 , -24.86]
Frih 2017a	415.6	36.3	20	480.5	31.9	21	13.6%	-64.90 [-85.86 , -43.94]
EXCITE 2014	2	44.82	123	39	35.99	104	18.9%	-37.00 [-47.52 , -26.48]
Total (95% CI)			**393**			**434**	**100.0%**	**-49.91 [-62.59 , -37.22]**

Heterogeneity: Tau² = 192.77; Chi² = 27.33, df = 18 (P = 0.07); I² = 34%
Test for overall effect: Z = 7.71 (P < 0.00001)
Test for subgroup differences: Not applicable



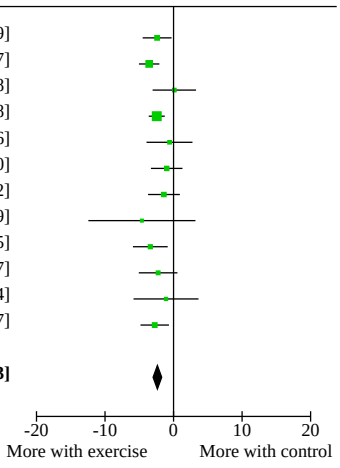
Footnotes

(1) standard deviation imputed from the highest standard deviation of the other included studies
(2) two intervention arms pooled together in the exercise group
(3) mean and standard deviation estimated from the median and interquartile range
(4) three intervention arms pooled together in the exercise group
(5) three interventions arms pooled together in the exercise group

Analysis 1.7. Comparison 1: Any exercise versus control (no exercise/placebo exercise), Outcome 7: Sit-To-Stand test [N reps/30 sec]

Study or Subgroup	Control Mean	Control SD	Control Total	Exercise Mean	Exercise SD	Exercise Total	Weight	Mean Difference IV, Random, 95% CI
Bennett 2013 (1)	7.8	3.1177	12	10.2	3.17	29	8.8%	-2.40 [-4.51 , -0.29]
Cho 2018 (2)	-0.5	2.2	13	3.058	2.6	33	17.7%	-3.56 [-5.05 , -2.07]
DIALY-SIZE 2016 (3)	1.4	4.3	8	1.287	2.64	23	3.9%	0.11 [-3.06 , 3.28]
Frih 2017a	10.85	2.05	20	13.3	1.75	21	28.7%	-2.45 [-3.62 , -1.28]
Giannaki 2013a	17.25	3.2	7	17.84	4.68	15	3.5%	-0.59 [-3.94 , 2.76]
IHOPE 2019	10.7	5.6	38	11.7	4	29	7.4%	-1.00 [-3.30 , 1.30]
Koufaki 2002	12.05	3.6	15	13.45	3.1	18	7.3%	-1.40 [-3.72 , 0.92]
Marchesan 2016 (4)	10	7.7	7	14.62	7.7	8	0.6%	-4.62 [-12.43 , 3.19]
Rosa 2018	11.79	2.93	24	15.18	6.07	28	6.1%	-3.39 [-5.93 , -0.85]
Segura-Orti 2009	0.3	3.55	8	2.55	2.9	17	4.9%	-2.25 [-5.07 , 0.57]
Song 2012a	7.1	7.6	20	8.2	7.7	20	1.7%	-1.10 [-5.84 , 3.64]
Wu 2014d	12.8	3.65	33	15.55	4.8	32	9.1%	-2.75 [-4.83 , -0.67]
Total (95% CI)			**205**			**273**	**100.0%**	**-2.36 [-2.98 , -1.73]**

Heterogeneity: Tau² = 0.00; Chi² = 9.29, df = 11 (P = 0.59); I² = 0%
Test for overall effect: Z = 7.37 (P < 0.00001)
Test for subgroup differences: Not applicable



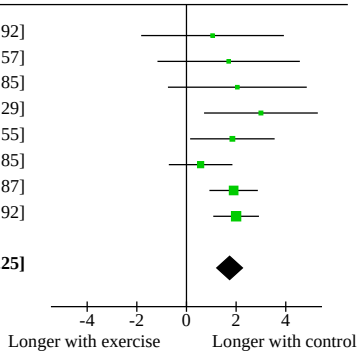
Footnotes

(1) results from group 1 (24 weeks of intervention) and group 2 (12 weeks of intervention) were pooled together in the exercise group. The number of participants was correc
(2) three interventions arms pooled together in the exercise group
(3) three intervention arms pooled together in the exercise group
(4) standard deviation imputed from the highest standard deviation of the other included studies

Analysis 1.8. Comparison 1: Any exercise versus control (no exercise/ placebo exercise), Outcome 8: Sit-To-Stand test [sit to 5 reps]

Study or Subgroup	Control Mean	Control SD	Control Total	Exercise Mean	Exercise SD	Exercise Total	Weight	Mean Difference IV, Random, 95% CI
Johansen 2006 (1)	15.1	5.41	33	14.05	6.65	35	3.2%	1.05 [-1.82 , 3.92]
Koufaki 2002	12.7	4.8	15	11	3.3	18	3.2%	1.70 [-1.17 , 4.57]
Segura-Orti 2009	-0.65	1.75	8	-2.7	5.3	17	3.4%	2.05 [-0.75 , 4.85]
Samara 2016	10.6	3.25	12	7.6	2.7	15	5.1%	3.00 [0.71 , 5.29]
Wu 2014d	12.6	3.6	33	10.75	3.4	32	9.2%	1.85 [0.15 , 3.55]
Giannaki 2013a	8.81	0.66	7	8.24	2.34	15	16.2%	0.57 [-0.71 , 1.85]
EXCITE 2014	-0.6	5.04	123	-2.5	2.06	104	28.1%	1.90 [0.93 , 2.87]
Frih 2017a	15.5	1.55	20	13.5	1.45	21	31.5%	2.00 [1.08 , 2.92]
Total (95% CI)			**251**			**257**	**100.0%**	**1.74 [1.22 , 2.25]**

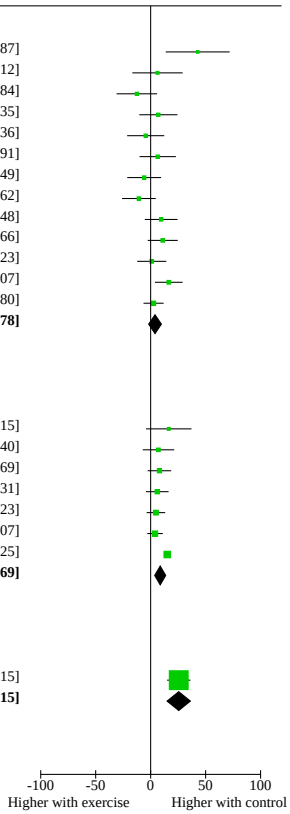
Heterogeneity: Tau² = 0.00; Chi² = 5.06, df = 7 (P = 0.65); I² = 0%
Test for overall effect: Z = 6.60 (P < 0.00001)
Test for subgroup differences: Not applicable



Footnotes
(1) Factorial design, two intervention arms pooled together in the exercise group and two control arms pooled together in the control group

Analysis 1.9. Comparison 1: Any exercise versus control (no exercise/placebo exercise), Outcome 9: Systolic blood pressure

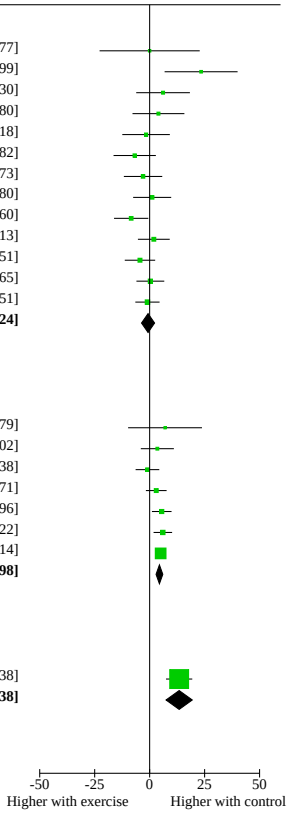
Study or Subgroup	Control Mean [mm Hg]	Control SD [mm Hg]	Control Total	Exercise Mean [mm Hg]	Exercise SD [mm Hg]	Exercise Total	Weight	Mean Difference IV, Random, 95% CI [mm Hg]
1.9.1 Aerobic								
Liao 2016 (1)	138.8	16.7	20	96	64.2	20	3.2%	42.80 [13.73 , 71.87]
CYCLE-HD 2016	148.5	28.23	13	142.27	25.99	9	4.7%	6.23 [-16.66 , 29.12]
McGregor 2018	123.17	29.52	18	135.75	25.28	16	6.4%	-12.58 [-31.00 , 5.84]
Goldberg 1983	149	17	11	142	27	14	6.9%	7.00 [-10.35 , 24.35]
Koh 2009 (2)	136	29	16	140.5	25.34	30	7.1%	-4.50 [-21.36 , 12.36]
Toussaint 2008	147.8	23.5	10	141.4	11.9	9	7.3%	6.40 [-10.11 , 22.91]
Wilund 2010	147.1	14.9	9	153	17.2	8	7.9%	-5.90 [-21.29 , 9.49]
Tsuyuki 2003	130.8	23.3	12	141.5	16.4	17	8.0%	-10.70 [-26.02 , 4.62]
Cooke 2018 (3)	0.4	9.89	10	-9.17	21.93	10	8.2%	9.57 [-5.34 , 24.48]
Paluchamy 2018	148	14.77	10	137	16.349	10	9.0%	11.00 [-2.66 , 24.66]
Deligiannis 1999a	144	10	6	143	17	10	9.3%	1.00 [-12.23 , 14.23]
IHOPE 2019	148.9	23.3	38	132.4	27.9	29	9.7%	16.50 [3.93 , 29.07]
Fernandes 2019	143.16	16.68	19	140.5	11.9	20	12.4%	2.66 [-6.48 , 11.80]
Subtotal (95% CI)			**192**			**202**	**100.0%**	**3.99 [-1.80 , 9.78]**
Heterogeneity: Tau² = 48.74; Chi² = 21.91, df = 12 (P = 0.04); I² = 45%								
Test for overall effect: Z = 1.35 (P = 0.18)								
1.9.2 Combined aerobic and resistance								
Molsted 2004 (4)	149	24.75	8	132.5	19.46	11	4.9%	16.50 [-4.15 , 37.15]
DePaul 2002	153.1	20.2	14	146	19	15	8.6%	7.10 [-7.20 , 21.40]
Deligiannis 1999a	144	10	6	136	14	15	12.6%	8.00 [-2.69 , 18.69]
van Vilsteren 2005	146	25	43	140	26.4	53	13.1%	6.00 [-4.31 , 16.31]
Kouidi 2008	133.7	14.9	21	128.9	13.2	22	16.0%	4.80 [-3.63 , 13.23]
Ouzouni 2009	139.3	9.1	14	135.3	11.6	19	18.5%	4.00 [-3.07 , 11.07]
Frih 2017a	149.2	5.1	20	134.1	5.2	21	26.3%	15.10 [11.95 , 18.25]
Subtotal (95% CI)			**126**			**156**	**100.0%**	**8.69 [3.69 , 13.69]**
Heterogeneity: Tau² = 22.20; Chi² = 13.84, df = 6 (P = 0.03); I² = 57%								
Test for overall effect: Z = 3.40 (P = 0.0007)								
1.9.3 Others								
Soliman 2015	143.33	16.14	12	117.78	11.66	18	100.0%	25.55 [14.95 , 36.15]
Subtotal (95% CI)			**12**			**18**	**100.0%**	**25.55 [14.95 , 36.15]**
Heterogeneity: Not applicable								
Test for overall effect: Z = 4.72 (P < 0.00001)								
Test for subgroup differences: Chi² = 12.24, df = 2 (P = 0.002), I² = 83.7%								



Footnotes
(1) these data have been verified
(2) Two intervention arms pooled together in the exercise group
(3) Mean and standard deviation estimated from the median and interquartile range
(4) mean and standard deviation estimated from the median and range

Analysis 1.10. Comparison 1: Any exercise versus control (no exercise/placebo exercise), Outcome 10: Diastolic blood pressure

Study or Subgroup	Control Mean [mm Hg]	Control SD [mm Hg]	Control Total	Exercise Mean [mm Hg]	Exercise SD [mm Hg]	Exercise Total	Weight	Mean Difference IV, Random, 95% CI [mm Hg]
1.10.1 Aerobic								
Paluchamy 2018	83	27.51	10	83	24.35	10	1.6%	0.00 [-22.77 , 22.77]
Liao 2016 (1)	77.1	13.7	20	53.7	35.3	20	2.9%	23.40 [6.81 , 39.99]
Cooke 2018 (2)	3.5	10.32	10	-2.6	16.77	10	4.8%	6.10 [-6.10 , 18.30]
Goldberg 1983	86	12	11	82	18	14	5.1%	4.00 [-7.80 , 15.80]
McGregor 2018	70.5	16.49	18	72.13	15.65	16	5.9%	-1.63 [-12.44 , 9.18]
Tsuyuki 2003	79	13.5	12	85.8	12.3	17	7.0%	-6.80 [-16.42 , 2.82]
Koh 2009 (3)	75	15	16	78	13.15	30	8.1%	-3.00 [-11.73 , 5.73]
CYCLE-HD 2016	79.06	11.98	13	77.91	8.72	9	8.2%	1.15 [-7.50 , 9.80]
Wilund 2010	77.3	8.7	9	85.7	7.7	8	9.4%	-8.40 [-16.20 , -0.60]
IHOPE 2019	78.5	12.5	38	76.6	16.6	29	10.3%	1.90 [-5.33 , 9.13]
Toussaint 2008	72.8	9.4	10	77.2	5.7	9	10.9%	-4.40 [-11.31 , 2.51]
Fernandes 2019	86.32	12.52	19	86	6.6	20	12.0%	0.32 [-6.01 , 6.65]
Deligiannis 1999a	82	3	6	83	8	10	13.9%	-1.00 [-6.51 , 4.51]
Subtotal (95% CI)			**192**			**202**	**100.0%**	**-0.72 [-3.69 , 2.24]**
Heterogeneity: Tau² = 8.63; Chi² = 17.33, df = 12 (P = 0.14); I² = 31%								
Test for overall effect: Z = 0.48 (P = 0.63)								
1.10.2 Combined aerobic and resistance								
Molsted 2004 (4)	86.25	18.83	8	79.25	17.89	11	0.8%	7.00 [-9.79 , 23.79]
DePaul 2002	85.2	11.7	14	81.7	8.6	15	4.2%	3.50 [-4.02 , 11.02]
van Vilsteren 2005	79	12	43	80	14.9	53	8.1%	-1.00 [-6.38 , 4.38]
Deligiannis 1999a (5)	82	3	6	79	8	15	10.6%	3.00 [-1.71 , 7.71]
Kouidi 2008	82.4	7	21	76.9	7.9	22	11.8%	5.50 [1.04 , 9.96]
Ouzouni 2009	85.2	4.6	14	79.2	7.7	19	13.2%	6.00 [1.78 , 10.22]
Frih 2017a	78	3.4	20	73	3.6	21	51.2%	5.00 [2.86 , 7.14]
Subtotal (95% CI)			**126**			**156**	**100.0%**	**4.45 [2.91 , 5.98]**
Heterogeneity: Tau² = 0.00; Chi² = 5.44, df = 6 (P = 0.49); I² = 0%								
Test for overall effect: Z = 5.68 (P < 0.00001)								
1.10.3 Others								
Soliman 2015	90.42	8.11	12	77	8.24	18	100.0%	13.42 [7.46 , 19.38]
Subtotal (95% CI)			**12**			**18**	**100.0%**	**13.42 [7.46 , 19.38]**
Heterogeneity: Not applicable								
Test for overall effect: Z = 4.41 (P < 0.0001)								
Test for subgroup differences: Chi² = 19.60, df = 2 (P < 0.0001), I² = 89.8%								



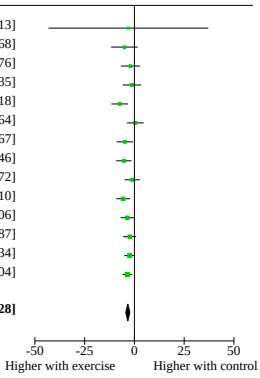
Footnotes

(1) these data have been verified
(2) Mean and standard deviation estimated from the median and interquartile range
(3) Two intervention arms pooled together in the exercise group
(4) mean and standard deviation estimated from the median and range
(5) data has been verified

Analysis 1.11. Comparison 1: Any exercise versus control (no exercise/ placebo exercise), Outcome 11: Aerobic capacity (VO max or peak)

Study or Subgroup	Control Mean [mL/kg/min]	Control SD [mL/kg/min]	Control Total	Exercise Mean [mL/kg/min]	Exercise SD [mL/kg/min]	Exercise Total	Weight	Mean Difference IV, Random, 95% CI [mL/kg/min]
Parsons 2004	55	26	7	58	44	6	0.1%	-3.00 [-43.13 , 37.13]
Goldberg 1983	20	8	11	25	9	14	2.3%	-5.00 [-11.68 , 1.68]
Deligiannis 1999a (1)	15.8	4.8	12	17.8	9.96	25	4.6%	-2.00 [-6.76 , 2.76]
Painter 2002a (2)	19.83	5.91	25	21.11	9.8	23	4.8%	-1.28 [-5.91 , 3.35]
Kouidi 1997	15.9	4.3	11	23.27	7.6	20	5.9%	-7.37 [-11.56 , -3.18]
Molsted 2004 (3)	19.5	3.81	9	19.03	5.12	9	5.9%	0.47 [-3.70 , 4.64]
McGregor 2018	15.93	5.168	18	20.71	6.831	16	6.1%	-4.78 [-8.89 , -0.67]
Tsuyuki 2003	21.7	4.9	12	27	5.6	17	6.9%	-5.30 [-9.14 , -1.46]
Koufaki 2002	18.8	4.9	15	19.9	6.3	18	7.0%	-1.10 [-4.92 , 2.72]
Konstantinidou 2002 (4)	15.8	4.8	12	21.4	6.76	36	8.3%	-5.60 [-9.10 , -2.10]
Carmack 1995	10.9	3.1	11	14.4	4.7	10	8.6%	-3.50 [-6.94 , -0.06]
Jong 2004	22.86	5.46	17	25.23	4.33	19	9.6%	-2.37 [-5.61 , 0.87]
Akiba 1995	17.6	2.6	6	20	2.4	7	13.4%	-2.40 [-5.14 , 0.34]
Kouidi 2004a	-0.4	2.3	11	3.1	3.3	10	16.5%	-3.50 [-5.96 , -1.04]
Total (95% CI)			**177**			**230**	**100.0%**	**-3.30 [-4.33 , -2.28]**

Heterogeneity: Tau² = 0.08; Chi² = 13.27, df = 13 (P = 0.43); I² = 2%
Test for overall effect: Z = 6.33 (P < 0.00001)
Test for subgroup differences: Not applicable

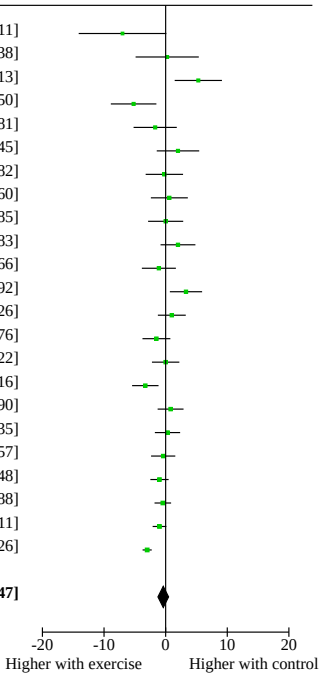


Footnotes
(1) two intervention arms pooled together in the exercise group
(2) factorial design: two intervention arms pooled together in the exercise group and two control arms pooled together in the control group
(3) mean and standard deviation estimated from the median and range
(4) three intervention arms pooled together in the exercise group

Analysis 1.12. Comparison 1: Any exercise versus control (no exercise/placebo exercise), Outcome 12: Albumin

Study or Subgroup	Control Mean [g/L]	Control SD [g/L]	Control Total	Exercise Mean [g/L]	Exercise SD [g/L]	Exercise Total	Weight	Mean Difference IV, Random, 95% CI [g/L]
Frey 1999	37	7	6	44	5	5	1.2%	-7.00 [-14.11 , 0.11]
CHAIR 2015 (1)	39.25	2.2	11	39	6.2	6	2.0%	0.25 [-4.88 , 5.38]
Koufaki 2002	40.5	3.6	15	35.2	7.3	18	3.0%	5.30 [1.47 , 9.13]
Jong 2004	33	6.1	17	38.2	5.1	19	3.1%	-5.20 [-8.90 , -1.50]
Matsumoto 2007	36.9	8.0435	32	38.6	4.4734	17	3.3%	-1.70 [-5.21 , 1.81]
Reboredo 2010	41	5	11	39	3	11	3.3%	2.00 [-1.45 , 5.45]
ACTINUT 2013	39.12	3.67	9	39.33	2.51	7	3.8%	-0.21 [-3.24 , 2.82]
Dong 2011	42.1	2.2	12	41.5	4.4	10	3.8%	0.60 [-2.40 , 3.60]
Afshar 2010 (2)	40	3	7	40	3.4	14	4.0%	0.00 [-2.85 , 2.85]
Martins do Valle 2020	39	3	12	37	4	12	4.0%	2.00 [-0.83 , 4.83]
Uchiyama 2019	33.7	5.2	23	34.8	4.4	24	4.1%	-1.10 [-3.86 , 1.66]
AVANTE-HEMO 2020	39	4	13	35.7	3.4	21	4.3%	3.30 [0.68 , 5.92]
Kopple 2007 (3)	39	3.7417	14	38	3.7	41	4.8%	1.00 [-1.26 , 3.26]
Liao 2016	40.1	4.2	20	41.6	3	20	4.8%	-1.50 [-3.76 , 0.76]
Martin-Alemany 2016	37	3.5	19	37	3.3	17	4.9%	0.00 [-2.22 , 2.22]
Fernandes 2019	34.6	4.1	19	37.9	2.5	20	5.0%	-3.30 [-5.44 , -1.16]
IHOPE 2019	40.1	3.1	38	39.3	5.1	29	5.0%	0.80 [-1.30 , 2.90]
Toussaint 2008	34.1	2	10	33.8	2.5	9	5.1%	0.30 [-1.75 , 2.35]
Frih 2017a	40	2.6	21	40.4	3.7	20	5.2%	-0.40 [-2.37 , 1.57]
Abreu 2017	42	2	19	43	3	25	5.9%	-1.00 [-2.48 , 0.48]
PEAK 2006	-0.16	2.4	25	0.3	2.4	24	6.1%	-0.46 [-1.80 , 0.88]
Wilund 2010	38	0.6	9	39	1.5	8	6.4%	-1.00 [-2.11 , 0.11]
Pellizzaro 2013	-2	1	14	1	1	14	6.8%	-3.00 [-3.74 , -2.26]
Total (95% CI)			**376**			**391**	**100.0%**	**-0.39 [-1.25 , 0.47]**

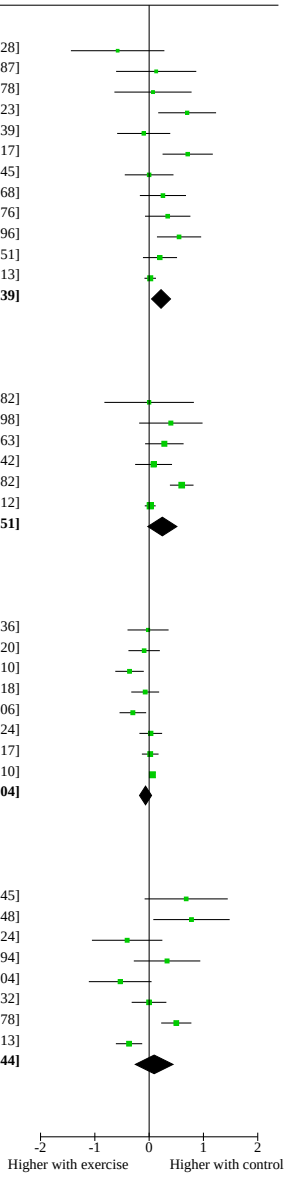
Heterogeneity: Tau² = 2.71; Chi² = 79.17, df = 22 (P < 0.00001); I² = 72%
Test for overall effect: Z = 0.88 (P = 0.38)
Test for subgroup differences: Not applicable



Footnotes
(1) mean and standard deviation estimated from the median and range
(2) Two intervention arms pooled together in the exercise group
(3) three intervention arms pooled together in the exercise group

Analysis 1.13. Comparison 1: Any exercise versus control (no exercise/placebo exercise), Outcome 13: Blood lipids

Study or Subgroup	Control Mean [mmol/L]	Control SD [mmol/L]	Control Total	Exercise Mean [mmol/L]	Exercise SD [mmol/L]	Exercise Total	Weight	Mean Difference IV, Random, 95% CI [mmol/L]
1.13.1 Total cholesterol [mmol/L]								
Molsted 2004 (1)	4.25	1.07	9	4.83	0.85	11	3.4%	-0.58 [-1.44 , 0.28]
Dong 2011	4.49	1.1	12	4.36	0.64	10	4.3%	0.13 [-0.61 , 0.87]
Afshar 2010 (2)	3.4	0.812	7	3.329	0.722	14	4.6%	0.07 [-0.64 , 0.78]
Lee 2001	5.08	0.7	21	4.38	0.98	19	6.8%	0.70 [0.17 , 1.23]
Uchiyama 2019	4.4	0.812	23	4.5	0.897	24	7.6%	-0.10 [-0.59 , 0.39]
Wilund 2010	4.25	0.61	9	3.54	0.339	8	8.1%	0.71 [0.25 , 1.17]
van Vilsteren 2005	4.6	1.2	43	4.6	1	53	8.4%	0.00 [-0.45 , 0.45]
Liao 2016	4.71	0.58	20	4.456	0.776	20	8.9%	0.25 [-0.17 , 0.68]
Song 2012a	4.192	0.67	20	3.85	0.678	20	9.1%	0.34 [-0.08 , 0.76]
Yurtkuran 2007	4.021	0.437	18	3.47	0.786	19	9.3%	0.55 [0.14 , 0.96]
Frih 2017a	4.1	0.6	20	3.9	0.4	21	11.7%	0.20 [-0.11 , 0.51]
Groussard 2015	1.63	0.09	10	1.61	0.13	8	17.7%	0.02 [-0.09 , 0.13]
Subtotal (95% CI)			**212**			**227**	**100.0%**	**0.22 [0.04 , 0.39]**
Heterogeneity: Tau² = 0.04; Chi² = 23.82, df = 11 (P = 0.01); I² = 54%								
Test for overall effect: Z = 2.47 (P = 0.01)								
1.13.2 LDL cholesterol [mmol/L]								
Molsted 2004 (1)	2.33	0.7	9	2.33	1.16	11	7.4%	0.00 [-0.82 , 0.82]
Lee 2001	2.91	0.97	21	2.51	0.913	19	11.4%	0.40 [-0.18 , 0.98]
Afshar 2010 (2)	1.56	0.33	7	1.28	0.49	14	17.4%	0.28 [-0.07 , 0.63]
Song 2012a	2.102	0.55	20	2.02	0.54564	20	17.9%	0.08 [-0.26 , 0.42]
Frih 2017a	2.5	0.4	20	1.9	0.3	21	21.5%	0.60 [0.38 , 0.82]
Groussard 2015	0.91	0.09	10	0.89	0.12	8	24.3%	0.02 [-0.08 , 0.12]
Subtotal (95% CI)			**87**			**93**	**100.0%**	**0.24 [-0.02 , 0.51]**
Heterogeneity: Tau² = 0.07; Chi² = 24.30, df = 5 (P = 0.0002); I² = 79%								
Test for overall effect: Z = 1.78 (P = 0.07)								
1.13.3 HDL cholesterol [mmol/L]								
Molsted 2004 (1)	1.33	0.42	9	1.35	0.44	11	6.3%	-0.02 [-0.40 , 0.36]
Afshar 2010 (2)	0.82	0.332	7	0.912	0.29	14	9.1%	-0.09 [-0.38 , 0.20]
Uchiyama 2019	1.182	0.367	23	1.543	0.538	24	10.2%	-0.36 [-0.62 , -0.10]
Yurtkuran 2007	1.065432	0.447	18	1.13784	0.33877	19	10.5%	-0.07 [-0.33 , 0.18]
Frih 2017a	1.4	0.4	20	1.7	0.4	21	11.1%	-0.30 [-0.54 , -0.06]
Song 2012a	1.1	0.4	20	1.07	0.26	20	13.0%	0.03 [-0.18 , 0.24]
Lee 2001	0.99	0.22	21	0.97	0.27	19	16.5%	0.02 [-0.13 , 0.17]
Groussard 2015	0.47	0.04	10	0.41	0.05	8	23.3%	0.06 [0.02 , 0.10]
Subtotal (95% CI)			**128**			**136**	**100.0%**	**-0.07 [-0.18 , 0.04]**
Heterogeneity: Tau² = 0.01; Chi² = 18.78, df = 7 (P = 0.009); I² = 63%								
Test for overall effect: Z = 1.17 (P = 0.24)								
1.13.4 Triglycerides [mmol/L]								
Afshar 2010 (2)	2.55	0.903	7	1.8677	0.71	14	9.4%	0.68 [-0.08 , 1.45]
Lee 2001	2.28	1.49	21	1.5	0.66	19	10.1%	0.78 [0.08 , 1.48]
Molsted 2004 (1)	1.135	0.428	9	1.54	0.99	11	10.8%	-0.41 [-1.05 , 0.24]
Song 2012a	1.6699	1.2	20	1.34	0.71469	20	11.3%	0.33 [-0.28 , 0.94]
Uchiyama 2019	1.305	1.009	23	1.838	1.0105	24	11.7%	-0.53 [-1.11 , 0.04]
Yurtkuran 2007	2.2055	0.1859	18	2.2077	0.6842	19	15.1%	-0.00 [-0.32 , 0.32]
Frih 2017a	1.9	0.5	20	1.4	0.4	21	15.6%	0.50 [0.22 , 0.78]
Groussard 2015	1.09	0.13	10	1.46	0.33	8	16.0%	-0.37 [-0.61 , -0.13]
Subtotal (95% CI)			**128**			**136**	**100.0%**	**0.09 [-0.25 , 0.44]**
Heterogeneity: Tau² = 0.18; Chi² = 34.93, df = 7 (P < 0.0001); I² = 80%								
Test for overall effect: Z = 0.52 (P = 0.60)								



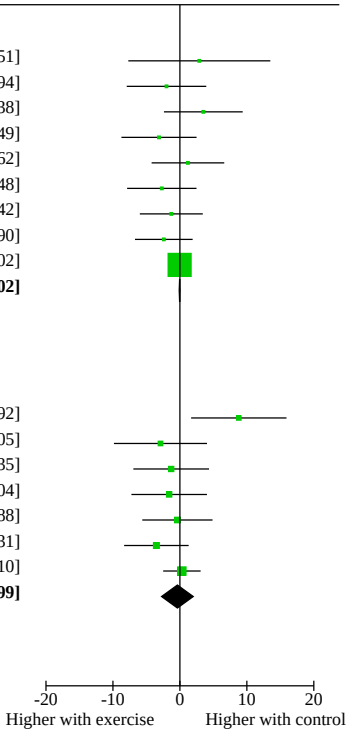
Footnotes

(1) mean and standard error estimated from the median and the range

(2) Two intervention arms pooled together in the exercise group

Analysis 1.14. Comparison 1: Any exercise versus control (no exercise/placebo exercise), Outcome 14: Body composition

Study or Subgroup	Control Mean	Control SD	Control Total	Exercise Mean	Exercise SD	Exercise Total	Weight	Mean Difference IV, Random, 95% CI
1.14.1 Fat mass [kg]								
Dong 2011	27.6	14.8	12	24.7	10.5	10	0.0%	2.90 [-7.71 , 13.51]
Giannaki 2013a	28.5	5.8	7	30.5	8.1	15	0.0%	-2.00 [-7.94 , 3.94]
Chen 2010	33.1	10.1	22	29.6	9.8	22	0.0%	3.50 [-2.38 , 9.38]
Johansen 2006 (1)	18.68	13.21	33	21.8	10.08	35	0.0%	-3.12 [-8.73 , 2.49]
Song 2012a	27.2	8.9	20	26	8.6	20	0.0%	1.20 [-4.22 , 6.62]
Martin-Alemany 2016	17.6	6.5	19	20.3	9	17	0.0%	-2.70 [-7.88 , 2.48]
Rosa 2018	21.92	8.81	24	23.2	8.4	28	0.0%	-1.28 [-5.98 , 3.42]
Kopple 2007 (2)	19.1	2.4	14	21.5	12.7738	37	0.0%	-2.40 [-6.70 , 1.90]
Sheshadri 2020	-0.04	0.1071	25	0	0.1071	24	99.9%	-0.04 [-0.10 , 0.02]
Subtotal (95% CI)			**176**			**208**	**100.0%**	**-0.04 [-0.10 , 0.02]**
Heterogeneity: Tau² = 0.00; Chi² = 5.90, df = 8 (P = 0.66); I² = 0%								
Test for overall effect: Z = 1.34 (P = 0.18)								
1.14.2 Lean mass [kg]								
Dong 2011	56.2	9.9	12	47.4	7.1	10	8.8%	8.80 [1.68 , 15.92]
IHOPE 2019	58.6	15.9	38	61.5	13.1	29	9.2%	-2.90 [-9.85 , 4.05]
Giannaki 2013a	45.4	5.1	7	46.7	8.3	15	12.5%	-1.30 [-6.95 , 4.35]
Chen 2010	46.3	8.7	21	47.9	9.9	21	12.6%	-1.60 [-7.24 , 4.04]
Johansen 2006 (1)	48.1	8.76	33	48.47	13.01	35	13.9%	-0.37 [-5.62 , 4.88]
Rosa 2018	44.04	8.23	24	47.55	9.49	28	15.6%	-3.51 [-8.33 , 1.31]
Song 2012a	22.5	5.2	20	22.2	3.7	20	27.3%	0.30 [-2.50 , 3.10]
Subtotal (95% CI)			**155**			**158**	**100.0%**	**-0.37 [-2.74 , 1.99]**
Heterogeneity: Tau² = 3.29; Chi² = 9.01, df = 6 (P = 0.17); I² = 33%								
Test for overall effect: Z = 0.31 (P = 0.76)								
Test for subgroup differences: Chi² = 0.08, df = 1 (P = 0.78), I² = 0%								



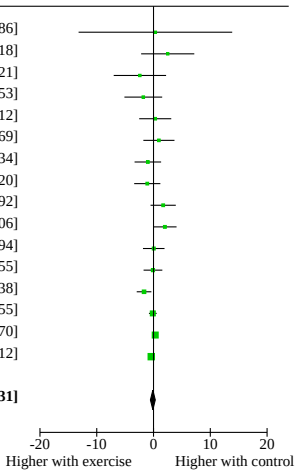
Footnotes

(1) Factorial design, two intervention arms pooled together in the exercise group and two control arms pooled together in the control group

(2) three intervention arms pooled together in the exercise group

Analysis 1.15. Comparison 1: Any exercise versus control (no exercise/placebo exercise), Outcome 15: Body mass index

Study or Subgroup	Control Mean [kg/m²]	Control SD [kg/m²]	Control Total	Exercise Mean [kg/m²]	Exercise SD [kg/m²]	Exercise Total	Weight	Mean Difference IV, Random, 95% CI [kg/m²]
Marinho 2016 (1)	29.13	10.655	7	28.8	13.73	6	0.1%	0.33 [-13.20 , 13.86]
Dong 2011	29.3	6.8	12	26.8	4.3	10	0.8%	2.50 [-2.18 , 7.18]
IHOPE 2019	31.5	7.4	38	33.9	10.9	29	0.8%	-2.40 [-7.01 , 2.21]
Kopple 2007 (2)	25.1	4.49	14	26.9	7.2993	37	1.6%	-1.80 [-5.13 , 1.53]
Abreu 2017	24.1	4.9	19	23.8	4.5	25	2.1%	0.30 [-2.52 , 3.12]
Liao 2016	23.91	5.27	20	22.96	3.36	20	2.2%	0.95 [-1.79 , 3.69]
Koufaki 2002	24.7	3.5	15	25.7	3.3	18	3.0%	-1.00 [-3.34 , 1.34]
Rosa 2018	25.51	4.03	24	26.61	4.44	28	3.0%	-1.10 [-3.40 , 1.20]
Uchiyama 2019	24.5	4.3	23	22.8	3.4	24	3.2%	1.70 [-0.52 , 3.92]
Wilund 2010	30.3	2.5	9	28.3	1.8	8	3.7%	2.00 [-0.06 , 4.06]
ACTINUT 2013	20.93	2.57	9	20.89	1.19	7	4.3%	0.04 [-1.86 , 1.94]
Martin-Alemany 2016 (1)	21.2	1.698	17	21.3	3.204	19	5.4%	-0.10 [-1.75 , 1.55]
AVANTE-HEMO 2020	19.8	1.7	13	21.47	2.1	21	7.8%	-1.67 [-2.96 , -0.38]
Cooke 2018 (1)	0.2067	0.413	10	0.3333	1.015	10	16.0%	-0.13 [-0.81 , 0.55]
Sheshadri 2020	0.5	0.7142	25	0.2	0.7142	24	21.8%	0.30 [-0.10 , 0.70]
PEAK 2006	-0.1	0.5	25	0.3	0.5	24	24.1%	-0.40 [-0.68 , -0.12]
Total (95% CI)			**280**			**310**	**100.0%**	**-0.12 [-0.55 , 0.31]**
Heterogeneity: Tau² = 0.18; Chi² = 25.11, df = 15 (P = 0.05); I² = 40%								
Test for overall effect: Z = 0.55 (P = 0.59)								
Test for subgroup differences: Not applicable								



Footnotes

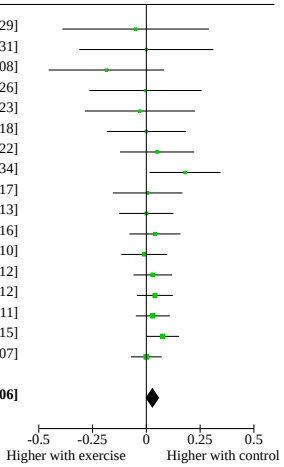
(1) mean and standard deviation estimated from the median and interquartile range

(2) three intervention arms pooled together in the exercise group

Analysis 1.16. Comparison 1: Any exercise versus control (no exercise/placebo exercise), Outcome 16: Calcium

Study or Subgroup	Control Mean [mmol/L]	Control SD [mmol/L]	Control Total	Exercise Mean [mmol/L]	Exercise SD [mmol/L]	Exercise Total	Weight	Mean Difference IV, Random, 95% CI [mmol/L]
Kouidi 1997	2.15	0.25	11	2.2	0.7	20	0.7%	-0.05 [-0.39 , 0.29]
Marinho 2016 (1)	2.2	0.367	7	2.2	0.19	6	0.8%	0.00 [-0.31 , 0.31]
Deligiannis 1999a (2)	2.02	0.2	12	2.206	0.62	25	1.1%	-0.19 [-0.45 , 0.08]
de Lima 2013 (2)	2.32	0.22	11	2.324	0.53	21	1.2%	-0.00 [-0.27 , 0.26]
Deligiannis 1999	2.17	0.15	30	2.2	0.7	30	1.3%	-0.03 [-0.29 , 0.23]
Yurtkuran 2007	2.37	0.27	18	2.37	0.3	19	2.4%	0.00 [-0.18 , 0.18]
Kouidi 2010	2.22	0.32	20	2.17	0.25	24	2.8%	0.05 [-0.12 , 0.22]
Martins do Valle 2020	2.4	0.15	12	2.22	0.25	12	3.0%	0.18 [0.02 , 0.34]
Soliman 2015	1.876	0.24	12	1.87	0.19	18	3.1%	0.01 [-0.16 , 0.17]
Makhlough 2012	2.2	0.18	23	2.2	0.26	25	5.2%	0.00 [-0.13 , 0.13]
ACTINUT 2013	2.29	0.12	9	2.25	0.12	7	5.8%	0.04 [-0.08 , 0.16]
Wilund 2010	2.2	0.15	9	2.21	0.06	8	7.2%	-0.01 [-0.12 , 0.10]
Momeni 2014	2.27	0.15	20	2.24	0.14	20	10.2%	0.03 [-0.06 , 0.12]
Paluchamy 2018	2.13	0.1	10	2.09	0.09	10	11.8%	0.04 [-0.04 , 0.12]
Liao 2016	2.45	0.1	20	2.42	0.15	20	13.2%	0.03 [-0.05 , 0.11]
Kouidi 2008	2.1457	0.15	29	2.07	0.15	30	14.0%	0.08 [-0.00 , 0.15]
Abreu 2017	2.22	0.12	19	2.22	0.12	25	16.0%	0.00 [-0.07 , 0.07]
Total (95% CI)			**272**			**320**	**100.0%**	**0.03 [-0.00 , 0.06]**

Heterogeneity: Tau² = 0.00; Chi² = 9.30, df = 16 (P = 0.90); I² = 0%
Test for overall effect: Z = 1.92 (P = 0.06)
Test for subgroup differences: Not applicable

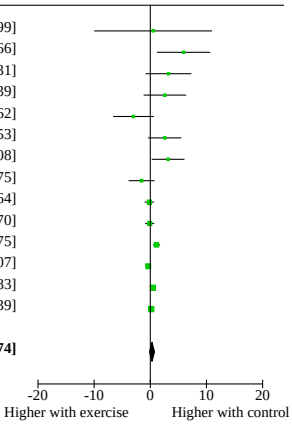


Footnotes
(1) mean and standard deviation estimated from the median and the interquartile range
(2) two intervention arms pooled together in the exercise group

Analysis 1.17. Comparison 1: Any exercise versus control (no exercise/placebo exercise), Outcome 17: C-reactive protein

Study or Subgroup	Control Mean [mg/dL]	Control SD [mg/dL]	Control Total	Exercise Mean [mg/dL]	Exercise SD [mg/dL]	Exercise Total	Weight	Mean Difference IV, Random, 95% CI [mg/dL]
Marinho 2016 (1)	6.43	11.298	7	5.93	7.91	6	0.2%	0.50 [-9.99 , 10.99]
Pellizzaro 2013 (1)	2.2	6.01	14	-3.73	6.75	14	0.8%	5.93 [1.20 , 10.66]
ACTINUT 2013	4.99	5.96	9	1.75	1.62	7	1.1%	3.24 [-0.83 , 7.31]
Abreu 2017	8.4	7.5	19	5.8	4.4	25	1.3%	2.60 [-1.19 , 6.39]
Toussaint 2008	4.3	0.7	10	7.3	5.5	9	1.4%	-3.00 [-6.62 , 0.62]
Afshar 2010 (2)	4.14	3.87	7	1.575	1.47	14	2.0%	2.56 [-0.40 , 5.53]
Afshar 2011	4.1	3.9	7	0.93	0.66	14	2.0%	3.17 [0.26 , 6.08]
Kopple 2007 (3)	2.8	2.9933	14	4.363	5.67	43	3.0%	-1.56 [-3.87 , 0.75]
IHOPE 2019	1.136	0.776	12	1.317	1.18	11	11.5%	-0.18 [-1.01 , 0.64]
Frih 2017a	4	1.4	20	4.1	1.2	21	11.8%	-0.10 [-0.90 , 0.70]
Wilund 2010	6	0.67	9	4.9	0.69	8	13.6%	1.10 [0.45 , 1.75]
AVANTE-HEMO 2020 (4)	0.38	0.349	13	0.76	0.95	21	16.1%	-0.38 [-0.83 , 0.07]
Liao 2016	1.23	0.211	20	0.78	0.83	20	17.0%	0.45 [0.07 , 0.83]
Uchiyama 2019	0.3	0.5	23	0.14	0.25	24	18.4%	0.16 [-0.07 , 0.39]
Total (95% CI)			**184**			**237**	**100.0%**	**0.31 [-0.13 , 0.74]**

Heterogeneity: Tau² = 0.26; Chi² = 38.01, df = 13 (P = 0.0003); I² = 66%
Test for overall effect: Z = 1.37 (P = 0.17)
Test for subgroup differences: Not applicable

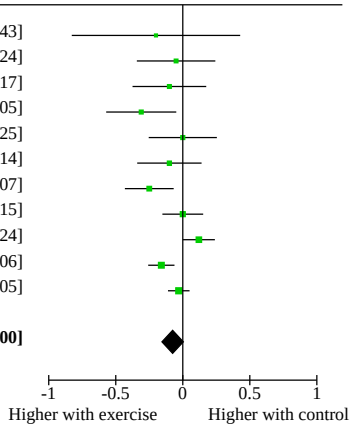


Footnotes
(1) mean and standard deviation estimated from the median and the interquartile range
(2) Two intervention arms pooled together in the exercise group
(3) three intervention arms pooled together in the exercise group
(4) Mean and standard deviation estimated from the median and the interquartile range

Analysis 1.18. Comparison 1: Any exercise versus control (no exercise/placebo exercise), Outcome 18: Dialysis adequacy: Kt/V

Study or Subgroup	Control Mean	Control SD	Control Total	Exercise Mean	Exercise SD	Exercise Total	Weight	Mean Difference IV, Random, 95% CI
Reboredo 2010	1.8	0.7	11	2	0.8	11	1.5%	-0.20 [-0.83 , 0.43]
Parsons 2004	1.22	0.21	7	1.27	0.31	6	5.4%	-0.05 [-0.34 , 0.24]
Frey 1999	1.7	0.1	6	1.8	0.3	5	5.9%	-0.10 [-0.37 , 0.17]
Dobsak 2012	1.33	0.31	10	1.64	0.3	11	6.3%	-0.31 [-0.57 , -0.05]
PEAK 2006	0.1	0.4	25	0.1	0.5	24	6.6%	0.00 [-0.25 , 0.25]
Martins do Valle 2020	1.6	0.3	12	1.7	0.3	12	7.1%	-0.10 [-0.34 , 0.14]
Makhlough 2012	0.95	0.2	24	1.2	0.4	23	9.8%	-0.25 [-0.43 , -0.07]
Liao 2016	1.52	0.23	20	1.52	0.26	20	11.6%	0.00 [-0.15 , 0.15]
Fernandes 2019	1.48	0.19	19	1.36	0.19	20	13.8%	0.12 [0.00 , 0.24]
Paluchamy 2018	0.99	0.1265	10	1.15	0.0949	10	15.4%	-0.16 [-0.26 , -0.06]
van Vilsteren 2005	1.23	0.2	43	1.26	0.2	53	16.6%	-0.03 [-0.11 , 0.05]
Total (95% CI)			**187**			**195**	**100.0%**	**-0.08 [-0.16 , 0.00]**

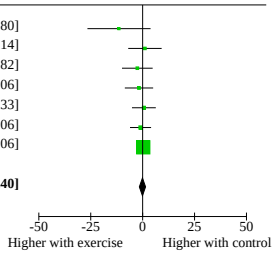
Heterogeneity: Tau² = 0.01; Chi² = 22.17, df = 10 (P = 0.01); I² = 55%
Test for overall effect: Z = 1.87 (P = 0.06)
Test for subgroup differences: Not applicable



Analysis 1.19. Comparison 1: Any exercise versus control (no exercise/placebo exercise), Outcome 19: Energy intake

Study or Subgroup	Control Mean [kCal/kg/d]	Control SD [kCal/kg/d]	Control Total	Exercise Mean [kCal/kg/d]	Exercise SD [kCal/kg/d]	Exercise Total	Weight	Mean Difference IV, Random, 95% CI [kCal/kg/d]
PEAK 2006	30.05	8.57	25	41.44	37.04	24	1.0%	-11.39 [-26.58 , 3.80]
Dong 2011	27.6	11.9	12	26.5	7.1	10	3.4%	1.10 [-6.94 , 9.14]
ACTINUT 2013	27.53	8.42	9	30.09	6.64	7	4.1%	-2.56 [-9.94 , 4.82]
Kopple 2007 (1)	24.2	7.8575	14	25.96	18.2	43	4.8%	-1.76 [-8.58 , 5.06]
Olvera-Soto 2016 (2)	23.77	13	31	23.17	9.65	30	6.8%	0.60 [-5.13 , 6.33]
IHOPE 2019	19.03	8.5	38	20.04	11.8	29	8.6%	-1.01 [-6.08 , 4.06]
Abreu 2017	30.9	3	19	30.6	2.9	25	71.4%	0.30 [-1.46 , 2.06]
Total (95% CI)			**148**			**168**	**100.0%**	**-0.09 [-1.58 , 1.40]**

Heterogeneity: Tau² = 0.00; Chi² = 3.24, df = 6 (P = 0.78); I² = 0%
Test for overall effect: Z = 0.12 (P = 0.90)
Test for subgroup differences: Not applicable

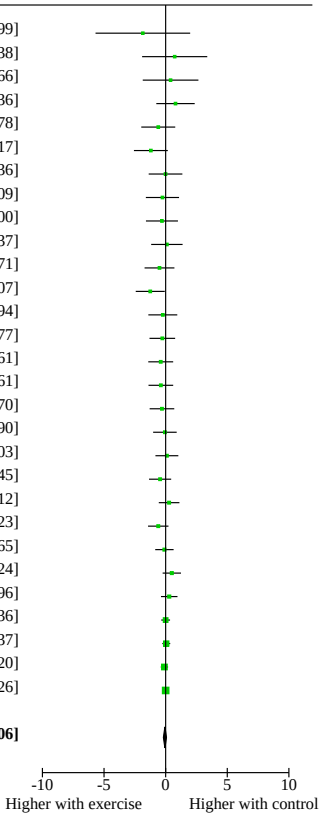


Footnotes
(1) three intervention arms pooled together in the exercise group
(2) mean and standard deviation estimated from the median and interquartile range

Analysis 1.20. Comparison 1: Any exercise versus control (no exercise/placebo exercise), Outcome 20: Haemoglobin

Study or Subgroup	Control Mean [g/L]	Control SD [g/L]	Control Total	Exercise Mean [g/L]	Exercise SD [g/L]	Exercise Total	Weight	Mean Difference IV, Random, 95% CI [g/L]
Soliman 2015	9.19	0.89	12	11.04	8.24	18	0.1%	-1.85 [-5.69 , 1.99]
Marinho 2016 (1)	11.2	2.756	7	10.467	2.098	6	0.2%	0.73 [-1.91 , 3.38]
Reboredo 2010	11.3	2.6	11	10.9	2.8	11	0.3%	0.40 [-1.86 , 2.66]
Dong 2011	12.2	1.8	12	11.4	1.9	10	0.6%	0.80 [-0.76 , 2.36]
Parsons 2004	11.1	1.7	7	11.7	0.7	6	0.8%	-0.60 [-1.98 , 0.78]
Goldberg 1983	8.8	1.3	7	10	1.5	9	0.8%	-1.20 [-2.57 , 0.17]
AVANTE-HEMO 2020	10.6	1.8	13	10.61	2.23	21	0.8%	-0.01 [-1.38 , 1.36]
Paluchamy 2018	8.09	1.4546	10	8.35	1.6128	10	0.8%	-0.26 [-1.61 , 1.09]
Martin-Alemany 2016 (1)	8.6	2.102	17	8.9	1.842	19	0.9%	-0.30 [-1.60 , 1.00]
Abreu 2017	10.6	2.3	19	10.5	1.9	25	0.9%	0.10 [-1.17 , 1.37]
Martins do Valle 2020	10.3	1.3	12	10.8	1.7	12	1.0%	-0.50 [-1.71 , 0.71]
Makhlough 2012	8.62	2.14	23	9.87	2.01	25	1.1%	-1.25 [-2.43 , -0.07]
Momeni 2014	9.8	1.7	20	10.03	2.07	20	1.1%	-0.23 [-1.40 , 0.94]
Kopple 2007 (2)	12.5	1.87	14	12.77	1.09	37	1.4%	-0.27 [-1.31 , 0.77]
Frih 2017a	10	1.6	20	10.4	1.7	21	1.5%	-0.40 [-1.41 , 0.61]
Painter 2002a (3)	11.81	1.56	26	12.2	1.92	22	1.5%	-0.39 [-1.39 , 0.61]
CHAIR 2015 (4)	10.93	0.72	11	11.23	1.13	6	1.5%	-0.30 [-1.30 , 0.70]
Toussaint 2008	12.03	1.41	10	12.09	0.59	9	1.7%	-0.06 [-1.02 , 0.90]
Koufaki 2002	12.2	1.4	15	12.1	1.3	18	1.8%	0.10 [-0.83 , 1.03]
Fernandes 2019	10.25	1.66	19	10.7	1.14	20	1.9%	-0.45 [-1.35 , 0.45]
de Lima 2013 (5)	11.1	1.2	11	10.82	1.04	21	2.2%	0.28 [-0.56 , 1.12]
Tsuyuki 2003	7.4	1.2	12	8	1	17	2.2%	-0.60 [-1.43 , 0.23]
Kouidi 2010	11.2	1.3	20	11.3	1.2	24	2.7%	-0.10 [-0.85 , 0.65]
Lee 2001	8.7	1.3	21	8.2	1.1	19	2.7%	0.50 [-0.24 , 1.24]
ACTINUT 2013	11.21	0.66	9	10.92	0.69	7	3.4%	0.29 [-0.38 , 0.96]
Kouidi 2008	11	0.7	29	11	0.7	30	11.9%	0.00 [-0.36 , 0.36]
van Vilsteren 2005	7.57	0.8	43	7.52	0.8	53	14.7%	0.05 [-0.27 , 0.37]
Pellizzaro 2013	0.5	0.4	14	0.6	0.4	14	17.3%	-0.10 [-0.40 , 0.20]
Afshar 2010 (6)	10.2	0.3	7	10.2	0.27	14	21.9%	0.00 [-0.26 , 0.26]
Total (95% CI)			**451**			**524**	**100.0%**	**-0.06 [-0.18 , 0.06]**

Heterogeneity: Tau² = 0.00; Chi² = 18.94, df = 28 (P = 0.90); I² = 0%
Test for overall effect: Z = 0.93 (P = 0.35)
Test for subgroup differences: Not applicable



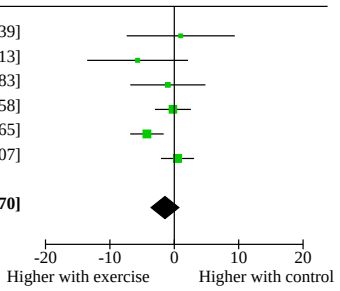
Footnotes

(1) mean and standard deviation estimated from the median and interquartile range
(2) three intervention arms pooled together in the exercise group
(3) factorial design: two intervention arms pooled together in the exercise group and two control arms pooled together in the control group
(4) mean and standard deviation estimated from the median and range
(5) two intervention arms pooled together in the exercise group
(6) Two intervention arms pooled together in the exercise group

Analysis 1.21. Comparison 1: Any exercise versus control (no exercise/placebo exercise), Outcome 21: Left ventricular ejection fraction

Study or Subgroup	Control Mean [%]	Control SD [%]	Control Total	Exercise Mean [%]	Exercise SD [%]	Exercise Total	Weight	Mean Difference IV, Random, 95% CI [%]
Reboredo 2010	71.4	7.6	11	70.4	12	11	5.7%	1.00 [-7.39 , 9.39]
Kouidi 2008	54.6	17.3	29	60.3	13	30	6.4%	-5.70 [-13.53 , 2.13]
McGregor 2018	53.22	7.1186	18	54.22	9.8337	16	10.3%	-1.00 [-6.83 , 4.83]
Cho 2018 (1)	0.3	3.9	13	0.512	5.32	33	24.8%	-0.21 [-3.00 , 2.58]
Momeni 2014	54.25	4.66	20	58.5	3.67	20	26.3%	-4.25 [-6.85 , -1.65]
Kouidi 2004a	0.2	3	10	-0.3	3	11	26.5%	0.50 [-2.07 , 3.07]
Total (95% CI)			**101**			**121**	**100.0%**	**-1.45 [-3.60 , 0.70]**

Heterogeneity: Tau² = 2.83; Chi² = 8.91, df = 5 (P = 0.11); I² = 44%
Test for overall effect: Z = 1.32 (P = 0.19)
Test for subgroup differences: Not applicable



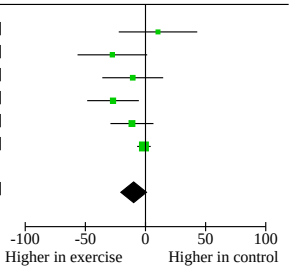
Footnotes

(1) Three interventions arms pooled together in the exercise group

Analysis 1.22. Comparison 1: Any exercise versus control (no exercise/placebo exercise), Outcome 22: Left ventricular mass index

Study or Subgroup	Control Mean [g/m²]	Control SD [g/m²]	Control Total	Exercise Mean [g/m²]	Exercise SD [g/m²]	Exercise Total	Weight	Mean Difference IV, Random, 95% CI [g/m²]
Reboredo 2010	131.3	48.4	11	120.9	26.6	11	8.4%	10.40 [-22.24 , 43.04]
McGregor 2018	111.65	39.7958	18	139.2	45.6215	16	10.1%	-27.55 [-56.49 , 1.39]
Deligiannis 1999a (1)	137	35	12	147.6	40.22	25	12.2%	-10.60 [-35.91 , 14.71]
Wilund 2010	127.4	18.17	9	154.4	25.83	8	15.1%	-27.00 [-48.48 , -5.52]
Cho 2018 (2)	-11.7	30.1	13	-0.44	21.1	33	18.7%	-11.26 [-29.14 , 6.62]
Kouidi 2008	137	11.9	29	138.3	10.1	30	35.5%	-1.30 [-6.94 , 4.34]
Total (95% CI)			**92**			**123**	**100.0%**	**-9.85 [-20.50 , 0.80]**

Heterogeneity: Tau² = 74.81; Chi² = 9.46, df = 5 (P = 0.09); I² = 47%
Test for overall effect: Z = 1.81 (P = 0.07)
Test for subgroup differences: Not applicable

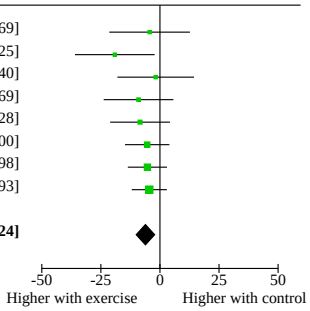


Footnotes
(1) two intervention arms pooled together in the exercise group
(2) Three interventions arms pooled together in the exercise group

Analysis 1.23. Comparison 1: Any exercise versus control (no exercise/placebo exercise), Outcome 23: Maximum heart rate

Study or Subgroup	Control Mean [bpm]	Control SD [bpm]	Control Total	Exercise Mean [bpm]	Exercise SD [bpm]	Exercise Total	Weight	Mean Difference IV, Random, 95% CI [bpm]
McGregor 2018	122.5	27.107	18	126.88	23.6646	16	5.2%	-4.38 [-21.45 , 12.69]
Akiba 1995	136.3	19.5	6	155.4	8.6	7	5.4%	-19.10 [-35.95 , -2.25]
Koufaki 2002	127.2	24.4	15	129	22.7	18	5.8%	-1.80 [-18.00 , 14.40]
Painter 2002a (1)	128.72	27.44	25	137.78	24.68	23	7.0%	-9.06 [-23.81 , 5.69]
Tsuyuki 2003	155.8	20.7	12	164.2	10.2	17	9.5%	-8.40 [-21.08 , 4.28]
Deligiannis 1999a (2)	139	12	12	144.4	16.58	25	17.3%	-5.40 [-14.80 , 4.00]
Konstantinidou 2002 (3)	139	12	12	144.3	14.52	36	22.2%	-5.30 [-13.58 , 2.98]
Ouzouni 2009	139.6	7.1	14	144.1	14.3	19	27.6%	-4.50 [-11.93 , 2.93]
Total (95% CI)			**114**			**161**	**100.0%**	**-6.14 [-10.05 , -2.24]**

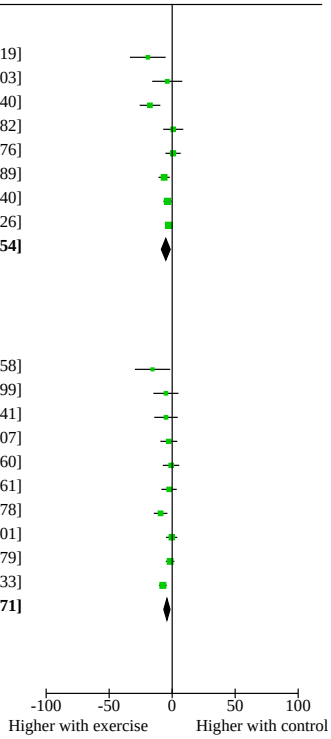
Heterogeneity: Tau² = 0.00; Chi² = 3.11, df = 7 (P = 0.87); I² = 0%
Test for overall effect: Z = 3.08 (P = 0.002)
Test for subgroup differences: Not applicable



Footnotes
(1) factorial design: two intervention arms pooled together in the exercise group and two control arms pooled together in the control group
(2) two intervention arms pooled together in the exercise group
(3) three intervention arms pooled together in the exercise group

Analysis 1.24. Comparison 1: Any exercise versus control (no exercise/placebo exercise), Outcome 24: Muscular strength

Study or Subgroup	Control Mean [kg]	Control SD [kg]	Control Total	Exercise Mean [kg]	Exercise SD [kg]	Exercise Total	Weight	Mean Difference IV, Random, 95% CI [kg]
1.24.1 Knee extension								
Dobsak 2012	85.36	18.32	10	104.68	14.23	11	4.9%	-19.32 [-33.45 , -5.19]
Song 2012a	33.4	19.5	20	37.3	19	20	6.3%	-3.90 [-15.83 , 8.03]
PEAK 2006	-2.4	13.8	25	15.2	15.4	24	10.1%	-17.60 [-25.80 , -9.40]
DIALY-SIZE 2016 (1)	9.3	10.1	8	8.448	9.32	23	10.5%	0.85 [-7.12 , 8.82]
Uchiyama 2019	24.9	10.5	23	24.2	10.7	24	13.5%	0.70 [-5.36 , 6.76]
Johansen 2006 (2)	17.28	8.63	33	23.65	10.18	35	16.5%	-6.37 [-10.85 , -1.89]
Chen 2010	12.1	6.1	22	15.8	5	22	18.8%	-3.70 [-7.00 , -0.40]
ACTINUT 2013	7.87	2.19	9	10.56	3.49	7	19.4%	-2.69 [-5.64 , 0.26]
Subtotal (95% CI)			**150**			**166**	**100.0%**	**-5.06 [-8.58 , -1.54]**
Heterogeneity: Tau² = 14.32; Chi² = 20.68, df = 7 (P = 0.004); I² = 66%								
Test for overall effect: Z = 2.81 (P = 0.005)								
1.24.2 Handgrip								
Yurtkuran 2007	62.86	20.36	18	78.45	23.09	19	2.7%	-15.59 [-29.60 , -1.58]
Koh 2009 (3)	31	12	7	35.97	12.35	29	4.9%	-4.97 [-14.93 , 4.99]
Samara 2016	32.3	9.9	12	37.2	14.7	15	5.4%	-4.90 [-14.21 , 4.41]
Martin-Alemany 2016 (4)	20.867	9.701	17	23.5	10.813	19	8.7%	-2.63 [-9.33 , 4.07]
Song 2012a	27.8	11.8	20	28.7	9	20	9.0%	-0.90 [-7.40 , 5.60]
Olvera-Soto 2016 (4)	19.6	8.56	31	22.07	14.77	30	9.8%	-2.47 [-8.55 , 3.61]
Wu 2014d	28.6	9	33	37.8	12.9	32	11.2%	-9.20 [-14.62 , -3.78]
Cooke 2018 (4)	2	3.87	10	2.43	6.02	10	13.7%	-0.43 [-4.87 , 4.01]
Uchiyama 2019	25.7	6.4	23	27.3	5.4	24	16.8%	-1.60 [-4.99 , 1.79]
Frih 2017a	30	5.2	20	37.4	4.8	21	17.8%	-7.40 [-10.47 , -4.33]
Subtotal (95% CI)			**191**			**219**	**100.0%**	**-4.16 [-6.61 , -1.71]**
Heterogeneity: Tau² = 6.31; Chi² = 16.57, df = 9 (P = 0.06); I² = 46%								
Test for overall effect: Z = 3.33 (P = 0.0009)								



Footnotes

(1) three intervention arms pooled together in the exercise group

(2) Factorial design, two intervention arms pooled together in the exercise group and two control arms pooled together in the control group

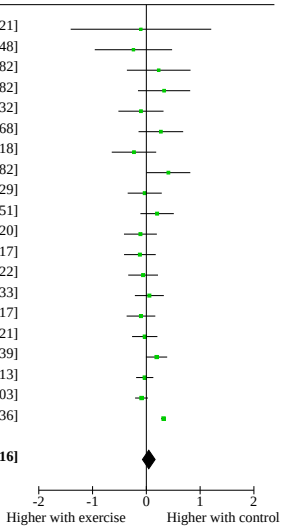
(3) two intervention arms polled together in the exercise group

(4) mean and standard deviation estimated from the median and interquartile range

Analysis 1.25. Comparison 1: Any exercise versus control (no exercise/placebo exercise), Outcome 25: Phosphate

Study or Subgroup	Control Mean [mmol/L]	Control SD [mmol/L]	Control Total	Exercise Mean [mmol/L]	Exercise SD [mmol/L]	Exercise Total	Weight	Mean Difference IV, Random, 95% CI [mmol/L]
Marinho 2016 (1)	1.367	1.653	7	1.467	0.57	6	0.7%	-0.10 [-1.41 , 1.21]
AVANTE-HEMO 2020 (2)	1.86	1.15	13	2.1	0.83	21	2.0%	-0.24 [-0.96 , 0.48]
Martins do Valle 2020	1.84	0.39	12	1.61	0.97	12	2.7%	0.23 [-0.36 , 0.82]
Reboredo 2010	1.91	0.61	11	1.58	0.55	11	3.4%	0.33 [-0.16 , 0.82]
Yurtkuran 2007	1.81	0.45	18	1.91	0.81	19	4.0%	-0.10 [-0.52 , 0.32]
ACTINUT 2013	1.59	0.42	9	1.32	0.42	7	4.1%	0.27 [-0.14 , 0.68]
Martin-Alemany 2016	1.84	0.61	19	2.07	0.65	17	4.1%	-0.23 [-0.64 , 0.18]
Makhlough 2012	2.29	0.67	23	1.88	0.77	25	4.2%	0.41 [0.00 , 0.82]
Kouidi 2010	2.1	0.52	20	2.13	0.55	24	5.2%	-0.03 [-0.35 , 0.29]
Paluchamy 2018	1.6855	0.4799	10	1.4853	0.143	10	5.3%	0.20 [-0.11 , 0.51]
Deligiannis 1999a (3)	1.94	0.42	12	2.05	0.49	25	5.3%	-0.11 [-0.42 , 0.20]
de Lima 2013 (3)	1.81	0.29	11	1.93	0.56	21	5.5%	-0.12 [-0.41 , 0.17]
Kouidi 1997	1.97	0.23	11	2.03	0.55	20	5.7%	-0.06 [-0.34 , 0.22]
Soliman 2015	1.776	0.38	12	1.72	0.35	18	5.8%	0.06 [-0.21 , 0.33]
Abreu 2017	2.1	0.42	19	2.2	0.48	25	5.8%	-0.10 [-0.37 , 0.17]
Deligiannis 1999	1.97	0.36	30	2	0.55	30	6.2%	-0.03 [-0.27 , 0.21]
Wilund 2010	2.1	0.25	9	1.91	0.16	8	6.7%	0.19 [-0.01 , 0.39]
Kouidi 2008	1.97	0.26	29	2	0.36	30	7.2%	-0.03 [-0.19 , 0.13]
Momeni 2014	1.69	0.27	20	1.78	0.03	20	7.7%	-0.09 [-0.21 , 0.03]
Pellizzaro 2013	0.19	0.06	14	-0.13	0.06	14	8.2%	0.32 [0.28 , 0.36]
Total (95% CI)			**309**			**363**	**100.0%**	**0.05 [-0.07 , 0.16]**

Heterogeneity: Tau² = 0.04; Chi² = 91.36, df = 19 (P < 0.00001); I² = 79%
Test for overall effect: Z = 0.75 (P = 0.45)
Test for subgroup differences: Not applicable

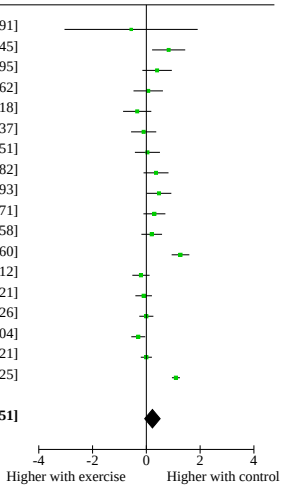


Footnotes
(1) mean and standard deviation estimated from the median and interquartile range
(2) Mean and standard deviation estimated from the median and the interquartile range
(3) two intervention arms pooled together in the exercise group

Analysis 1.26. Comparison 1: Any exercise versus control (no exercise/placebo exercise), Outcome 26: Potassium

Study or Subgroup	Control Mean [mmol/L]	Control SD [mmol/L]	Control Total	Exercise Mean [mmol/L]	Exercise SD [mmol/L]	Exercise Total	Weight	Mean Difference IV, Random, 95% CI [mmol/L]
Marinho 2016 (1)	4.5	2.848	7	5.067	1.62	6	1.1%	-0.57 [-3.04 , 1.91]
Martin-Alemany 2016 (1)	5.93	1.213	17	5.1	0.481	19	5.1%	0.83 [0.21 , 1.45]
Parsons 2004	4.8	0.6	7	4.4	0.4	6	5.3%	0.40 [-0.15 , 0.95]
Momeni 2014	5.47	0.95	20	5.4	0.81	20	5.3%	0.07 [-0.48 , 0.62]
AVANTE-HEMO 2020	5.2	0.92	13	5.54	0.37	21	5.4%	-0.34 [-0.86 , 0.18]
Kouidi 1997	5.5	0.7	11	5.6	0.5	20	5.6%	-0.10 [-0.57 , 0.37]
Makhlough 2012	5.16	0.67	23	5.12	0.96	25	5.6%	0.04 [-0.43 , 0.51]
de Lima 2013	5.8	0.6	11	5.44	0.7	21	5.6%	0.36 [-0.10 , 0.82]
Paluchamy 2018	5.65	0.5692	10	5.18	0.4743	10	5.6%	0.47 [0.01 , 0.93]
Martins do Valle 2020	5.3	0.4	12	5	0.6	12	5.8%	0.30 [-0.11 , 0.71]
Kouidi 2010	5.8	0.6	20	5.6	0.7	24	5.9%	0.20 [-0.18 , 0.58]
Soliman 2015	5.61	0.45	12	4.34	0.45	18	6.1%	1.27 [0.94 , 1.60]
Deligiannis 1999a (2)	5.4	0.4	12	5.6	0.58	25	6.1%	-0.20 [-0.52 , 0.12]
Deligiannis 1999	5.7	0.7	30	5.8	0.5	30	6.1%	-0.10 [-0.41 , 0.21]
Wilund 2010	4.9	0.3	9	4.9	0.25	8	6.2%	0.00 [-0.26 , 0.26]
Kouidi 2008	5.3	0.4	29	5.6	0.6	30	6.3%	-0.30 [-0.56 , -0.04]
Abreu 2017	4.7	0.3	19	4.7	0.4	25	6.4%	0.00 [-0.21 , 0.21]
Pellizzaro 2013	0.6	0.2	14	-0.5	0.2	14	6.5%	1.10 [0.95 , 1.25]
Total (95% CI)			**276**			**334**	**100.0%**	**0.23 [-0.06 , 0.51]**

Heterogeneity: Tau² = 0.33; Chi² = 206.50, df = 17 (P < 0.00001); I² = 92%
Test for overall effect: Z = 1.54 (P = 0.12)
Test for subgroup differences: Not applicable

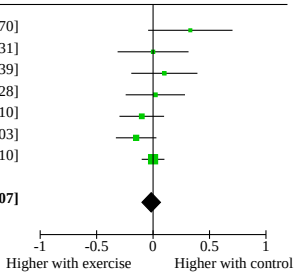


Footnotes
(1) mean and standard deviation estimated from the median and interquartile range
(2) two intervention arms pooled together in the exercise group

Analysis 1.27. Comparison 1: Any exercise versus control (no exercise/placebo exercise), Outcome 27: Protein intake

Study or Subgroup	Control Mean [g/kg/d]	Control SD [g/kg/d]	Control Total	Exercise Mean [g/kg/d]	Exercise SD [g/kg/d]	Exercise Total	Weight	Mean Difference IV, Random, 95% CI [g/kg/d]
Kopple 2007 (1)	1.35	0.5987	14	1.02	0.68	43	4.6%	0.33 [-0.04 , 0.70]
ACTINUT 2013	1.17	0.38	9	1.17	0.26	7	6.4%	0.00 [-0.31 , 0.31]
Dong 2011	1.1	0.4	12	1	0.3	10	7.3%	0.10 [-0.19 , 0.39]
Olvera-Soto 2016 (2)	1.03	0.4	31	1.01	0.62	30	8.9%	0.02 [-0.24 , 0.28]
IHOPE 2019	0.9	0.33	38	1	0.46	29	14.8%	-0.10 [-0.30 , 0.10]
PEAK 2006	1.36	0.38	25	1.51	0.25	24	17.4%	-0.15 [-0.33 , 0.03]
Abreu 2017	1.2	0.14	19	1.2	0.2	25	40.5%	0.00 [-0.10 , 0.10]
Total (95% CI)			**148**			**168**	**100.0%**	**-0.02 [-0.10 , 0.07]**

Heterogeneity: Tau² = 0.00; Chi² = 6.91, df = 6 (P = 0.33); I² = 13%
Test for overall effect: Z = 0.40 (P = 0.69)
Test for subgroup differences: Not applicable

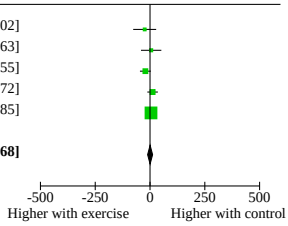


Footnotes
(1) three intervention arms pooled together in the exercise group
(2) mean and standard deviation estimated from the median and interquartile range

Analysis 1.28. Comparison 1: Any exercise versus control (no exercise/placebo exercise), Outcome 28: Parathyroid hormone

Study or Subgroup	Control Mean [pmol/L]	Control SD [pmol/L]	Control Total	Exercise Mean [pmol/L]	Exercise SD [pmol/L]	Exercise Total	Weight	Mean Difference IV, Random, 95% CI [pmol/L]
Martins do Valle 2020	56.28	37.28	12	80.64	84.74	12	4.3%	-24.36 [-76.74 , 28.02]
Toussaint 2008	42.7	57.2	10	37.5	45.9	9	5.4%	5.20 [-41.23 , 51.63]
Koufaki 2002	13.6	15.8	15	34.8	50.7	18	15.9%	-21.20 [-45.95 , 3.55]
Marinho 2016 (1)	28.11	28.06	7	16.37	14.93	6	16.6%	11.74 [-12.24 , 35.72]
Liao 2016	30.2	9.42	20	25.74	7.92	20	57.7%	4.46 [-0.93 , 9.85]
Total (95% CI)			**64**			**65**	**100.0%**	**0.39 [-10.90 , 11.68]**

Heterogeneity: Tau² = 49.91; Chi² = 5.49, df = 4 (P = 0.24); I² = 27%
Test for overall effect: Z = 0.07 (P = 0.95)
Test for subgroup differences: Not applicable

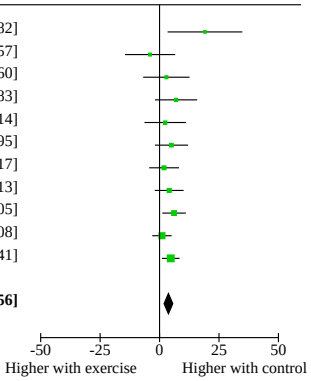


Footnotes
(1) mean and standard deviation estimated from the median and interquartile range

Analysis 1.29. Comparison 1: Any exercise versus control (no exercise/placebo exercise), Outcome 29: Resting heart rate

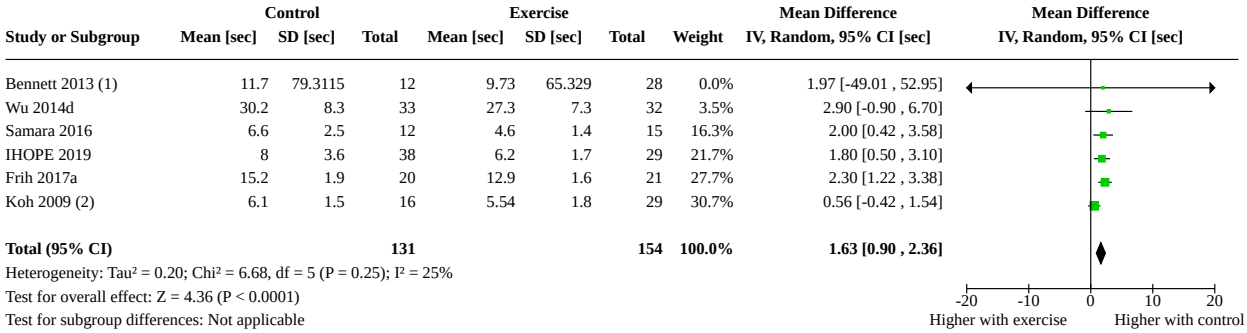
Study or Subgroup	Control Mean [bpm]	Control SD [bpm]	Control Total	Exercise Mean [bpm]	Exercise SD [bpm]	Exercise Total	Weight	Mean Difference IV, Random, 95% CI [bpm]
Liao 2016	71	10.5	20	51.9	34.3	20	1.4%	19.10 [3.38 , 34.82]
Goldberg 1983	79	15	11	83	11	14	3.0%	-4.00 [-14.57 , 6.57]
CYCLE-HD 2016	75.31	13.95	13	72.45	9.36	9	3.6%	2.86 [-6.88 , 12.60]
McGregor 2018	80.94	11.7854	16	74	14.6193	18	4.3%	6.94 [-1.95 , 15.83]
Tsuyuki 2003	84.3	13.6	12	81.9	8.7	17	4.4%	2.40 [-6.34 , 11.14]
Koh 2009 (1)	75	12	16	70	10.38	30	7.0%	5.00 [-1.95 , 11.95]
Ouzouni 2009	78.2	10.3	14	76.3	7.1	19	8.6%	1.90 [-4.37 , 8.17]
Deligiannis 1999a	81.8	8.5	12	77.74	9.43	25	9.2%	4.06 [-2.01 , 10.13]
Cooke 2018 (2)	2.33	6.45	10	-3.767	4.73	10	13.7%	6.10 [1.14 , 11.05]
Deligiannis 1999	76	7	30	75	9	30	20.3%	1.00 [-3.08 , 5.08]
Kouidi 2008	78.4	8.1	29	73.7	6.3	30	24.5%	4.70 [0.99 , 8.41]
Total (95% CI)			**183**			**222**	**100.0%**	**3.72 [1.89 , 5.56]**

Heterogeneity: Tau² = 0.00; Chi² = 9.67, df = 10 (P = 0.47); I² = 0%
Test for overall effect: Z = 3.97 (P < 0.0001)
Test for subgroup differences: Not applicable



Footnotes
(1) two intervention arms polled together in the exercise group
(2) mean and standard deviation estimated from the median and interquartile range

Analysis 1.30. Comparison 1: Any exercise versus control (no exercise/placebo exercise), Outcome 30: Timed up-and-go test



Footnotes

(1) results from group 1 (24 weeks of intervention) and group 2 (12 weeks of intervention) were pooled together in the exercise group. The number of participants was corrected to account for

(2) two intervention arms polled together in the exercise group

Comparison 2. Aerobic exercise versus control (no exercise/placebo exercise)

Outcome or subgroup title	No. of studies	No. of participants	Statistical method	Effect size
2.1 Death	1	296	Risk Ratio (M-H, Random, 95% CI)	0.95 [0.56, 1.62]
2.2 Fatigue	4		Std. Mean Difference (IV, Random, 95% CI)	Totals not selected
2.3 HRQoL: Summary component scores	9		Mean Difference (IV, Random, 95% CI)	Subtotals only
2.3.1 Physical Component Score	9	306	Mean Difference (IV, Random, 95% CI)	-6.00 [-10.71, -1.30]
2.3.2 Mental Component Score	9	306	Mean Difference (IV, Random, 95% CI)	-3.33 [-7.56, 0.90]
2.4 HRQoL: Individual domains	11		Mean Difference (IV, Random, 95% CI)	Subtotals only
2.4.1 Physical Functioning	10	649	Mean Difference (IV, Random, 95% CI)	-2.87 [-10.12, 4.38]
2.4.2 Role-physical	8	560	Mean Difference (IV, Random, 95% CI)	-2.31 [-17.29, 12.67]
2.4.3 Pain	8	570	Mean Difference (IV, Random, 95% CI)	-2.26 [-6.12, 1.61]
2.4.4 General health perceptions	8	560	Mean Difference (IV, Random, 95% CI)	-5.38 [-10.32, -0.43]
2.4.5 Emotional well-being	7	515	Mean Difference (IV, Random, 95% CI)	-5.63 [-10.58, -0.67]
2.4.6 Role-emotional	8	560	Mean Difference (IV, Random, 95% CI)	-8.02 [-11.45, -4.58]
2.4.7 Vitality	9	613	Mean Difference (IV, Random, 95% CI)	-0.43 [-6.45, 5.60]

Outcome or subgroup title	No. of studies	No. of participants	Statistical method	Effect size
2.4.8 Social function	9	577	Mean Difference (IV, Random, 95% CI)	0.94 [-4.48, 6.37]
2.4.9 Symptoms	3	317	Mean Difference (IV, Random, 95% CI)	-7.65 [-20.65, 5.35]
2.4.10 Effects of kidney disease	3	317	Mean Difference (IV, Random, 95% CI)	-4.27 [-6.87, -1.66]
2.4.11 Burden of kidney disease	3	317	Mean Difference (IV, Random, 95% CI)	0.05 [-2.63, 2.72]
2.4.12 Work status	3	317	Mean Difference (IV, Random, 95% CI)	-0.44 [-3.87, 2.99]
2.4.13 Cognitive function	3	317	Mean Difference (IV, Random, 95% CI)	-6.36 [-10.11, -2.60]
2.4.14 Quality of social interactions	3	317	Mean Difference (IV, Random, 95% CI)	-6.96 [-10.57, -3.36]
2.4.15 Sexual function	3	317	Mean Difference (IV, Random, 95% CI)	-0.87 [-7.23, 5.48]
2.4.16 Sleep	3	317	Mean Difference (IV, Random, 95% CI)	-6.44 [-13.46, 0.58]
2.4.17 Social support	3	317	Mean Difference (IV, Random, 95% CI)	-4.35 [-8.51, -0.19]
2.4.18 Dialysis staff encouragement	3	317	Mean Difference (IV, Random, 95% CI)	-5.49 [-11.11, 0.13]
2.4.19 Patient satisfaction	3	317	Mean Difference (IV, Random, 95% CI)	-7.52 [-13.12, -1.92]
2.5 Depression	4	127	Std. Mean Difference (IV, Random, 95% CI)	0.19 [-0.52, 0.89]
2.6 6MWT	10	515	Mean Difference (IV, Random, 95% CI)	-53.00 [-72.17, -33.84]
2.7 Sit-To-Stand test [N reps/30 sec]	6	227	Mean Difference (IV, Random, 95% CI)	-1.81 [-2.76, -0.86]
2.8 Sit-To-Stand test [sit to 5 reps]	5	374	Mean Difference (IV, Random, 95% CI)	1.63 [0.92, 2.33]
2.9 Resting blood pressure	13		Mean Difference (IV, Random, 95% CI)	Subtotals only
2.9.1 Systolic blood pressure	13	400	Mean Difference (IV, Random, 95% CI)	3.96 [-1.78, 9.70]
2.9.2 Diastolic blood pressure	13	400	Mean Difference (IV, Random, 95% CI)	-0.73 [-3.68, 2.22]
2.10 Aerobic capacity (VO2 max or peak)	12	326	Mean Difference (IV, Random, 95% CI)	-2.69 [-4.55, -0.82]
2.11 Albumin	15	429	Mean Difference (IV, Random, 95% CI)	-0.23 [-1.45, 0.99]
2.12 Blood lipids	5		Mean Difference (IV, Random, 95% CI)	Subtotals only

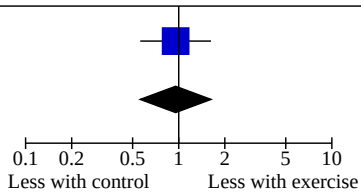
Outcome or subgroup title	No. of studies	No. of participants	Statistical method	Effect size
2.12.1 Total cholesterol [mmol/L]	5	129	Mean Difference (IV, Random, 95% CI)	0.30 [-0.03, 0.63]
2.12.2 LDL cholesterol [mmol/L]	3	72	Mean Difference (IV, Random, 95% CI)	0.17 [-0.08, 0.42]
2.12.3 HDL cholesterol [mmol/L]	3	72	Mean Difference (IV, Random, 95% CI)	0.05 [0.01, 0.09]
2.12.4 Triglycerides [mmol/L]	3	72	Mean Difference (IV, Random, 95% CI)	0.23 [-0.59, 1.05]
2.13 Body composition	4		Mean Difference (IV, Random, 95% CI)	Subtotals only
2.13.1 Fat mass [kg]	3	95	Mean Difference (IV, Random, 95% CI)	-0.04 [-0.10, 0.02]
2.13.2 Lean mass [kg]	2	89	Mean Difference (IV, Random, 95% CI)	-1.94 [-6.32, 2.45]
2.14 Body mass index	9	291	Mean Difference (IV, Random, 95% CI)	-0.17 [-0.78, 0.45]
2.15 Calcium	8	208	Mean Difference (IV, Random, 95% CI)	0.01 [-0.04, 0.06]
2.16 C-reactive protein	9	206	Mean Difference (IV, Random, 95% CI)	0.60 [-0.12, 1.32]
2.17 Dialysis adequacy: Kt/V	7	166	Mean Difference (IV, Random, 95% CI)	-0.07 [-0.20, 0.05]
2.18 Energy intake	4	118	Mean Difference (IV, Random, 95% CI)	-1.84 [-6.87, 3.20]
2.19 Haemoglobin	17	437	Mean Difference (IV, Random, 95% CI)	0.01 [-0.18, 0.21]
2.20 Heart rate	10		Mean Difference (IV, Random, 95% CI)	Subtotals only
2.20.1 Resting	7	218	Mean Difference (IV, Random, 95% CI)	4.07 [0.49, 7.65]
2.20.2 Maximum	6	179	Mean Difference (IV, Random, 95% CI)	-6.54 [-12.01, -1.07]
2.21 Left ventricular ejection fraction	5	141	Mean Difference (IV, Random, 95% CI)	-1.65 [-3.93, 0.62]
2.22 Left ventricular mass index	5	119	Mean Difference (IV, Random, 95% CI)	-14.47 [-26.25, -2.69]
2.23 Muscular strength	7		Mean Difference (IV, Random, 95% CI)	Subtotals only
2.23.1 Knee extension	3	53	Mean Difference (IV, Random, 95% CI)	-5.94 [-13.95, 2.07]
2.23.2 handgrip	4	148	Mean Difference (IV, Random, 95% CI)	-4.65 [-9.44, 0.14]
2.24 Phosphate	9	214	Mean Difference (IV, Random, 95% CI)	0.05 [-0.07, 0.17]
2.25 Potassium	8	190	Mean Difference (IV, Random, 95% CI)	0.08 [-0.08, 0.24]
2.26 Protein intake	4	118	Mean Difference (IV, Random, 95% CI)	0.04 [-0.25, 0.33]

Outcome or subgroup title	No. of studies	No. of participants	Statistical method	Effect size
2.27 Parathyroid hormone	3	92	Mean Difference (IV, Random, 95% CI)	-2.69 [-20.31, 14.93]
2.28 Timed up-and-go test	4	204	Mean Difference (IV, Random, 95% CI)	1.38 [0.50, 2.26]

Analysis 2.1. Comparison 2: Aerobic exercise versus control (no exercise/placebo exercise), Outcome 1: Death

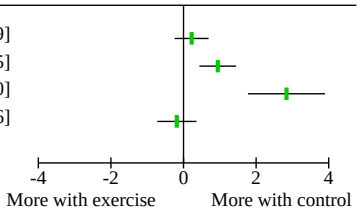
Study or Subgroup	Control Events	Control Total	Exercise Events	Exercise Total	Weight	Risk Ratio M-H, Random, 95% CI
EXCITE 2014	22	145	24	151	100.0%	0.95 [0.56 , 1.62]
Total (95% CI)		**145**		**151**	**100.0%**	**0.95 [0.56 , 1.62]**
Total events:	22		24			

Heterogeneity: Not applicable
Test for overall effect: Z = 0.17 (P = 0.86)
Test for subgroup differences: Not applicable



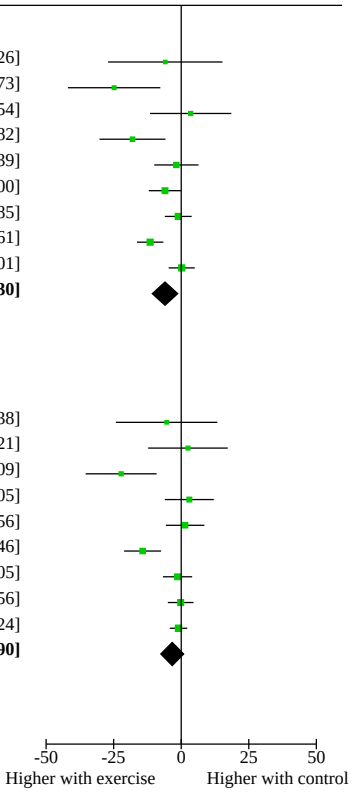
Analysis 2.2. Comparison 2: Aerobic exercise versus control (no exercise/placebo exercise), Outcome 2: Fatigue

Study or Subgroup	Control Mean	Control SD	Control Total	Exercise Mean	Exercise SD	Exercise Total	Std. Mean Difference IV, Random, 95% CI
Chang 2010	45.5	19.66	35	41	20.09	36	0.22 [-0.24 , 0.69]
Amini 2016	6.2	2.15	35	4.37	1.62	32	0.94 [0.44 , 1.45]
Soliman 2015	29.75	5.19	12	14.44	5.29	18	2.84 [1.78 , 3.90]
Sheshadri 2020	2	1.6	26	2.3	1.6	27	-0.18 [-0.72 , 0.36]



Analysis 2.3. Comparison 2: Aerobic exercise versus control (no exercise/ placebo exercise), Outcome 3: HRQoL: Summary component scores

Study or Subgroup	Control Mean	Control SD	Control Total	Exercise Mean	Exercise SD	Exercise Total	Weight	Mean Difference IV, Random, 95% CI
2.3.1 Physical Component Score								
Giannaki 2013a	70.5	26.5	7	76.4	15.6	15	3.9%	-5.90 [-27.06 , 15.26]
ACTINUT 2013	59.87	21.37	9	84.7	13.32	7	5.5%	-24.83 [-41.93 , -7.73]
Koh 2009 (1)	55	25	15	51.5	22.71	30	6.5%	3.50 [-11.54 , 18.54]
CHAIR 2015 (2)	33.58	18.05	11	51.6	7.41	6	8.4%	-18.02 [-30.22 , -5.82]
DIALY-SIZE 2016	3.4	7.3	8	5.2	9.3	8	12.3%	-1.80 [-9.99 , 6.39]
Samara 2016	43.9	8.8	12	49.9	6.6	15	14.9%	-6.00 [-12.00 , -0.00]
Dobsak 2012	50.6	6.8	10	51.7	4.4	11	16.1%	-1.10 [-6.05 , 3.85]
Suhardjono 2019 (2)	-3.45	12.45	38	8.04	8.84	37	16.2%	-11.49 [-16.37 , -6.61]
IHOPE 2019	38.9	9.42	38	38.72	10.4	29	16.2%	0.18 [-4.65 , 5.01]
Subtotal (95% CI)			**148**			**158**	**100.0%**	**-6.00 [-10.71 , -1.30]**
Heterogeneity: Tau² = 29.44; Chi² = 25.08, df = 8 (P = 0.002); I² = 68%								
Test for overall effect: Z = 2.50 (P = 0.01)								
2.3.2 Mental Component Score								
Giannaki 2013a	65	21.9	7	70.4	18.7	15	4.0%	-5.40 [-24.18 , 13.38]
Koh 2009 (1)	64	25	15	61.5	20.96	30	5.8%	2.50 [-12.21 , 17.21]
ACTINUT 2013	52.07	16.11	9	74.3	10.61	7	6.8%	-22.23 [-35.37 , -9.09]
DIALY-SIZE 2016	0.7	7.5	8	-2.3	10.7	8	10.3%	3.00 [-6.05 , 12.05]
CHAIR 2015 (2)	53.05	6.65	11	51.6	7.41	6	12.5%	1.45 [-5.66 , 8.56]
Samara 2016	39	10.4	12	53.3	6.9	15	12.9%	-14.30 [-21.14 , -7.46]
IHOPE 2019	50.7	11.63	38	52.05	10.81	29	14.7%	-1.35 [-6.75 , 4.05]
Dobsak 2012	59.3	5.6	10	59.5	5.5	11	15.6%	-0.20 [-4.96 , 4.56]
Suhardjono 2019 (2)	1.67	4.46	38	2.673	9.05	37	17.4%	-1.00 [-4.25 , 2.24]
Subtotal (95% CI)			**148**			**158**	**100.0%**	**-3.33 [-7.56 , 0.90]**
Heterogeneity: Tau² = 23.94; Chi² = 25.03, df = 8 (P = 0.002); I² = 68%								
Test for overall effect: Z = 1.54 (P = 0.12)								



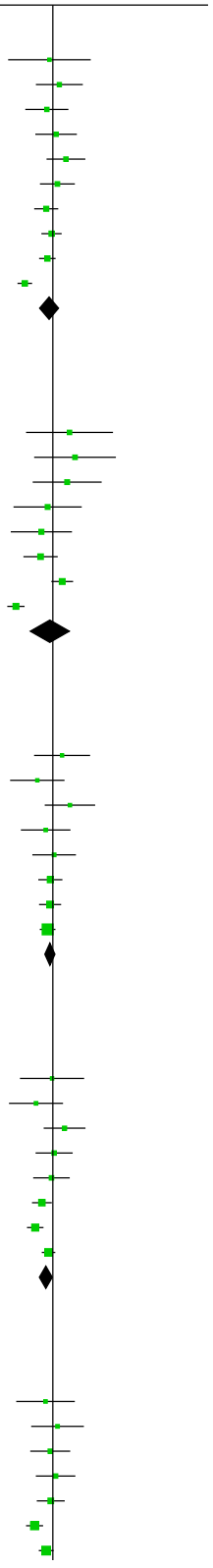
Footnotes

(1) two intervention arms polled together in the exercise group

(2) mean and standard deviation estimated from the median and range

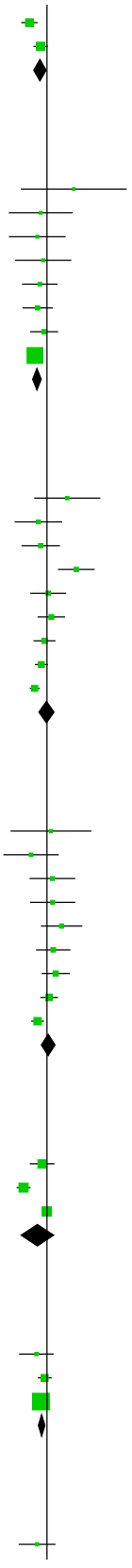
Analysis 2.4. Comparison 2: Aerobic exercise versus control (no exercise/placebo exercise), Outcome 4: HRQoL: Individual domains

Study or Subgroup	Control Mean	Control SD	Control Total	Exercise Mean	Exercise SD	Exercise Total	Weight	Mean Difference IV, Random, 95% CI
2.4.1 Physical Functioning								
Parsons 2004	65.7	27.1	7	68.3	30.6	6	3.9%	-2.60 [-34.26 , 29.06]
Matsumoto 2007	48	36.0572	32	43	27.2293	17	7.8%	5.00 [-12.99 , 22.99]
Zhao 2017	64.2	55.464	56	68.8	30.7879	59	8.4%	-4.60 [-21.11 , 11.91]
Koh 2009 (1)	70	26	15	67.5	25.04	30	8.7%	2.50 [-13.42 , 18.42]
AVANTE-HEMO 2020	84.44	22.7	13	74.38	14.7	12	9.2%	10.06 [-4.82 , 24.94]
Sheshadri 2020	63.7	24.3	26	60.2	25.4	27	9.9%	3.50 [-9.88 , 16.88]
Jong 2004	2.35	10.62	17	7.42	17.17	19	12.1%	-5.07 [-14.29 , 4.15]
Dobsak 2012	53.1	10	10	54.1	7.9	11	12.8%	-1.00 [-8.76 , 6.76]
EXCITE 2014	-2.7	27.4518	123	1.5	21.0824	104	13.5%	-4.20 [-10.52 , 2.12]
Wu 2014d	60.6	12.9	33	82.1	10	32	13.8%	-21.50 [-27.10 , -15.90]
Subtotal (95% CI)			**332**			**317**	**100.0%**	**-2.87 [-10.12 , 4.38]**
Heterogeneity: Tau² = 91.35; Chi² = 39.53, df = 9 (P < 0.00001); I² = 77%								
Test for overall effect: Z = 0.78 (P = 0.44)								
2.4.2 Role-physical								
Parsons 2004	90.5	25.2	7	77.7	34.5	6	9.2%	12.80 [-20.52 , 46.12]
AVANTE-HEMO 2020	88.89	33.3	13	71.88	45.2	12	9.7%	17.01 [-14.32 , 48.34]
Koh 2009 (1)	48	44	15	37	39.82	30	11.0%	11.00 [-15.44 , 37.44]
Matsumoto 2007	40	58.2462	32	44	35.0091	17	11.1%	-4.00 [-30.16 , 22.16]
Zhao 2017	54.4	65.3044	56	63.2	62.9545	59	11.9%	-8.80 [-32.26 , 14.66]
EXCITE 2014	-9.2	53.2229	123	0.2	47.821	104	14.9%	-9.40 [-22.55 , 3.75]
Dobsak 2012	51.3	8.9	10	44.1	10.6	11	16.0%	7.20 [-1.15 , 15.55]
Wu 2014d	26.3	11.5	33	54.6	15.4	32	16.3%	-28.30 [-34.92 , -21.68]
Subtotal (95% CI)			**289**			**271**	**100.0%**	**-2.31 [-17.29 , 12.67]**
Heterogeneity: Tau² = 347.56; Chi² = 52.47, df = 7 (P < 0.00001); I² = 87%								
Test for overall effect: Z = 0.30 (P = 0.76)								
2.4.3 Pain								
Parsons 2004	86.6	13.2	7	79.5	23.9	6	3.2%	7.10 [-14.38 , 28.58]
Zhao 2017	52.7	54.6641	56	64.6	59.4176	59	3.4%	-11.90 [-32.75 , 8.95]
AVANTE-HEMO 2020	85	18.3	13	71.88	29.3	12	4.0%	13.12 [-6.21 , 32.45]
Koh 2009 (1)	57	31	15	62.5	29.98	30	4.1%	-5.50 [-24.51 , 13.51]
Matsumoto 2007	47	36.0572	32	46	23.3394	17	5.3%	1.00 [-15.71 , 17.71]
Dobsak 2012	55.7	10.7	10	57.6	10.9	11	17.5%	-1.90 [-11.15 , 7.35]
EXCITE 2014	-3.2	34.1747	123	-1.1	30.8523	104	20.8%	-2.10 [-10.56 , 6.36]
Wu 2014d	59	12.7	43	63	13.4	32	41.5%	-4.00 [-10.00 , 2.00]
Subtotal (95% CI)			**299**			**271**	**100.0%**	**-2.26 [-6.12 , 1.61]**
Heterogeneity: Tau² = 0.00; Chi² = 4.57, df = 7 (P = 0.71); I² = 0%								
Test for overall effect: Z = 1.15 (P = 0.25)								
2.4.4 General health perceptions								
Parsons 2004	50.1	22.4	7	50.7	22.7	6	3.6%	-0.60 [-25.20 , 24.00]
Zhao 2017	52.2	50.9911	56	65.1	62.0354	59	4.9%	-12.90 [-33.61 , 7.81]
Koh 2009 (1)	48	27	15	39	23.42	30	7.5%	9.00 [-7.03 , 25.03]
Matsumoto 2007	44	33.2836	32	43	17.5045	17	8.9%	1.00 [-13.22 , 15.22]
AVANTE-HEMO 2020	53.33	17.5	13	54.38	18.2	12	9.1%	-1.05 [-15.07 , 12.97]
Dobsak 2012	42.5	9	10	50.9	8.7	11	19.0%	-8.40 [-15.99 , -0.81]
Wu 2014d	34.6	9.3	33	48.1	15.8	32	22.0%	-13.50 [-19.83 , -7.17]
EXCITE 2014	-2.5	20.1687	123	0.8	19.5398	104	25.0%	-3.30 [-8.48 , 1.88]
Subtotal (95% CI)			**289**			**271**	**100.0%**	**-5.38 [-10.32 , -0.43]**
Heterogeneity: Tau² = 18.53; Chi² = 12.20, df = 7 (P = 0.09); I² = 43%								
Test for overall effect: Z = 2.13 (P = 0.03)								
2.4.5 Emotional well-being								
Zhao 2017	55.3	61.2787	56	60.9	61.5759	59	4.4%	-5.60 [-28.06 , 16.86]
Parsons 2004	84.3	16.9	7	80.7	19.8	6	5.4%	3.60 [-16.59 , 23.79]
Matsumoto 2007	52	30.5099	32	54	23.3394	17	8.7%	-2.00 [-17.32 , 13.32]
AVANTE-HEMO 2020	75.11	24.7	13	73	12.4	12	8.8%	2.11 [-13.04 , 17.26]
Dobsak 2012	63.4	14.9	10	65	9.2	11	15.1%	-1.60 [-12.32 , 9.12]
Wu 2014d	54.2	14.1	33	68.2	12.8	32	27.0%	-14.00 [-20.54 , -7.46]
EXCITE 2014	-3.9	24.0904	123	1.2	19.5398	104	30.6%	-5.10 [-10.78 , 0.58]

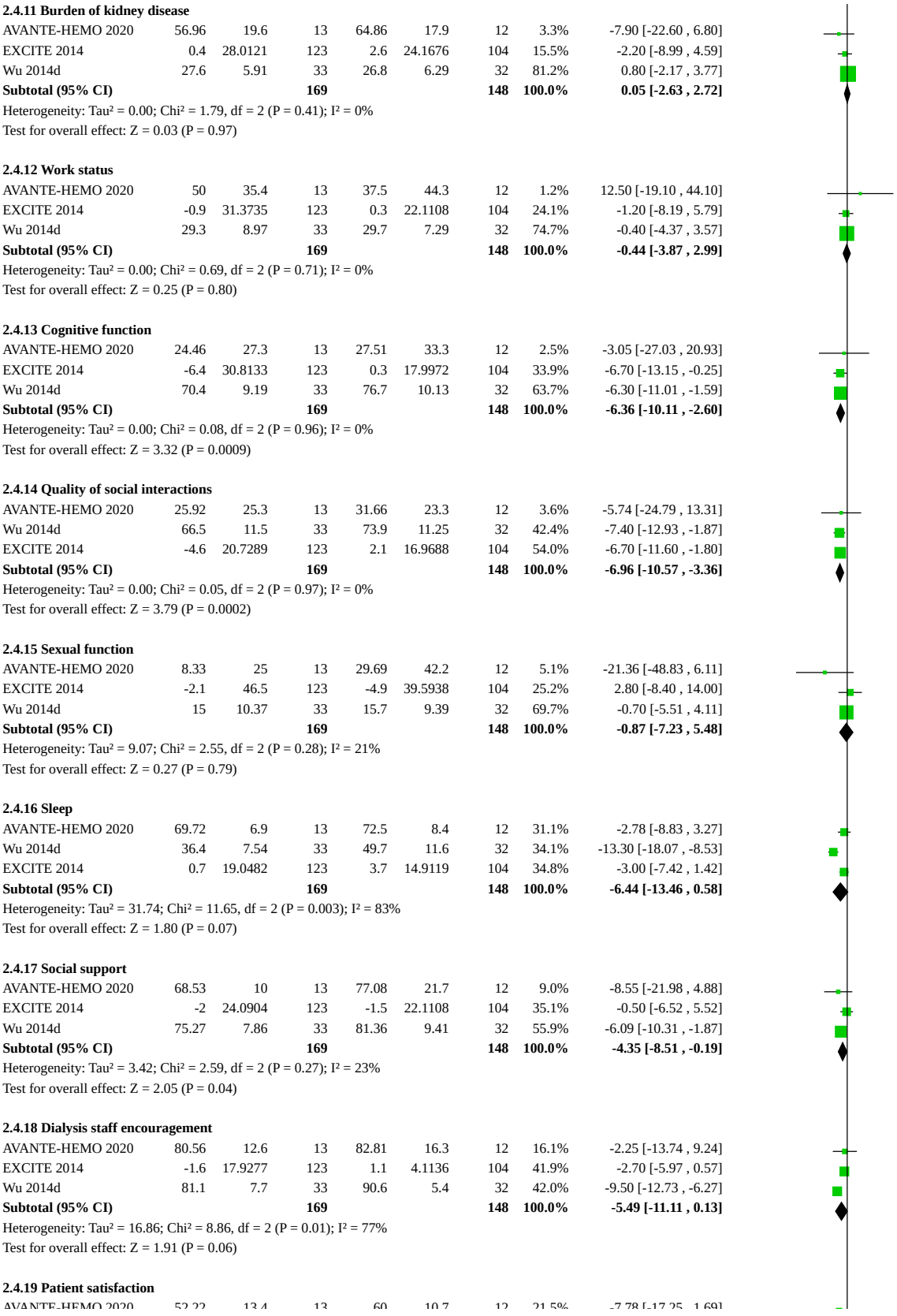


Analysis 2.4. (Continued)

Wu 2014d	54.2	14.1	33	68.2	12.8	32	27.0%	-14.00 [-20.54 , -7.46]
EXCITE 2014	-3.9	24.0904	123	1.2	19.5398	104	30.6%	-5.10 [-10.78 , 0.58]
Subtotal (95% CI)			**274**			**241**	**100.0%**	**-5.63 [-10.58 , -0.67]**
Heterogeneity: Tau² = 12.47; Chi² = 8.62, df = 6 (P = 0.20); I² = 30%								
Test for overall effect: Z = 2.23 (P = 0.03)								
2.4.6 Role-emotional								
Parsons 2004	71.4	30.4	7	50	44.7	6	0.7%	21.40 [-20.87 , 63.67]
Koh 2009 (1)	69	41	15	74	41.43	30	1.8%	-5.00 [-30.50 , 20.50]
Zhao 2017	54.1	52.7802	56	61.8	70.3068	59	2.3%	-7.70 [-30.35 , 14.95]
Matsumoto 2007	47	52.699	32	50	27.2293	17	2.4%	-3.00 [-25.38 , 19.38]
EXCITE 2014	-7.5	57.1446	123	-1.8	51.9278	104	5.9%	-5.70 [-19.90 , 8.50]
AVANTE-HEMO 2020	92.59	22.2	13	100	0.001	12	8.1%	-7.41 [-19.48 , 4.66]
Dobsak 2012	57	14.7	10	59.3	10.9	11	9.5%	-2.30 [-13.46 , 8.86]
Wu 2014d	30.4	7.4	33	40	9.4	32	69.5%	-9.60 [-13.72 , -5.48]
Subtotal (95% CI)			**289**			**271**	**100.0%**	**-8.02 [-11.45 , -4.58]**
Heterogeneity: Tau² = 0.00; Chi² = 3.80, df = 7 (P = 0.80); I² = 0%								
Test for overall effect: Z = 4.57 (P < 0.00001)								
2.4.7 Vitality								
Parsons 2004	62.9	14.1	7	46.7	30.3	6	4.1%	16.20 [-10.20 , 42.60]
Zhao 2017	50.4	58.4669	56	57.2	44.2067	59	6.7%	-6.80 [-25.82 , 12.22]
Matsumoto 2007	47	30.5099	32	52	23.3394	17	8.7%	-5.00 [-20.32 , 10.32]
AVANTE-HEMO 2020	72.78	22.6	13	49.38	14	12	9.2%	23.40 [8.78 , 38.02]
Koh 2009 (1)	52	23	15	51	23.31	30	9.4%	1.00 [-13.32 , 15.32]
Sheshadri 2020	63.7	24.3	26	60.2	15.4	27	12.0%	3.50 [-7.50 , 14.50]
Dobsak 2012	50.2	13.3	10	52.2	5.1	11	14.0%	-2.00 [-10.78 , 6.78]
EXCITE 2014	-3.7	25.2109	123	0.8	13.3693	104	17.4%	-4.50 [-9.64 , 0.64]
Wu 2014d	42.5	7.8	33	52.3	8.5	32	18.4%	-9.80 [-13.77 , -5.83]
Subtotal (95% CI)			**315**			**298**	**100.0%**	**-0.43 [-6.45 , 5.60]**
Heterogeneity: Tau² = 47.31; Chi² = 26.08, df = 8 (P = 0.001); I² = 69%								
Test for overall effect: Z = 0.14 (P = 0.89)								
2.4.8 Social function								
Parsons 2004	80.3	20.3	7	77.1	35.7	6	2.6%	3.20 [-29.08 , 35.48]
Zhao 2017	53.7	66.1989	56	66.4	53.764	59	5.1%	-12.70 [-34.81 , 9.41]
AVANTE-HEMO 2020	90.28	19.5	13	85.94	26.2	12	7.0%	4.34 [-13.88 , 22.56]
Koh 2009 (1)	73	30	15	68.5	27.42	30	7.0%	4.50 [-13.58 , 22.58]
CHAIR 2015 (2)	41.68	14.78	11	30.01	17.5	6	8.1%	11.67 [-4.83 , 28.17]
Dobsak 2012	66.5	17.6	10	61.5	14	11	10.6%	5.00 [-8.69 , 18.69]
Matsumoto 2007	59	13.8681	32	52	21.3944	17	13.5%	7.00 [-4.25 , 18.25]
EXCITE 2014	-0.8	22.9699	123	-2.5	29.8239	104	20.9%	1.70 [-5.32 , 8.72]
Wu 2014d	37	8.9	33	44.5	11.7	32	25.2%	-7.50 [-12.56 , -2.44]
Subtotal (95% CI)			**300**			**277**	**100.0%**	**0.94 [-4.48 , 6.37]**
Heterogeneity: Tau² = 23.77; Chi² = 13.58, df = 8 (P = 0.09); I² = 41%								
Test for overall effect: Z = 0.34 (P = 0.73)								
2.4.9 Symptoms								
AVANTE-HEMO 2020	76.87	13.4	13	80.75	11.7	12	30.2%	-3.88 [-13.72 , 5.96]
Wu 2014d	43.5	8.8	33	62.2	13.6	32	34.2%	-18.70 [-24.29 , -13.11]
EXCITE 2014	-0.8	15.6868	123	-0.6	12.3409	104	35.5%	-0.20 [-3.85 , 3.45]
Subtotal (95% CI)			**169**			**148**	**100.0%**	**-7.65 [-20.65 , 5.35]**
Heterogeneity: Tau² = 120.36; Chi² = 29.65, df = 2 (P < 0.00001); I² = 93%								
Test for overall effect: Z = 1.15 (P = 0.25)								
2.4.10 Effects of kidney disease								
AVANTE-HEMO 2020	64.59	18.1	13	73.06	17	12	3.6%	-8.47 [-22.23 , 5.29]
EXCITE 2014	-0.3	20.7289	123	1.5	21.5966	104	22.2%	-1.80 [-7.34 , 3.74]
Wu 2014d	34.6	5.7	33	39.4	6.7	32	74.2%	-4.80 [-7.83 , -1.77]
Subtotal (95% CI)			**169**			**148**	**100.0%**	**-4.27 [-6.87 , -1.66]**
Heterogeneity: Tau² = 0.00; Chi² = 1.24, df = 2 (P = 0.54); I² = 0%								
Test for overall effect: Z = 3.21 (P = 0.001)								
2.4.11 Burden of kidney disease								
AVANTE-HEMO 2020	56.96	19.6	13	64.86	17.9	12	3.3%	-7.90 [-22.60 , 6.80]



Analysis 2.4. (Continued)



2.4.11 Burden of kidney disease

AVANTE-HEMO 2020	56.96	19.6	13	64.86	17.9	12	3.3%	-7.90 [-22.60 , 6.80]
EXCITE 2014	0.4	28.0121	123	2.6	24.1676	104	15.5%	-2.20 [-8.99 , 4.59]
Wu 2014d	27.6	5.91	33	26.8	6.29	32	81.2%	0.80 [-2.17 , 3.77]
Subtotal (95% CI)			**169**			**148**	**100.0%**	**0.05 [-2.63 , 2.72]**

Heterogeneity: Tau² = 0.00; Chi² = 1.79, df = 2 (P = 0.41); I² = 0%
Test for overall effect: Z = 0.03 (P = 0.97)

2.4.12 Work status

AVANTE-HEMO 2020	50	35.4	13	37.5	44.3	12	1.2%	12.50 [-19.10 , 44.10]
EXCITE 2014	-0.9	31.3735	123	0.3	22.1108	104	24.1%	-1.20 [-8.19 , 5.79]
Wu 2014d	29.3	8.97	33	29.7	7.29	32	74.7%	-0.40 [-4.37 , 3.57]
Subtotal (95% CI)			**169**			**148**	**100.0%**	**-0.44 [-3.87 , 2.99]**

Heterogeneity: Tau² = 0.00; Chi² = 0.69, df = 2 (P = 0.71); I² = 0%
Test for overall effect: Z = 0.25 (P = 0.80)

2.4.13 Cognitive function

AVANTE-HEMO 2020	24.46	27.3	13	27.51	33.3	12	2.5%	-3.05 [-27.03 , 20.93]
EXCITE 2014	-6.4	30.8133	123	0.3	17.9972	104	33.9%	-6.70 [-13.15 , -0.25]
Wu 2014d	70.4	9.19	33	76.7	10.13	32	63.7%	-6.30 [-11.01 , -1.59]
Subtotal (95% CI)			**169**			**148**	**100.0%**	**-6.36 [-10.11 , -2.60]**

Heterogeneity: Tau² = 0.00; Chi² = 0.08, df = 2 (P = 0.96); I² = 0%
Test for overall effect: Z = 3.32 (P = 0.0009)

2.4.14 Quality of social interactions

AVANTE-HEMO 2020	25.92	25.3	13	31.66	23.3	12	3.6%	-5.74 [-24.79 , 13.31]
Wu 2014d	66.5	11.5	33	73.9	11.25	32	42.4%	-7.40 [-12.93 , -1.87]
EXCITE 2014	-4.6	20.7289	123	2.1	16.9688	104	54.0%	-6.70 [-11.60 , -1.80]
Subtotal (95% CI)			**169**			**148**	**100.0%**	**-6.96 [-10.57 , -3.36]**

Heterogeneity: Tau² = 0.00; Chi² = 0.05, df = 2 (P = 0.97); I² = 0%
Test for overall effect: Z = 3.79 (P = 0.0002)

2.4.15 Sexual function

AVANTE-HEMO 2020	8.33	25	13	29.69	42.2	12	5.1%	-21.36 [-48.83 , 6.11]
EXCITE 2014	-2.1	46.5	123	-4.9	39.5938	104	25.2%	2.80 [-8.40 , 14.00]
Wu 2014d	15	10.37	33	15.7	9.39	32	69.7%	-0.70 [-5.51 , 4.11]
Subtotal (95% CI)			**169**			**148**	**100.0%**	**-0.87 [-7.23 , 5.48]**

Heterogeneity: Tau² = 9.07; Chi² = 2.55, df = 2 (P = 0.28); I² = 21%
Test for overall effect: Z = 0.27 (P = 0.79)

2.4.16 Sleep

AVANTE-HEMO 2020	69.72	6.9	13	72.5	8.4	12	31.1%	-2.78 [-8.83 , 3.27]
Wu 2014d	36.4	7.54	33	49.7	11.6	32	34.1%	-13.30 [-18.07 , -8.53]
EXCITE 2014	0.7	19.0482	123	3.7	14.9119	104	34.8%	-3.00 [-7.42 , 1.42]
Subtotal (95% CI)			**169**			**148**	**100.0%**	**-6.44 [-13.46 , 0.58]**

Heterogeneity: Tau² = 31.74; Chi² = 11.65, df = 2 (P = 0.003); I² = 83%
Test for overall effect: Z = 1.80 (P = 0.07)

2.4.17 Social support

AVANTE-HEMO 2020	68.53	10	13	77.08	21.7	12	9.0%	-8.55 [-21.98 , 4.88]
EXCITE 2014	-2	24.0904	123	-1.5	22.1108	104	35.1%	-0.50 [-6.52 , 5.52]
Wu 2014d	75.27	7.86	33	81.36	9.41	32	55.9%	-6.09 [-10.31 , -1.87]
Subtotal (95% CI)			**169**			**148**	**100.0%**	**-4.35 [-8.51 , -0.19]**

Heterogeneity: Tau² = 3.42; Chi² = 2.59, df = 2 (P = 0.27); I² = 23%
Test for overall effect: Z = 2.05 (P = 0.04)

2.4.18 Dialysis staff encouragement

AVANTE-HEMO 2020	80.56	12.6	13	82.81	16.3	12	16.1%	-2.25 [-13.74 , 9.24]
EXCITE 2014	-1.6	17.9277	123	1.1	4.1136	104	41.9%	-2.70 [-5.97 , 0.57]
Wu 2014d	81.1	7.7	33	90.6	5.4	32	42.0%	-9.50 [-12.73 , -6.27]
Subtotal (95% CI)			**169**			**148**	**100.0%**	**-5.49 [-11.11 , 0.13]**

Heterogeneity: Tau² = 16.86; Chi² = 8.86, df = 2 (P = 0.01); I² = 77%
Test for overall effect: Z = 1.91 (P = 0.06)

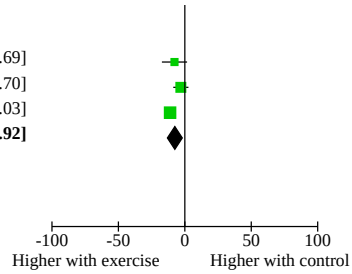
2.4.19 Patient satisfaction

AVANTE-HEMO 2020	52.22	13.4	13	60	10.7	12	21.5%	-7.78 [-17.25 , 1.69]

Analysis 2.4. (Continued)

2.4.19 Patient satisfaction								
AVANTE-HEMO 2020	52.22	13.4	13	60	10.7	12	21.5%	-7.78 [-17.25 , 1.69]
EXCITE 2014	-4.6	25.2109	123	-1.6	18.5114	104	35.4%	-3.00 [-8.70 , 2.70]
Wu 2014d	74.8	8.6	33	85.9	8.16	32	43.1%	-11.10 [-15.17 , -7.03]
Subtotal (95% CI)			**169**			**148**	**100.0%**	**-7.52 [-13.12 , -1.92]**

Heterogeneity: Tau² = 14.58; Chi² = 5.14, df = 2 (P = 0.08); I² = 61%
Test for overall effect: Z = 2.63 (P = 0.008)

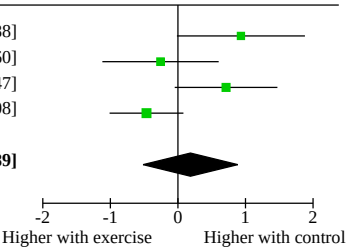


Footnotes
(1) two intervention arms polled together in the exercise group
(2) mean and standard deviation estimated from the median and range

Analysis 2.5. Comparison 2: Aerobic exercise versus control (no exercise/placebo exercise), Outcome 5: Depression

	Control			Exercise				Std. Mean Difference	Std. Mean Difference
Study or Subgroup	**Mean**	**SD**	**Total**	**Mean**	**SD**	**Total**	**Weight**	**IV, Random, 95% CI**	**IV, Random, 95% CI**
Giannaki 2013a	43.71	11.17	7	35.84	6.38	15	21.7%	0.93 [-0.01 , 1.88]	
Carmack 1995	5	5	11	6.8	8.2	10	23.4%	-0.26 [-1.12 , 0.60]	
Kouidi 1997	21.3	11.9	11	13.7	9.5	20	25.3%	0.71 [-0.05 , 1.47]	
Sheshadri 2020	6.6	6.5	26	11.3	12.4	27	29.6%	-0.47 [-1.01 , 0.08]	
Total (95% CI)			**55**			**72**	**100.0%**	**0.19 [-0.52 , 0.89]**	

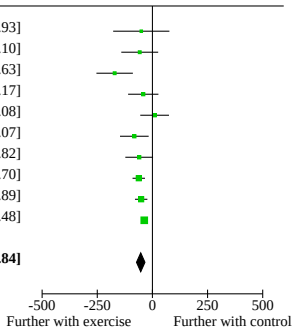
Heterogeneity: Tau² = 0.35; Chi² = 10.16, df = 3 (P = 0.02); I² = 70%
Test for overall effect: Z = 0.52 (P = 0.60)
Test for subgroup differences: Not applicable



Analysis 2.6. Comparison 2: Aerobic exercise versus control (no exercise/placebo exercise), Outcome 6: 6MWT

	Control			Exercise				Mean Difference	Mean Difference
Study or Subgroup	**Mean [metres]**	**SD [metres]**	**Total**	**Mean [metres]**	**SD [metres]**	**Total**	**Weight**	**IV, Random, 95% CI [metres]**	**IV, Random, 95% CI [metres]**
ACTINUT 2013	295.77	121.07	9	346.28	134.88	7	2.1%	-50.51 [-177.95 , 76.93]	
Koh 2009 (1)	452	144	16	509.5	121.07	28	4.5%	-57.50 [-141.10 , 26.10]	
Samara 2016	454.4	90.4	12	625.6	128.1	15	4.5%	-171.20 [-253.77 , -88.63]	
DIALY-SIZE 2016	0.8	44	8	42.3	88.8	8	6.1%	-41.50 [-110.17 , 27.17]	
CHAIR 2015 (2)	317.5	81.6	11	307.5	54.62	6	6.7%	10.00 [-55.08 , 75.08]	
Wu 2014d	359	132	33	441	135	32	6.7%	-82.00 [-146.93 , -17.07]	
Liao 2016	290	64.1006	20	350	128.2012	20	7.0%	-60.00 [-122.82 , 2.82]	
Fernandes 2019	325	59.8	19	386.9	19.38	20	17.8%	-61.90 [-90.10 , -33.70]	
Cho 2018	-26	41	13	25	29	11	17.9%	-51.00 [-79.11 , -22.89]	
EXCITE 2014	2	44.8193	123	39	35.9943	104	26.7%	-37.00 [-47.52 , -26.48]	
Total (95% CI)			**264**			**251**	**100.0%**	**-53.00 [-72.17 , -33.84]**	

Heterogeneity: Tau² = 329.93; Chi² = 16.89, df = 9 (P = 0.05); I² = 47%
Test for overall effect: Z = 5.42 (P < 0.00001)
Test for subgroup differences: Not applicable

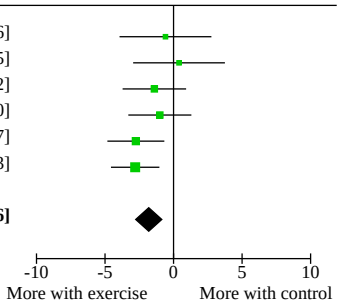


Footnotes
(1) two intervention arms polled together in the exercise group
(2) mean and standard deviation estimated from the median and range

Analysis 2.7. Comparison 2: Aerobic exercise versus control (no exercise/placebo exercise), Outcome 7: Sit-To-Stand test [N reps/30 sec]

Study or Subgroup	Control Mean	Control SD	Control Total	Exercise Mean	Exercise SD	Exercise Total	Weight	Mean Difference IV, Random, 95% CI
Giannaki 2013a	17.25	3.2	7	17.84	4.68	15	8.1%	-0.59 [-3.94 , 2.76]
DIALY-SIZE 2016	1.4	4.3	8	1	2.2	8	8.1%	0.40 [-2.95 , 3.75]
Koufaki 2002	12.05	3.6	15	13.45	3.1	18	16.8%	-1.40 [-3.72 , 0.92]
IHOPE 2019	10.7	5.6	38	11.7	4	29	17.1%	-1.00 [-3.30 , 1.30]
Wu 2014d	12.8	3.65	33	15.55	4.8	32	21.0%	-2.75 [-4.83 , -0.67]
Cho 2018	-0.5	2.2	13	2.3	2.2	11	29.0%	-2.80 [-4.57 , -1.03]
Total (95% CI)			**114**			**113**	**100.0%**	**-1.81 [-2.76 , -0.86]**

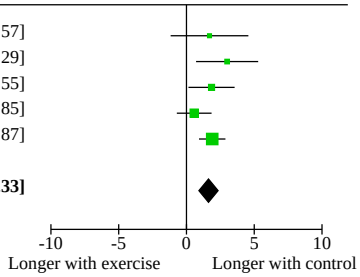
Heterogeneity: Tau² = 0.00; Chi² = 4.77, df = 5 (P = 0.44); I² = 0%
Test for overall effect: Z = 3.73 (P = 0.0002)
Test for subgroup differences: Not applicable



Analysis 2.8. Comparison 2: Aerobic exercise versus control (no exercise/placebo exercise), Outcome 8: Sit-To-Stand test [sit to 5 reps]

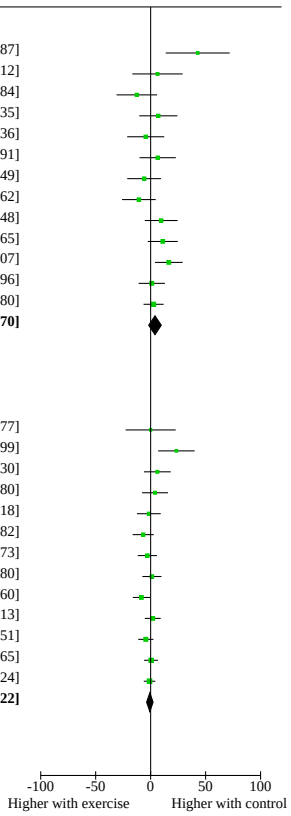
Study or Subgroup	Control Mean	Control SD	Control Total	Exercise Mean	Exercise SD	Exercise Total	Weight	Mean Difference IV, Random, 95% CI
Koufaki 2002	12.7	4.8	15	11	3.3	18	5.9%	1.70 [-1.17 , 4.57]
Samara 2016	10.6	3.25	12	7.6	2.7	15	9.1%	3.00 [0.71 , 5.29]
Wu 2014d	12.6	3.6	33	10.75	3.4	32	16.0%	1.85 [0.15 , 3.55]
Giannaki 2013a	8.81	0.66	7	8.24	2.34	15	26.7%	0.57 [-0.71 , 1.85]
EXCITE 2014	-0.6	5.0422	123	-2.5	2.0568	104	42.4%	1.90 [0.93 , 2.87]
Total (95% CI)			**190**			**184**	**100.0%**	**1.63 [0.92 , 2.33]**

Heterogeneity: Tau² = 0.06; Chi² = 4.36, df = 4 (P = 0.36); I² = 8%
Test for overall effect: Z = 4.51 (P < 0.00001)
Test for subgroup differences: Not applicable



Analysis 2.9. Comparison 2: Aerobic exercise versus control (no exercise/placebo exercise), Outcome 9: Resting blood pressure

Study or Subgroup	Control Mean [mm Hg]	Control SD [mm Hg]	Control Total	Exercise Mean [mm Hg]	Exercise SD [mm Hg]	Exercise Total	Weight	Mean Difference IV, Random, 95% CI [mm Hg]
2.9.1 Systolic blood pressure								
Liao 2016	138.8	16.7	20	96	64.2	20	3.2%	42.80 [13.73 , 71.87]
CYCLE-HD 2016	148.5	28.23	13	142.27	25.99	9	4.7%	6.23 [-16.66 , 29.12]
McGregor 2018	123.17	29.5201	18	135.75	25.2786	16	6.3%	-12.58 [-31.00 , 5.84]
Goldberg 1983	149	17	11	142	27	14	6.8%	7.00 [-10.35 , 24.35]
Koh 2009 (1)	136	29	16	140.5	25.34	30	7.0%	-4.50 [-21.36 , 12.36]
Toussaint 2008	147.8	23.5	10	141.4	11.9	9	7.2%	6.40 [-10.11 , 22.91]
Wilund 2010	147.1	14.9	9	153	17.2	8	7.8%	-5.90 [-21.29 , 9.49]
Tsuyuki 2003	130.8	23.3	12	141.5	16.4	17	7.9%	-10.70 [-26.02 , 4.62]
Cooke 2018 (2)	0.4	9.89	10	-9.167	21.93	10	8.1%	9.57 [-5.34 , 24.48]
Paluchamy 2018	148	14.7678	10	137	16.349	10	8.9%	11.00 [-2.65 , 24.65]
IHOPE 2019	148.9	23.3	38	132.4	27.9	29	9.6%	16.50 [3.93 , 29.07]
Deligiannis 1999a	144	10	12	143	17	10	10.1%	1.00 [-10.96 , 12.96]
Fernandes 2019	143.16	16.68	19	140.5	11.9	20	12.3%	2.66 [-6.48 , 11.80]
Subtotal (95% CI)			**198**			**202**	**100.0%**	**3.96 [-1.78 , 9.70]**
Heterogeneity: Tau² = 47.91; Chi² = 21.95, df = 12 (P = 0.04); I² = 45%								
Test for overall effect: Z = 1.35 (P = 0.18)								
2.9.2 Diastolic blood pressure								
Paluchamy 2018	83	27.5118	10	83	24.3495	10	1.6%	0.00 [-22.77 , 22.77]
Liao 2016	77.1	13.7	20	53.7	35.3	20	2.8%	23.40 [6.81 , 39.99]
Cooke 2018 (3)	3.5	10.32	10	-2.6	16.77	10	4.8%	6.10 [-6.10 , 18.30]
Goldberg 1983	86	12	11	82	18	14	5.1%	4.00 [-7.80 , 15.80]
McGregor 2018	70.5	16.4894	18	72.13	15.6513	16	5.8%	-1.63 [-12.44 , 9.18]
Tsuyuki 2003	79	13.5	12	85.8	12.3	17	7.0%	-6.80 [-16.42 , 2.82]
Koh 2009 (4)	75	15	16	78	13.15	30	8.0%	-3.00 [-11.73 , 5.73]
CYCLE-HD 2016	79.06	11.98	13	77.91	8.72	9	8.1%	1.15 [-7.50 , 9.80]
Wilund 2010	77.3	8.7	9	85.7	7.7	8	9.3%	-8.40 [-16.20 , -0.60]
IHOPE 2019	78.5	12.5	38	76.6	16.6	29	10.3%	1.90 [-5.33 , 9.13]
Toussaint 2008	72.8	9.4	10	77.2	5.7	9	10.8%	-4.40 [-11.31 , 2.51]
Fernandes 2019	86.32	12.52	19	86	6.6	20	12.0%	0.32 [-6.01 , 6.65]
Deligiannis 1999a	82	3	12	83	8	10	14.5%	-1.00 [-6.24 , 4.24]
Subtotal (95% CI)			**198**			**202**	**100.0%**	**-0.73 [-3.68 , 2.22]**
Heterogeneity: Tau² = 8.50; Chi² = 17.33, df = 12 (P = 0.14); I² = 31%								
Test for overall effect: Z = 0.48 (P = 0.63)								

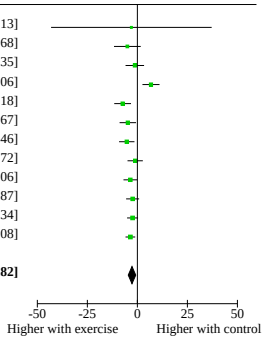


Footnotes

(1) two intervention arms polled together in the exercise group
(2) mean and standard deviation estimated from the median and interquartile range
(3) Mean and standard deviation estimated from the median and interquartile range
(4) Two intervention arms polled together in the exercise group

Analysis 2.10. Comparison 2: Aerobic exercise versus control (no exercise/placebo exercise), Outcome 10: Aerobic capacity (VO2 max or peak)

Study or Subgroup	Control Mean [mL/kg/min]	Control SD [mL/kg/min]	Control Total	Exercise Mean [mL/kg/min]	Exercise SD [mL/kg/min]	Exercise Total	Weight	Mean Difference IV, Random, 95% CI [mL/kg/min]
Parsons 2004	55	26	7	58	44	6	0.2%	-3.00 [-43.13 , 37.13]
Goldberg 1983	20	8	11	25	9	14	5.1%	-5.00 [-11.68 , 1.68]
Painter 2002a (1)	19.83	5.91	25	21.11	9.8	23	7.8%	-1.28 [-5.91 , 3.35]
Deligiannis 1999a	15.8	4.8	12	9	5.3	10	8.4%	6.80 [2.54 , 11.06]
Kouidi 1997	15.9	4.3	11	23.27	7.6	20	8.5%	-7.37 [-11.56 , -3.18]
McGregor 2018	15.93	5.168	18	20.71	6.831	16	8.6%	-4.78 [-8.89 , -0.67]
Tsuyuki 2003	21.7	4.9	12	27	5.6	17	9.1%	-5.30 [-9.14 , -1.46]
Koufaki 2002	18.8	4.9	15	19.9	6.3	18	9.1%	-1.10 [-4.92 , 2.72]
Carmack 1995	10.9	3.1	11	14.4	4.7	10	9.9%	-3.50 [-6.94 , -0.06]
Jong 2004	22.86	5.46	17	25.23	4.33	19	10.2%	-2.37 [-5.61 , 0.87]
Akiba 1995	17.6	2.6	6	20	2.4	7	11.3%	-2.40 [-5.14 , 0.34]
Kouidi 2004a	-0.4	2.3	10	3.1	3.3	11	11.9%	-3.50 [-5.92 , -1.08]
Total (95% CI)			**155**			**171**	**100.0%**	**-2.69 [-4.55 , -0.82]**
Heterogeneity: Tau² = 6.07; Chi² = 28.79, df = 11 (P = 0.002); I² = 62%								
Test for overall effect: Z = 2.83 (P = 0.005)								
Test for subgroup differences: Not applicable								



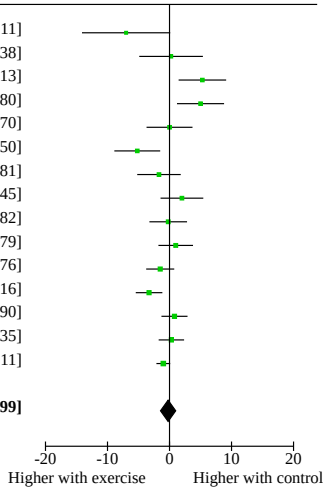
Footnotes

(1) factorial design: two intervention arms pooled together in the exercise group and two control arms pooled together in the control group

Analysis 2.11. Comparison 2: Aerobic exercise versus control (no exercise/placebo exercise), Outcome 11: Albumin

Study or Subgroup	Favours exercise Mean [g/L]	SD [g/L]	Total	Exercise Mean [g/L]	SD [g/L]	Total	Weight	Mean Difference IV, Random, 95% CI [g/L]
Frey 1999	37	7	6	44	5	5	2.4%	-7.00 [-14.11 , 0.11]
CHAIR 2015 (1)	39.25	2.2	11	39	6.2	6	3.8%	0.25 [-4.88 , 5.38]
Koufaki 2002	40.5	3.6	15	35.2	7.3	18	5.5%	5.30 [1.47 , 9.13]
AVANTE-HEMO 2020	39	4	13	34	5.5	12	5.5%	5.00 [1.20 , 8.80]
Afshar 2010	40	3	7	40	4	7	5.7%	0.00 [-3.70 , 3.70]
Jong 2004	33	6.1	17	38.2	5.1	19	5.7%	-5.20 [-8.90 , -1.50]
Matsumoto 2007	36.9	8.0435	32	38.6	4.4734	17	6.0%	-1.70 [-5.21 , 1.81]
Reboredo 2010	41	5	11	39	3	11	6.1%	2.00 [-1.45 , 5.45]
ACTINUT 2013	39.12	3.67	9	39.33	2.51	7	6.8%	-0.21 [-3.24 , 2.82]
Kopple 2007	39	3.7417	14	38	3.2	10	7.3%	1.00 [-1.79 , 3.79]
Liao 2016	40.1	4.2	20	41.6	3	20	8.4%	-1.50 [-3.76 , 0.76]
Fernandes 2019	34.6	4.1	19	37.9	2.5	20	8.6%	-3.30 [-5.44 , -1.16]
IHOPE 2019	40.1	3.1	38	39.3	5.1	29	8.7%	0.80 [-1.30 , 2.90]
Toussaint 2008	34.1	2	10	33.8	2.5	9	8.8%	0.30 [-1.75 , 2.35]
Wilund 2010	38	0.6	9	39	1.5	8	10.7%	-1.00 [-2.11 , 0.11]
Total (95% CI)			**231**			**198**	**100.0%**	**-0.23 [-1.45 , 0.99]**

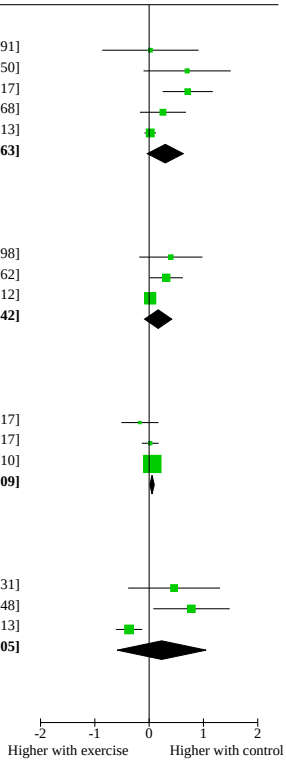
Heterogeneity: Tau² = 3.32; Chi² = 40.18, df = 14 (P = 0.0002); I² = 65%
Test for overall effect: Z = 0.37 (P = 0.71)
Test for subgroup differences: Not applicable



Footnotes
(1) mean and standard deviation estimated from the median and range

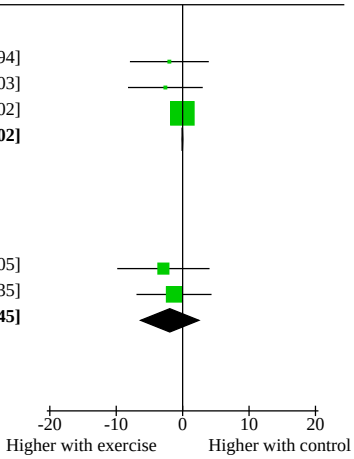
Analysis 2.12. Comparison 2: Aerobic exercise versus control (no exercise/placebo exercise), Outcome 12: Blood lipids

Study or Subgroup	Control Mean [mmol/L]	SD [mmol/L]	Total	Exercise Mean [mmol/L]	SD [mmol/L]	Total	Weight	Mean Difference IV, Random, 95% CI [mmol/L]
2.12.1 Total cholesterol [mmol/L]								
Afshar 2010	3.4	0.812	7	3.377	0.88	7	10.1%	0.02 [-0.86 , 0.91]
Lee 2001	5.08	1.57	21	4.38	0.98	19	11.6%	0.70 [-0.10 , 1.50]
Wilund 2010	4.25	0.61	9	3.54	0.339	8	21.1%	0.71 [0.25 , 1.17]
Liao 2016	4.71	0.58	20	4.456	0.776	20	22.6%	0.25 [-0.17 , 0.68]
Groussard 2015	1.63	0.09	10	1.61	0.13	8	34.7%	0.02 [-0.09 , 0.13]
Subtotal (95% CI)			**67**			**62**	**100.0%**	**0.30 [-0.03 , 0.63]**
Heterogeneity: Tau² = 0.08; Chi² = 11.30, df = 4 (P = 0.02); I² = 65%								
Test for overall effect: Z = 1.76 (P = 0.08)								
2.12.2 LDL cholesterol [mmol/L]								
Lee 2001	2.91	0.97	21	2.51	0.91	19	14.1%	0.40 [-0.18 , 0.98]
Afshar 2010	1.56	0.33	7	1.245	0.25	7	31.5%	0.31 [0.01 , 0.62]
Groussard 2015	0.91	0.09	10	0.89	0.12	8	54.4%	0.02 [-0.08 , 0.12]
Subtotal (95% CI)			**38**			**34**	**100.0%**	**0.17 [-0.08 , 0.42]**
Heterogeneity: Tau² = 0.03; Chi² = 4.57, df = 2 (P = 0.10); I² = 56%								
Test for overall effect: Z = 1.30 (P = 0.19)								
2.12.3 HDL cholesterol [mmol/L]								
Afshar 2010	0.82	0.332	7	0.99	0.32	7	1.4%	-0.17 [-0.51 , 0.17]
Lee 2001	0.99	0.22	21	0.97	0.27	19	7.0%	0.02 [-0.13 , 0.17]
Groussard 2015	0.47	0.04	10	0.41	0.05	8	91.5%	0.06 [0.02 , 0.10]
Subtotal (95% CI)			**38**			**34**	**100.0%**	**0.05 [0.01 , 0.09]**
Heterogeneity: Tau² = 0.00; Chi² = 1.92, df = 2 (P = 0.38); I² = 0%								
Test for overall effect: Z = 2.59 (P = 0.010)								
2.12.4 Triglycerides [mmol/L]								
Afshar 2010	2.55	0.903	7	2.09	0.7	7	28.6%	0.46 [-0.39 , 1.31]
Lee 2001	2.28	1.49	21	1.5	0.66	19	31.6%	0.78 [0.08 , 1.48]
Groussard 2015	1.09	0.13	10	1.46	0.33	8	39.8%	-0.37 [-0.61 , -0.13]
Subtotal (95% CI)			**38**			**34**	**100.0%**	**0.23 [-0.59 , 1.05]**
Heterogeneity: Tau² = 0.42; Chi² = 11.69, df = 2 (P = 0.003); I² = 83%								
Test for overall effect: Z = 0.55 (P = 0.58)								



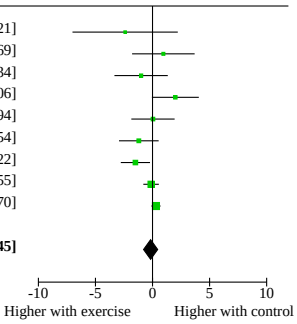
Analysis 2.13. Comparison 2: Aerobic exercise versus control (no exercise/placebo exercise), Outcome 13: Body composition

Study or Subgroup	Control Mean	Control SD	Control Total	Exercise Mean	Exercise SD	Exercise Total	Weight	Mean Difference IV, Random, 95% CI
2.13.1 Fat mass [kg]								
Giannaki 2013a	28.5	5.8	7	30.5	8.1	15	0.0%	-2.00 [-7.94 , 3.94]
Kopple 2007	19.1	2.4	14	21.7	8.85	10	0.0%	-2.60 [-8.23 , 3.03]
Sheshadri 2020	-0.04	0.1071	25	0	0.1071	24	100.0%	-0.04 [-0.10 , 0.02]
Subtotal (95% CI)			**46**			**49**	**100.0%**	**-0.04 [-0.10 , 0.02]**
Heterogeneity: Tau² = 0.00; Chi² = 1.21, df = 2 (P = 0.55); I² = 0%								
Test for overall effect: Z = 1.32 (P = 0.19)								
2.13.2 Lean mass [kg]								
IHOPE 2019	58.6	15.9	38	61.5	13.1	29	39.8%	-2.90 [-9.85 , 4.05]
Giannaki 2013a	45.4	5.1	7	46.7	8.3	15	60.2%	-1.30 [-6.95 , 4.35]
Subtotal (95% CI)			**45**			**44**	**100.0%**	**-1.94 [-6.32 , 2.45]**
Heterogeneity: Tau² = 0.00; Chi² = 0.12, df = 1 (P = 0.73); I² = 0%								
Test for overall effect: Z = 0.87 (P = 0.39)								



Analysis 2.14. Comparison 2: Aerobic exercise versus control (no exercise/placebo exercise), Outcome 14: Body mass index

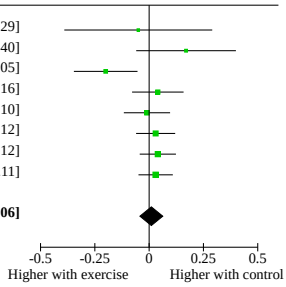
Study or Subgroup	Control Mean [kg/m²]	Control SD [kg/m²]	Control Total	Exercise Mean [kg/m²]	Exercise SD [kg/m²]	Exercise Total	Weight	Mean Difference IV, Random, 95% CI [kg/m²]
IHOPE 2019	31.5	7.4	38	33.9	10.9	29	1.7%	-2.40 [-7.01 , 2.21]
Liao 2016	23.91	5.27	20	22.96	3.36	20	4.4%	0.95 [-1.79 , 3.69]
Koufaki 2002	24.7	3.5	15	25.7	3.3	18	5.7%	-1.00 [-3.34 , 1.34]
Wilund 2010	30.3	2.5	9	28.3	1.8	8	7.0%	2.00 [-0.06 , 4.06]
ACTINUT 2013	20.93	2.57	9	20.89	1.19	7	7.9%	0.04 [-1.86 , 1.94]
AVANTE-HEMO 2020	19.8	1.7	13	21	2.6	12	9.0%	-1.20 [-2.94 , 0.54]
Kopple 2007	25.1	1.2	14	26.6	1.8	10	13.4%	-1.50 [-2.78 , -0.22]
Cooke 2018 (1)	0.2067	0.413	10	0.3333	1.015	10	22.9%	-0.13 [-0.81 , 0.55]
Sheshadri 2020	0.5	0.7142	25	0.2	0.7142	24	27.9%	0.30 [-0.10 , 0.70]
Total (95% CI)			**153**			**138**	**100.0%**	**-0.17 [-0.78 , 0.45]**
Heterogeneity: Tau² = 0.31; Chi² = 15.11, df = 8 (P = 0.06); I² = 47%								
Test for overall effect: Z = 0.53 (P = 0.60)								
Test for subgroup differences: Not applicable								



Footnotes
(1) mean and standard deviation estimated from the median and interquartile range

Analysis 2.15. Comparison 2: Aerobic exercise versus control (no exercise/placebo exercise), Outcome 15: Calcium

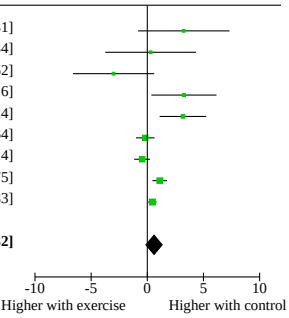
Study or Subgroup	Control Mean [mmol/L]	Control SD [mmol/L]	Control Total	Exercise Mean [mmol/L]	Exercise SD [mmol/L]	Exercise Total	Weight	Mean Difference IV, Random, 95% CI [mmol/L]
Kouidi 1997	2.15	0.25	11	2.2	0.7	20	2.2%	-0.05 [-0.39 , 0.29]
de Lima 2013	2.32	0.22	11	2.15	0.32	11	4.6%	0.17 [-0.06 , 0.40]
Deligiannis 1999a	2.02	0.2	12	2.22	0.15	10	9.5%	-0.20 [-0.35 , -0.05]
ACTINUT 2013	2.29	0.12	9	2.25	0.12	7	12.7%	0.04 [-0.08 , 0.16]
Wilund 2010	2.2	0.15	9	2.21	0.06	8	14.6%	-0.01 [-0.12 , 0.10]
Momeni 2014	2.27	0.15	20	2.24	0.14	20	17.6%	0.03 [-0.06 , 0.12]
Paluchamy 2018	2.13	0.1	10	2.09	0.09	10	18.9%	0.04 [-0.04 , 0.12]
Liao 2016	2.45	0.1	20	2.42	0.15	20	19.9%	0.03 [-0.05 , 0.11]
Total (95% CI)			**102**			**106**	**100.0%**	**0.01 [-0.04 , 0.06]**
Heterogeneity: Tau² = 0.00; Chi² = 11.14, df = 7 (P = 0.13); I² = 37%								
Test for overall effect: Z = 0.38 (P = 0.71)								
Test for subgroup differences: Not applicable								



Analysis 2.16. Comparison 2: Aerobic exercise versus control (no exercise/placebo exercise), Outcome 16: C-reactive protein

Study or Subgroup	Control Mean [mg/dL]	Control SD [mg/dL]	Control Total	Exercise Mean [mg/dL]	Exercise SD [mg/dL]	Exercise Total	Weight	Mean Difference IV, Random, 95% CI [mg/dL]
ACTINUT 2013	4.99	5.96	9	1.75	1.62	7	2.8%	3.24 [-0.83 , 7.31]
Kopple 2007	2.8	2.9933	14	2.5	6.0083	10	2.8%	0.30 [-3.74 , 4.34]
Toussaint 2008	4.3	0.7	10	7.3	5.5	9	3.4%	-3.00 [-6.62 , 0.62]
Afshar 2010	4.14	3.87	7	0.88	0.59	7	4.9%	3.26 [0.36 , 6.16]
Afshar 2011	4.1	3.9	14	0.93	0.66	14	8.0%	3.17 [1.10 , 5.24]
IHOPE 2019	1.136	0.776	12	1.317	1.18	11	17.8%	-0.18 [-1.01 , 0.64]
AVANTE-HEMO 2020 (1)	0.38	0.349	13	0.843	1.2	12	19.0%	-0.46 [-1.17 , 0.24]
Wilund 2010	6	0.67	9	4.9	0.69	8	19.5%	1.10 [0.45 , 1.75]
Liao 2016	1.23	0.211	20	0.78	0.83	20	21.8%	0.45 [0.07 , 0.83]
Total (95% CI)			**108**			**98**	**100.0%**	**0.60 [-0.12 , 1.32]**

Heterogeneity: Tau² = 0.59; Chi² = 28.05, df = 8 (P = 0.0005); I² = 71%
Test for overall effect: Z = 1.63 (P = 0.10)
Test for subgroup differences: Not applicable

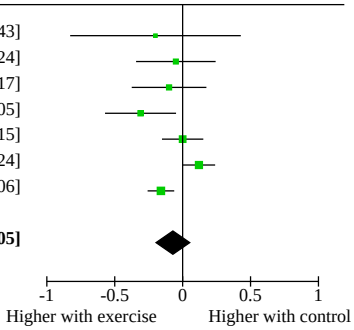


Footnotes
(1) Mean and standard deviation estimated from the median and the interquartile range

Analysis 2.17. Comparison 2: Aerobic exercise versus control (no exercise/placebo exercise), Outcome 17: Dialysis adequacy: Kt/V

Study or Subgroup	Control Mean	Control SD	Control Total	Exercise Mean	Exercise SD	Exercise Total	Weight	Mean Difference IV, Random, 95% CI
Reboredo 2010	1.8	0.7	11	2	0.8	11	3.4%	-0.20 [-0.83 , 0.43]
Parsons 2004	1.22	0.21	7	1.27	0.31	6	10.6%	-0.05 [-0.34 , 0.24]
Frey 1999	1.7	0.1	6	1.8	0.3	5	11.5%	-0.10 [-0.37 , 0.17]
Dobsak 2012	1.33	0.31	10	1.64	0.3	11	12.1%	-0.31 [-0.57 , -0.05]
Liao 2016	1.52	0.23	20	1.52	0.26	20	18.8%	0.00 [-0.15 , 0.15]
Fernandes 2019	1.48	0.19	19	1.36	0.19	20	21.1%	0.12 [0.00 , 0.24]
Paluchamy 2018	0.99	0.1265	10	1.15	0.0949	10	22.5%	-0.16 [-0.26 , -0.06]
Total (95% CI)			**83**			**83**	**100.0%**	**-0.07 [-0.20 , 0.05]**

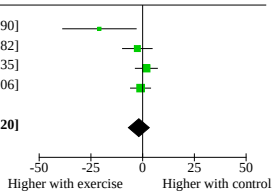
Heterogeneity: Tau² = 0.02; Chi² = 17.13, df = 6 (P = 0.009); I² = 65%
Test for overall effect: Z = 1.14 (P = 0.26)
Test for subgroup differences: Not applicable



Analysis 2.18. Comparison 2: Aerobic exercise versus control (no exercise/placebo exercise), Outcome 18: Energy intake

Study or Subgroup	Control Mean [kCal/kg/d]	Control SD [kCal/kg/d]	Control Total	Exercise Mean [kCal/kg/d]	Exercise SD [kCal/kg/d]	Exercise Total	Weight	Mean Difference IV, Random, 95% CI [kCal/kg/d]
Frey 1999	45.76	10.68	6	66.64	18.05	5	6.9%	-20.88 [-38.86 , -2.90]
ACTINUT 2013	27.53	8.42	9	30.09	6.64	7	25.1%	-2.56 [-9.94 , 4.82]
Kopple 2007	24.2	7.8575	14	22.4	6.01	10	32.8%	1.80 [-3.75 , 7.35]
IHOPE 2019	19.03	8.5	38	20.04	11.8	29	35.2%	-1.01 [-6.08 , 4.06]
Total (95% CI)			**67**			**51**	**100.0%**	**-1.84 [-6.87 , 3.20]**

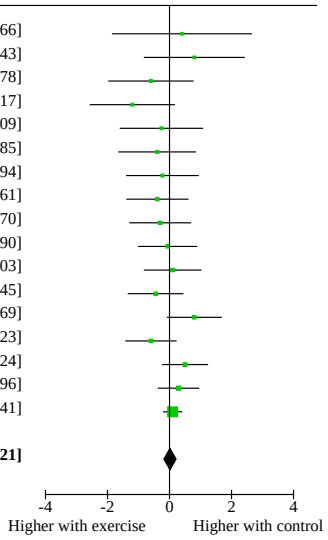
Heterogeneity: Tau² = 12.06; Chi² = 5.84, df = 3 (P = 0.12); I² = 49%
Test for overall effect: Z = 0.72 (P = 0.47)
Test for subgroup differences: Not applicable



Analysis 2.19. Comparison 2: Aerobic exercise versus control (no exercise/placebo exercise), Outcome 19: Haemoglobin

Study or Subgroup	Control Mean [g/L]	Control SD [g/L]	Control Total	Exercise Mean [g/L]	Exercise SD [g/L]	Exercise Total	Weight	Mean Difference IV, Random, 95% CI [g/L]
Reboredo 2010	11.3	2.6	11	10.9	2.8	11	0.8%	0.40 [-1.86 , 2.66]
AVANTE-HEMO 2020	10.6	1.8	13	9.8	2.3	12	1.5%	0.80 [-0.83 , 2.43]
Parsons 2004	11.1	1.7	7	11.7	0.7	6	2.0%	-0.60 [-1.98 , 0.78]
Goldberg 1983	8.8	1.3	7	10	1.5	9	2.0%	-1.20 [-2.57 , 0.17]
Paluchamy 2018	8.09	1.4546	10	8.35	1.6128	10	2.1%	-0.26 [-1.61 , 1.09]
Kopple 2007	12.5	1.87	14	12.9	1.26	10	2.5%	-0.40 [-1.65 , 0.85]
Momeni 2014	9.8	1.7	20	10.03	2.07	20	2.8%	-0.23 [-1.40 , 0.94]
Painter 2002a (1)	11.81	1.56	26	12.2	1.92	22	3.8%	-0.39 [-1.39 , 0.61]
CHAIR 2015 (2)	10.93	0.72	11	11.23	1.13	6	3.9%	-0.30 [-1.30 , 0.70]
Toussaint 2008	12.03	1.41	10	12.09	0.59	9	4.2%	-0.06 [-1.02 , 0.90]
Koufaki 2002	12.2	1.4	15	12.1	1.3	18	4.5%	0.10 [-0.83 , 1.03]
Fernandes 2019	10.25	1.66	19	10.7	1.14	20	4.8%	-0.45 [-1.35 , 0.45]
de Lima 2013	11.1	1.2	11	10.3	0.9	11	4.9%	0.80 [-0.09 , 1.69]
Tsuyuki 2003	7.4	1.2	12	8	1	17	5.6%	-0.60 [-1.43 , 0.23]
Lee 2001	8.7	1.3	21	8.2	1.1	19	7.0%	0.50 [-0.24 , 1.24]
ACTINUT 2013	11.21	0.66	9	10.92	0.69	7	8.6%	0.29 [-0.38 , 0.96]
Afshar 2010	10.2	0.3	7	10.1	0.3	7	39.0%	0.10 [-0.21 , 0.41]
Total (95% CI)			**223**			**214**	**100.0%**	**0.01 [-0.18 , 0.21]**

Heterogeneity: Tau² = 0.00; Chi² = 15.31, df = 16 (P = 0.50); I² = 0%
Test for overall effect: Z = 0.14 (P = 0.89)
Test for subgroup differences: Not applicable



Footnotes
(1) factorial design: two intervention arms pooled together in the exercise group and two control arms pooled together in the control group
(2) mean and standard deviation estimated from the median and range

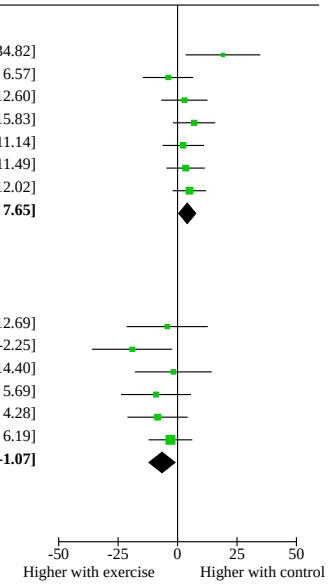
Analysis 2.20. Comparison 2: Aerobic exercise versus control (no exercise/placebo exercise), Outcome 20: Heart rate

Study or Subgroup	Favours exercise Mean [bpm]	Favours exercise SD [bpm]	Favours exercise Total	Exercise Mean [bpm]	Exercise SD [bpm]	Exercise Total	Weight	Mean Difference IV, Random, 95% CI [bpm]
2.20.1 Resting								
Liao 2016	71	10.5	20	51.9	34.3	20	5.1%	19.10 [3.38 , 34.82]
Goldberg 1983	79	15	11	83	11	14	10.8%	-4.00 [-14.57 , 6.57]
CYCLE-HD 2016	75.31	13.95	13	72.45	9.36	9	12.7%	2.86 [-6.88 , 12.60]
McGregor 2018	80.94	11.7854	16	74	14.6193	18	15.0%	6.94 [-1.95 , 15.83]
Tsuyuki 2003	84.3	13.6	12	81.9	8.7	17	15.5%	2.40 [-6.34 , 11.14]
Deligiannis 1999a	81.8	8.5	12	78.4	10.5	10	17.8%	3.40 [-4.69 , 11.49]
Koh 2009	75	12	16	70	10.7	30	23.1%	5.00 [-2.02 , 12.02]
Subtotal (95% CI)			**100**			**118**	**100.0%**	**4.07 [0.49 , 7.65]**

Heterogeneity: Tau² = 1.63; Chi² = 6.44, df = 6 (P = 0.38); I² = 7%
Test for overall effect: Z = 2.23 (P = 0.03)

2.20.2 Maximum								
McGregor 2018	122.5	27.107	18	126.88	23.6646	16	10.3%	-4.38 [-21.45 , 12.69]
Akiba 1995	136.3	19.5	6	155.4	8.6	7	10.5%	-19.10 [-35.95 , -2.25]
Koufaki 2002	127.2	24.4	15	129	22.7	18	11.4%	-1.80 [-18.00 , 14.40]
Painter 2002a (1)	128.72	27.44	25	137.78	24.68	23	13.8%	-9.06 [-23.81 , 5.69]
Tsuyuki 2003	155.8	20.7	12	164.2	10.2	17	18.6%	-8.40 [-21.08 , 4.28]
Deligiannis 1999a	139	12	12	142	10	10	35.4%	-3.00 [-12.19 , 6.19]
Subtotal (95% CI)			**88**			**91**	**100.0%**	**-6.54 [-12.01 , -1.07]**

Heterogeneity: Tau² = 0.00; Chi² = 3.29, df = 5 (P = 0.66); I² = 0%
Test for overall effect: Z = 2.34 (P = 0.02)

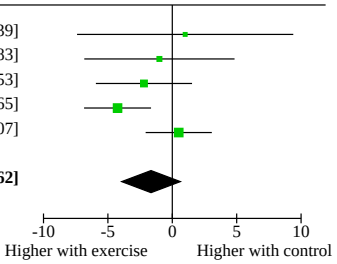


Footnotes
(1) factorial design: two intervention arms pooled together in the exercise group and two control arms pooled together in the control group

Analysis 2.21. Comparison 2: Aerobic exercise versus control (no exercise/placebo exercise), Outcome 21: Left ventricular ejection fraction

Study or Subgroup	Control Mean [%]	Control SD [%]	Control Total	Exercise Mean [%]	Exercise SD [%]	Exercise Total	Weight	Mean Difference IV, Random, 95% CI [%]
Reboredo 2010	71.4	7.6	11	70.4	12	11	6.4%	1.00 [-7.39 , 9.39]
McGregor 2018	53.22	7.1186	18	54.22	9.8337	16	11.7%	-1.00 [-6.83 , 4.83]
Cho 2018	0.3	3.9	13	2.5	5.2	11	21.3%	-2.20 [-5.93 , 1.53]
Momeni 2014	54.25	4.66	20	58.5	3.67	20	30.2%	-4.25 [-6.85 , -1.65]
Kouidi 2004a	0.2	3	10	-0.3	3	11	30.5%	0.50 [-2.07 , 3.07]
Total (95% CI)			**72**			**69**	**100.0%**	**-1.65 [-3.93 , 0.62]**

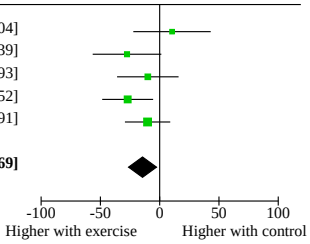
Heterogeneity: Tau² = 2.70; Chi² = 7.03, df = 4 (P = 0.13); I² = 43%
Test for overall effect: Z = 1.42 (P = 0.15)
Test for subgroup differences: Not applicable



Analysis 2.22. Comparison 2: Aerobic exercise versus control (no exercise/placebo exercise), Outcome 22: Left ventricular mass index

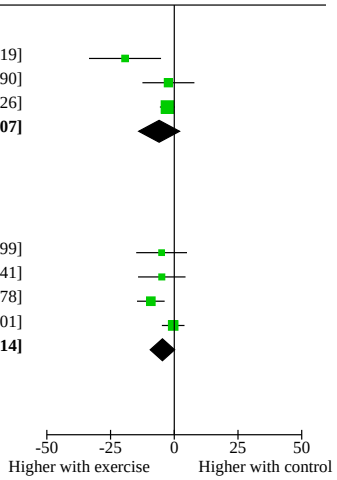
Study or Subgroup	Control Mean [g/m²]	Control SD [g/m²]	Control Total	Exercise Mean [g/m²]	Exercise SD [g/m²]	Exercise Total	Weight	Mean Difference IV, Random, 95% CI [g/m²]
Reboredo 2010	131.3	48.4	11	120.9	26.6	11	12.0%	10.40 [-22.24 , 43.04]
McGregor 2018	111.65	39.7958	18	139.2	45.6215	16	14.9%	-27.55 [-56.49 , 1.39]
Deligiannis 1999a	137	35	12	147	27	10	18.1%	-10.00 [-35.93 , 15.93]
Wilund 2010	127.4	18.17	9	154.4	25.83	8	24.9%	-27.00 [-48.48 , -5.52]
Cho 2018	-11.7	30.1	13	-1.5	16.7	11	30.1%	-10.20 [-29.31 , 8.91]
Total (95% CI)			**63**			**56**	**100.0%**	**-14.47 [-26.25 , -2.69]**

Heterogeneity: Tau² = 24.90; Chi² = 4.63, df = 4 (P = 0.33); I² = 14%
Test for overall effect: Z = 2.41 (P = 0.02)
Test for subgroup differences: Not applicable



Analysis 2.23. Comparison 2: Aerobic exercise versus control (no exercise/placebo exercise), Outcome 23: Muscular strength

Study or Subgroup	Control Mean [kg]	Control SD [kg]	Control Total	Exercise Mean [kg]	Exercise SD [kg]	Exercise Total	Weight	Mean Difference IV, Random, 95% CI [kg]
2.23.1 Knee extension								
Dobsak 2012	85.36	18.32	10	104.68	14.23	11	20.2%	-19.32 [-33.45 , -5.19]
DIALY-SIZE 2016	9.3	10.1	8	11.6	10.7	8	29.0%	-2.30 [-12.50 , 7.90]
ACTINUT 2013	7.87	2.19	9	10.56	3.49	7	50.8%	-2.69 [-5.64 , 0.26]
Subtotal (95% CI)			**27**			**26**	**100.0%**	**-5.94 [-13.95 , 2.07]**
Heterogeneity: Tau² = 30.62; Chi² = 5.14, df = 2 (P = 0.08); I² = 61%								
Test for overall effect: Z = 1.45 (P = 0.15)								
2.23.2 handgrip								
Koh 2009 (1)	31	12	7	35.97	12.35	29	15.9%	-4.97 [-14.93 , 4.99]
Samara 2016	32.3	9.9	12	37.2	14.7	15	17.5%	-4.90 [-14.21 , 4.41]
Wu 2014d	28.6	9	33	37.8	12.9	32	31.0%	-9.20 [-14.62 , -3.78]
Cooke 2018 (2)	2	3.87	10	2.43	6.02	10	35.6%	-0.43 [-4.87 , 4.01]
Subtotal (95% CI)			**62**			**86**	**100.0%**	**-4.65 [-9.44 , 0.14]**
Heterogeneity: Tau² = 11.62; Chi² = 6.08, df = 3 (P = 0.11); I² = 51%								
Test for overall effect: Z = 1.90 (P = 0.06)								



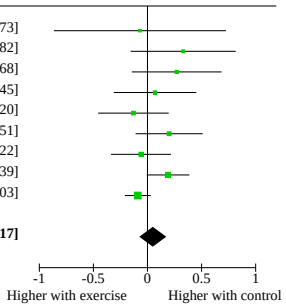
Footnotes

(1) two intervention arms polled together in the exercise group
(2) mean and standard deviation estimated from the median and interquartile range

Analysis 2.24. Comparison 2: Aerobic exercise versus control (no exercise/placebo exercise), Outcome 24: Phosphate

Study or Subgroup	Control Mean [mmol/L]	Control SD [mmol/L]	Control Total	Exercise Mean [mmol/L]	Exercise SD [mmol/L]	Exercise Total	Weight	Mean Difference IV, Random, 95% CI [mmol/L]
AVANTE-HEMO 2020 (1)	1.86	1.15	13	1.93	0.87	12	2.0%	-0.07 [-0.87 , 0.73]
Reboredo 2010	1.91	0.61	11	1.58	0.55	11	5.0%	0.33 [-0.16 , 0.82]
ACTINUT 2013	1.59	0.42	9	1.32	0.42	7	6.6%	0.27 [-0.14 , 0.68]
de Lima 2013	1.81	0.29	11	1.74	0.55	10	7.5%	0.07 [-0.31 , 0.45]
Deligiannis 1999a	1.94	0.42	12	2.07	0.36	10	9.6%	-0.13 [-0.46 , 0.20]
Paluchamy 2018	1.6855	0.4799	10	1.4853	0.143	10	10.4%	0.20 [-0.11 , 0.51]
Kouidi 1997	1.97	0.23	11	2.03	0.55	20	12.2%	-0.06 [-0.34 , 0.22]
Wilund 2010	2.1	0.25	9	1.91	0.16	8	18.5%	0.19 [-0.01 , 0.39]
Momeni 2014	1.69	0.27	20	1.78	0.03	20	28.1%	-0.09 [-0.21 , 0.03]
Total (95% CI)			**106**			**108**	**100.0%**	**0.05 [-0.07 , 0.17]**

Heterogeneity: Tau² = 0.01; Chi² = 11.61, df = 8 (P = 0.17); I² = 31%
Test for overall effect: Z = 0.83 (P = 0.41)
Test for subgroup differences: Not applicable

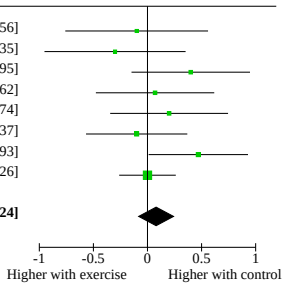


Footnotes
(1) Mean and standard deviation estimated from the median and the interquartile range

Analysis 2.25. Comparison 2: Aerobic exercise versus control (no exercise/placebo exercise), Outcome 25: Potassium

Study or Subgroup	Control Mean [mmol/L]	Control SD [mmol/L]	Control Total	Exercise Mean [mmol/L]	Exercise SD [mmol/L]	Exercise Total	Weight	Mean Difference IV, Random, 95% CI [mmol/L]
Deligiannis 1999a	5.4	0.4	12	5.5	1	10	5.9%	-0.10 [-0.76 , 0.56]
AVANTE-HEMO 2020	5.2	0.92	13	5.5	0.74	12	6.1%	-0.30 [-0.95 , 0.35]
Parsons 2004	4.8	0.6	7	4.4	0.4	6	8.6%	0.40 [-0.15 , 0.95]
Momeni 2014	5.47	0.95	20	5.4	0.81	20	8.7%	0.07 [-0.48 , 0.62]
de Lima 2013	5.8	0.6	11	5.6	0.7	11	8.7%	0.20 [-0.34 , 0.74]
Kouidi 1997	5.5	0.7	11	5.6	0.5	20	11.8%	-0.10 [-0.57 , 0.37]
Paluchamy 2018	5.65	0.5692	10	5.18	0.4743	10	12.3%	0.47 [0.01 , 0.93]
Wilund 2010	4.9	0.3	9	4.9	0.25	8	37.9%	0.00 [-0.26 , 0.26]
Total (95% CI)			**93**			**97**	**100.0%**	**0.08 [-0.08 , 0.24]**

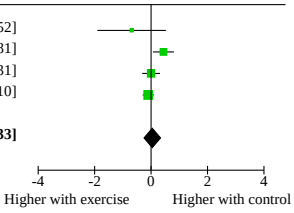
Heterogeneity: Tau² = 0.00; Chi² = 6.79, df = 7 (P = 0.45); I² = 0%
Test for overall effect: Z = 0.97 (P = 0.33)
Test for subgroup differences: Not applicable



Analysis 2.26. Comparison 2: Aerobic exercise versus control (no exercise/placebo exercise), Outcome 26: Protein intake

Study or Subgroup	Control Mean [g/kg/d]	Control SD [g/kg/d]	Control Total	Exercise Mean [g/kg/d]	Exercise SD [g/kg/d]	Exercise Total	Weight	Mean Difference IV, Random, 95% CI [g/kg/d]
Frey 1999	1.91	0.34	6	2.6	1.35	5	5.1%	-0.69 [-1.90 , 0.52]
Kopple 2007	1.35	0.5987	14	0.91	0.32	10	26.5%	0.44 [0.07 , 0.81]
ACTINUT 2013	1.17	0.38	9	1.17	0.26	7	30.1%	0.00 [-0.31 , 0.31]
IHOPE 2019	0.9	0.33	38	1	0.46	29	38.2%	-0.10 [-0.30 , 0.10]
Total (95% CI)			**67**			**51**	**100.0%**	**0.04 [-0.25 , 0.33]**

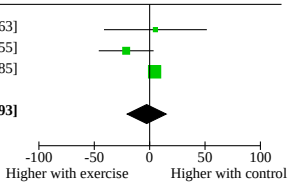
Heterogeneity: Tau² = 0.05; Chi² = 7.62, df = 3 (P = 0.05); I² = 61%
Test for overall effect: Z = 0.29 (P = 0.77)
Test for subgroup differences: Not applicable



Analysis 2.27. Comparison 2: Aerobic exercise versus control (no exercise/placebo exercise), Outcome 27: Parathyroid hormone

Study or Subgroup	Control Mean [pmol/L]	Control SD [pmol/L]	Control Total	Exercise Mean [pmol/L]	Exercise SD [pmol/L]	Exercise Total	Weight	Mean Difference IV, Random, 95% CI [pmol/L]
Toussaint 2008	42.7	57.2	10	37.5	45.9	9	11.7%	5.20 [-41.23 , 51.63]
Koufaki 2002	13.6	15.8	15	34.8	50.7	18	28.2%	-21.20 [-45.95 , 3.55]
Liao 2016	30.2	9.42	20	25.74	7.92	20	60.0%	4.46 [-0.93 , 9.85]
Total (95% CI)			**45**			**47**	**100.0%**	**-2.69 [-20.31 , 14.93]**

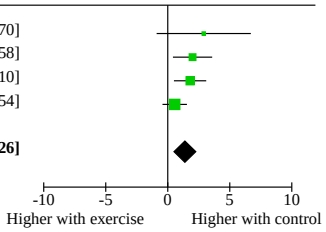
Heterogeneity: Tau² = 127.03; Chi² = 3.95, df = 2 (P = 0.14); I² = 49%
Test for overall effect: Z = 0.30 (P = 0.76)
Test for subgroup differences: Not applicable



Analysis 2.28. Comparison 2: Aerobic exercise versus control (no exercise/placebo exercise), Outcome 28: Timed up-and-go test

Study or Subgroup	Control Mean [sec]	Control SD [sec]	Control Total	Exercise Mean [sec]	Exercise SD [sec]	Exercise Total	Weight	Mean Difference IV, Random, 95% CI [sec]
Wu 2014d	30.2	8.3	33	27.3	7.3	32	5.0%	2.90 [-0.90 , 6.70]
Samara 2016	6.6	2.5	12	4.6	1.4	15	22.9%	2.00 [0.42 , 3.58]
IHOPE 2019	8	3.6	38	6.2	1.7	29	30.1%	1.80 [0.50 , 3.10]
Koh 2009 (1)	6.1	1.5	16	5.54	1.8	29	42.0%	0.56 [-0.42 , 1.54]
Total (95% CI)			**99**			**105**	**100.0%**	**1.38 [0.50 , 2.26]**

Heterogeneity: Tau² = 0.23; Chi² = 4.16, df = 3 (P = 0.24); I² = 28%
Test for overall effect: Z = 3.08 (P = 0.002)
Test for subgroup differences: Not applicable



Footnotes
(1) two intervention arms polled together in the exercise group

Comparison 3. Resistance exercise versus control (no exercise/placebo exercise)

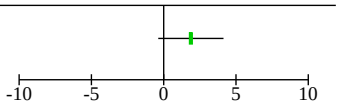
Outcome or subgroup title	No. of studies	No. of participants	Statistical method	Effect size
3.1 Fatigue	1		Mean Difference (IV, Random, 95% CI)	Totals not selected
3.2 HRQoL: Summary component scores	5		Mean Difference (IV, Random, 95% CI)	Subtotals only
3.2.1 Physical Component Score	5	176	Mean Difference (IV, Random, 95% CI)	-2.52 [-6.32, 1.29]
3.2.2 Mental Component Score	5	176	Mean Difference (IV, Random, 95% CI)	0.68 [-4.57, 5.94]
3.3 HR-QoL: Individual domains	7		Mean Difference (IV, Random, 95% CI)	Subtotals only
3.3.1 Physical functioning	6	243	Mean Difference (IV, Random, 95% CI)	-5.28 [-10.09, -0.46]
3.3.2 Role-physical	3	102	Mean Difference (IV, Random, 95% CI)	-8.13 [-21.33, 5.07]
3.3.3 Pain	5	154	Mean Difference (IV, Random, 95% CI)	-10.74 [-27.96, 6.47]
3.3.4 General health perceptions	4	126	Mean Difference (IV, Random, 95% CI)	-0.05 [-6.43, 6.33]

Outcome or subgroup title	No. of studies	No. of participants	Statistical method	Effect size
3.3.5 Emotional well-being	4	126	Mean Difference (IV, Random, 95% CI)	-7.22 [-13.98, -0.46]
3.3.6 Role-emotional	4	126	Mean Difference (IV, Random, 95% CI)	-4.25 [-14.62, 6.12]
3.3.7 Vitality	5	179	Mean Difference (IV, Random, 95% CI)	-5.17 [-15.18, 4.85]
3.3.8 Social function	4	126	Mean Difference (IV, Random, 95% CI)	-9.28 [-17.08, -1.47]
3.3.9 Symptoms	3	86	Mean Difference (IV, Random, 95% CI)	-9.25 [-15.19, -3.30]
3.3.10 Effects of kidney disease	2	58	Mean Difference (IV, Random, 95% CI)	-4.87 [-16.82, 7.08]
3.3.11 Burden of kidney disease	2	58	Mean Difference (IV, Random, 95% CI)	3.35 [-9.05, 15.75]
3.3.12 Work status	2	58	Mean Difference (IV, Random, 95% CI)	4.30 [-14.99, 23.59]
3.3.13 Cognitive function	2	58	Mean Difference (IV, Random, 95% CI)	6.31 [-6.73, 19.36]
3.3.14 Quality of social interactions	2	58	Mean Difference (IV, Random, 95% CI)	8.30 [-3.74, 20.34]
3.3.15 Sexual function	2	58	Mean Difference (IV, Random, 95% CI)	-14.16 [-35.63, 7.31]
3.3.16 Sleep	3	86	Mean Difference (IV, Random, 95% CI)	-10.70 [-20.99, -0.40]
3.3.17 Social support	2	58	Mean Difference (IV, Random, 95% CI)	-4.41 [-13.92, 5.09]
3.3.18 Dialysis staff encouragement	2	58	Mean Difference (IV, Random, 95% CI)	-1.10 [-8.72, 6.52]
3.3.19 Patient satisfaction	2	58	Mean Difference (IV, Random, 95% CI)	-1.07 [-10.75, 8.60]
3.4 Depression	2	99	Std. Mean Difference (IV, Random, 95% CI)	0.52 [0.12, 0.92]
3.5 6MWT	7	216	Mean Difference (IV, Random, 95% CI)	-44.71 [-62.43, -27.00]
3.6 Sit-To-Stand test [N reps/30 sec]	6	196	Mean Difference (IV, Random, 95% CI)	-2.76 [-3.83, -1.68]
3.7 Sit-To-Stand test [N reps/30 sec]	2	93	Mean Difference (IV, Random, 95% CI)	1.56 [-0.44, 3.57]
3.8 Albumin	9	268	Mean Difference (IV, Random, 95% CI)	-0.27 [-1.59, 1.05]
3.9 Blood lipids	3		Mean Difference (IV, Random, 95% CI)	Subtotals only
3.9.1 Total cholesterol [mmol/L]	3	76	Mean Difference (IV, Random, 95% CI)	0.26 [-0.07, 0.58]

Outcome or subgroup title	No. of studies	No. of participants	Statistical method	Effect size
3.9.2 LDL cholesterol [mmol/L]	2	54	Mean Difference (IV, Random, 95% CI)	0.12 [-0.17, 0.41]
3.9.3 HDL cholesterol [mmol/L]	2	54	Mean Difference (IV, Random, 95% CI)	0.02 [-0.16, 0.19]
3.9.4 Triglycerides [mmol/L]	2	54	Mean Difference (IV, Random, 95% CI)	0.54 [-0.00, 1.07]
3.10 Body composition	7		Mean Difference (IV, Random, 95% CI)	Subtotals only
3.10.1 Fat mass [kg]	7	291	Mean Difference (IV, Random, 95% CI)	-0.69 [-2.94, 1.56]
3.10.2 Lean mass [kg]	5	224	Mean Difference (IV, Random, 95% CI)	0.16 [-2.95, 3.28]
3.11 Body mass index	8	267	Mean Difference (IV, Random, 95% CI)	-1.00 [-1.98, -0.01]
3.12 Calcium	4	102	Mean Difference (IV, Random, 95% CI)	0.04 [-0.08, 0.16]
3.13 CRP	6	153	Mean Difference (IV, Random, 95% CI)	-0.22 [-0.58, 0.14]
3.14 Dialysis adequacy: Kt/V	2	73	Mean Difference (IV, Random, 95% CI)	-0.05 [-0.23, 0.12]
3.15 Energy intake	5	208	Mean Difference (IV, Random, 95% CI)	0.17 [-1.45, 1.80]
3.16 Haemoglobin	10	254	Mean Difference (IV, Random, 95% CI)	-0.11 [-0.29, 0.07]
3.17 Muscular strength	8		Mean Difference (IV, Random, 95% CI)	Subtotals only
3.17.1 knee extension	6	238	Mean Difference (IV, Random, 95% CI)	-6.09 [-10.68, -1.50]
3.17.2 handgrip	3	137	Mean Difference (IV, Random, 95% CI)	-2.01 [-5.71, 1.69]
3.18 Phosphate	7	188	Mean Difference (IV, Random, 95% CI)	-0.06 [-0.36, 0.24]
3.19 Potassium	7	188	Mean Difference (IV, Random, 95% CI)	0.32 [-0.23, 0.86]
3.20 Protein intake	5	208	Mean Difference (IV, Random, 95% CI)	-0.01 [-0.09, 0.07]
3.21 PTH	2	37	Mean Difference (IV, Random, 95% CI)	1.51 [-30.38, 33.39]
3.22 Timed up-and-go test	1		Mean Difference (IV, Random, 95% CI)	Totals not selected

Analysis 3.1. Comparison 3: Resistance exercise versus control (no exercise/placebo exercise), Outcome 1: Fatigue

Study or Subgroup	Control Mean	Control SD	Control Total	Exercise Mean	Exercise SD	Exercise Total	Mean Difference IV, Random, 95% CI
Johansen 2006 (1)	8.95	4.71	33	7.07	4.78	35	1.88 [-0.38 , 4.14]

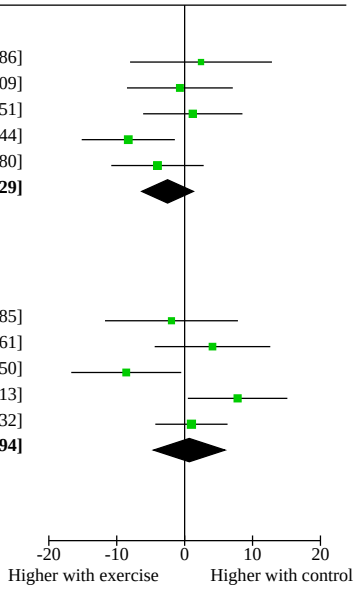


Footnotes

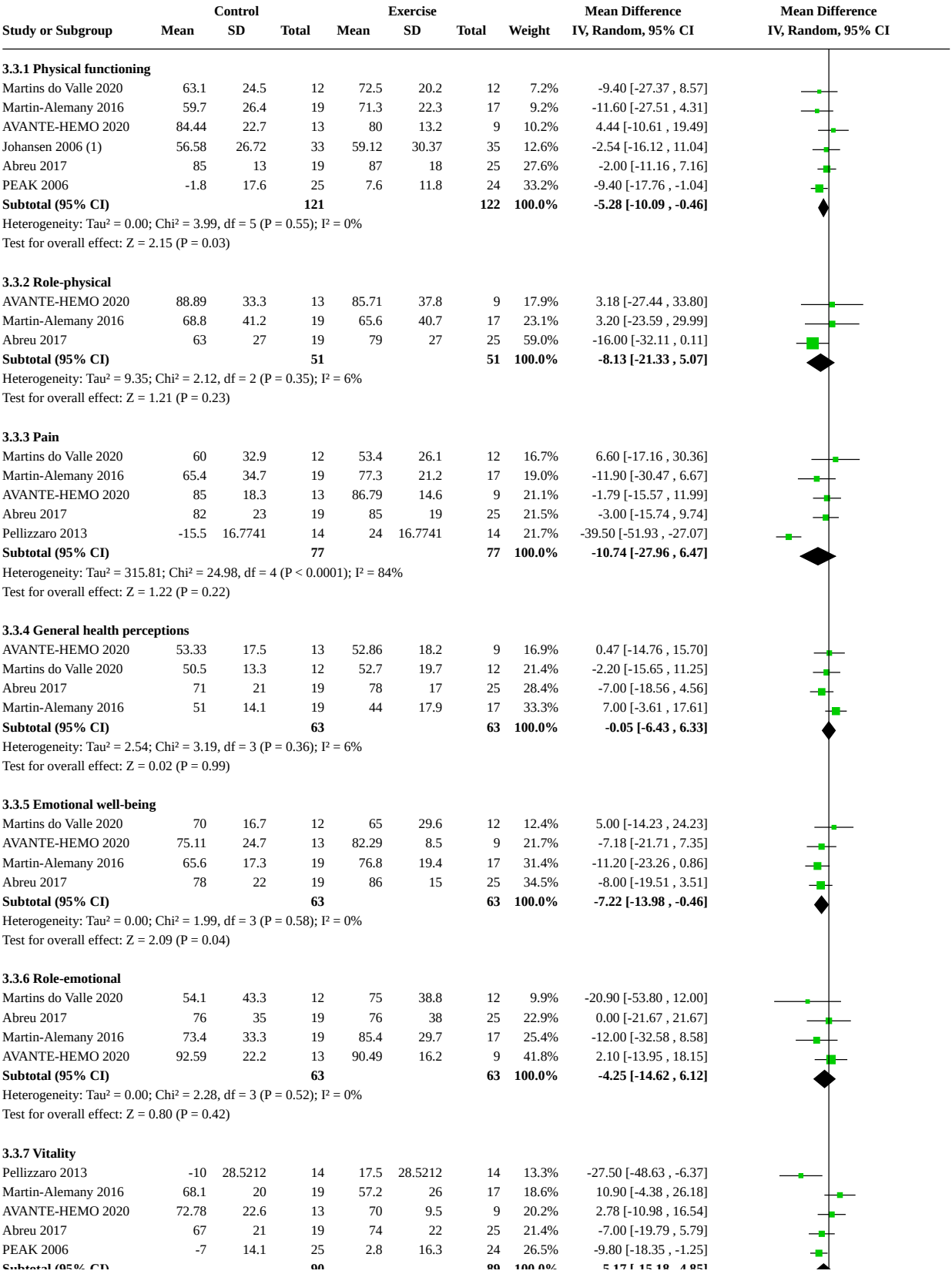
(1) Factorial design, two intervention arms pooled together in the exercise group and two control arms pooled together in the control group

Analysis 3.2. Comparison 3: Resistance exercise versus control (no exercise/placebo exercise), Outcome 2: HRQoL: Summary component scores

Study or Subgroup	Control Mean	Control SD	Control Total	Exercise Mean	Exercise SD	Exercise Total	Weight	Mean Difference IV, Random, 95% CI
3.2.1 Physical Component Score								
Rosa 2018	74.43	18.07	24	72.02	20.36	28	11.7%	2.41 [-8.04 , 12.86]
DIALY-SIZE 2016	3.4	7.3	8	4.1	8	7	19.3%	-0.70 [-8.49 , 7.09]
Segura-Orti 2009	45.9	8.7	8	44.7	8.7	17	21.4%	1.20 [-6.11 , 8.51]
Song 2012a	64.2	12.2	20	72.5	9.8	20	23.6%	-8.30 [-15.16 , -1.44]
Chen 2010	50	11	22	54	12	22	23.9%	-4.00 [-10.80 , 2.80]
Subtotal (95% CI)			**82**			**94**	**100.0%**	**-2.52 [-6.32 , 1.29]**
Heterogeneity: Tau² = 3.66; Chi² = 4.97, df = 4 (P = 0.29); I² = 19%								
Test for overall effect: Z = 1.30 (P = 0.19)								
3.2.2 Mental Component Score								
Rosa 2018	76.08	19.15	24	78.02	16.44	28	15.8%	-1.94 [-11.73 , 7.85]
DIALY-SIZE 2016	0.7	7.5	8	-3.4	9.1	7	18.3%	4.10 [-4.41 , 12.61]
Song 2012a	60.8	12.4	20	69.4	13.7	20	19.2%	-8.60 [-16.70 , -0.50]
Segura-Orti 2009	54.3	5.1	8	46.5	13.5	17	20.9%	7.80 [0.47 , 15.13]
Chen 2010	38	9	22	37	9	22	25.8%	1.00 [-4.32 , 6.32]
Subtotal (95% CI)			**82**			**94**	**100.0%**	**0.68 [-4.57 , 5.94]**
Heterogeneity: Tau² = 20.48; Chi² = 9.56, df = 4 (P = 0.05); I² = 58%								
Test for overall effect: Z = 0.25 (P = 0.80)								



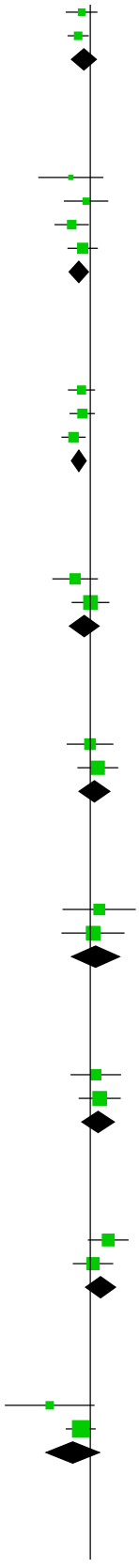
Analysis 3.3. Comparison 3: Resistance exercise versus control (no exercise/placebo exercise), Outcome 3: HR-QoL: Individual domains



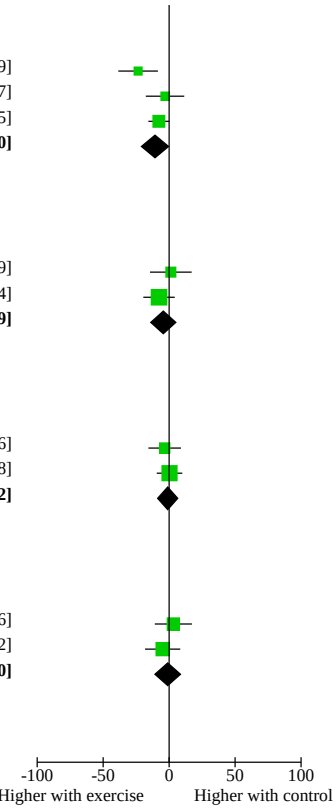
Study or Subgroup	Control Mean	Control SD	Control Total	Exercise Mean	Exercise SD	Exercise Total	Weight	Mean Difference IV, Random, 95% CI
3.3.1 Physical functioning								
Martins do Valle 2020	63.1	24.5	12	72.5	20.2	12	7.2%	-9.40 [-27.37 , 8.57]
Martin-Alemany 2016	59.7	26.4	19	71.3	22.3	17	9.2%	-11.60 [-27.51 , 4.31]
AVANTE-HEMO 2020	84.44	22.7	13	80	13.2	9	10.2%	4.44 [-10.61 , 19.49]
Johansen 2006 (1)	56.58	26.72	33	59.12	30.37	35	12.6%	-2.54 [-16.12 , 11.04]
Abreu 2017	85	13	19	87	18	25	27.6%	-2.00 [-11.16 , 7.16]
PEAK 2006	-1.8	17.6	25	7.6	11.8	24	33.2%	-9.40 [-17.76 , -1.04]
Subtotal (95% CI)			**121**			**122**	**100.0%**	**-5.28 [-10.09 , -0.46]**
Heterogeneity: Tau² = 0.00; Chi² = 3.99, df = 5 (P = 0.55); I² = 0%								
Test for overall effect: Z = 2.15 (P = 0.03)								
3.3.2 Role-physical								
AVANTE-HEMO 2020	88.89	33.3	13	85.71	37.8	9	17.9%	3.18 [-27.44 , 33.80]
Martin-Alemany 2016	68.8	41.2	19	65.6	40.7	17	23.1%	3.20 [-23.59 , 29.99]
Abreu 2017	63	27	19	79	27	25	59.0%	-16.00 [-32.11 , 0.11]
Subtotal (95% CI)			**51**			**51**	**100.0%**	**-8.13 [-21.33 , 5.07]**
Heterogeneity: Tau² = 9.35; Chi² = 2.12, df = 2 (P = 0.35); I² = 6%								
Test for overall effect: Z = 1.21 (P = 0.23)								
3.3.3 Pain								
Martins do Valle 2020	60	32.9	12	53.4	26.1	12	16.7%	6.60 [-17.16 , 30.36]
Martin-Alemany 2016	65.4	34.7	19	77.3	21.2	17	19.0%	-11.90 [-30.47 , 6.67]
AVANTE-HEMO 2020	85	18.3	13	86.79	14.6	9	21.1%	-1.79 [-15.57 , 11.99]
Abreu 2017	82	23	19	85	19	25	21.5%	-3.00 [-15.74 , 9.74]
Pellizzaro 2013	-15.5	16.7741	14	24	16.7741	14	21.7%	-39.50 [-51.93 , -27.07]
Subtotal (95% CI)			**77**			**77**	**100.0%**	**-10.74 [-27.96 , 6.47]**
Heterogeneity: Tau² = 315.81; Chi² = 24.98, df = 4 (P < 0.0001); I² = 84%								
Test for overall effect: Z = 1.22 (P = 0.22)								
3.3.4 General health perceptions								
AVANTE-HEMO 2020	53.33	17.5	13	52.86	18.2	9	16.9%	0.47 [-14.76 , 15.70]
Martins do Valle 2020	50.5	13.3	12	52.7	19.7	12	21.4%	-2.20 [-15.65 , 11.25]
Abreu 2017	71	21	19	78	17	25	28.4%	-7.00 [-18.56 , 4.56]
Martin-Alemany 2016	51	14.1	19	44	17.9	17	33.3%	7.00 [-3.61 , 17.61]
Subtotal (95% CI)			**63**			**63**	**100.0%**	**-0.05 [-6.43 , 6.33]**
Heterogeneity: Tau² = 2.54; Chi² = 3.19, df = 3 (P = 0.36); I² = 6%								
Test for overall effect: Z = 0.02 (P = 0.99)								
3.3.5 Emotional well-being								
Martins do Valle 2020	70	16.7	12	65	29.6	12	12.4%	5.00 [-14.23 , 24.23]
AVANTE-HEMO 2020	75.11	24.7	13	82.29	8.5	9	21.7%	-7.18 [-21.71 , 7.35]
Martin-Alemany 2016	65.6	17.3	19	76.8	19.4	17	31.4%	-11.20 [-23.26 , 0.86]
Abreu 2017	78	22	19	86	15	25	34.5%	-8.00 [-19.51 , 3.51]
Subtotal (95% CI)			**63**			**63**	**100.0%**	**-7.22 [-13.98 , -0.46]**
Heterogeneity: Tau² = 0.00; Chi² = 1.99, df = 3 (P = 0.58); I² = 0%								
Test for overall effect: Z = 2.09 (P = 0.04)								
3.3.6 Role-emotional								
Martins do Valle 2020	54.1	43.3	12	75	38.8	12	9.9%	-20.90 [-53.80 , 12.00]
Abreu 2017	76	35	19	76	38	25	22.9%	0.00 [-21.67 , 21.67]
Martin-Alemany 2016	73.4	33.3	19	85.4	29.7	17	25.4%	-12.00 [-32.58 , 8.58]
AVANTE-HEMO 2020	92.59	22.2	13	90.49	16.2	9	41.8%	2.10 [-13.95 , 18.15]
Subtotal (95% CI)			**63**			**63**	**100.0%**	**-4.25 [-14.62 , 6.12]**
Heterogeneity: Tau² = 0.00; Chi² = 2.28, df = 3 (P = 0.52); I² = 0%								
Test for overall effect: Z = 0.80 (P = 0.42)								
3.3.7 Vitality								
Pellizzaro 2013	-10	28.5212	14	17.5	28.5212	14	13.3%	-27.50 [-48.63 , -6.37]
Martin-Alemany 2016	68.1	20	19	57.2	26	17	18.6%	10.90 [-4.38 , 26.18]
AVANTE-HEMO 2020	72.78	22.6	13	70	9.5	9	20.2%	2.78 [-10.98 , 16.54]
Abreu 2017	67	21	19	74	22	25	21.4%	-7.00 [-19.79 , 5.79]
PEAK 2006	-7	14.1	25	2.8	16.3	24	26.5%	-9.80 [-18.35 , -1.25]
Subtotal (95% CI)			**90**			**89**	**100.0%**	**-5.17 [-15.18 , 4.85]**

Analysis 3.3. (Continued)

Abreu 2017	67	21	19	74	22	25	21.4%	-7.00 [-19.79 , 5.79]
PEAK 2006	-7	14.1	25	2.8	16.3	24	26.5%	-9.80 [-18.35 , -1.25]
Subtotal (95% CI)			**90**			**89**	**100.0%**	**-5.17 [-15.18 , 4.85]**
Heterogeneity: Tau² = 79.69; Chi² = 11.00, df = 4 (P = 0.03); I² = 64%								
Test for overall effect: Z = 1.01 (P = 0.31)								
3.3.8 Social function								
Martins do Valle 2020	64	35.6	12	79.7	29.8	12	8.8%	-15.70 [-41.97 , 10.57]
Martin-Alemany 2016	76.4	25.5	19	79.8	29	17	18.9%	-3.40 [-21.33 , 14.53]
Abreu 2017	76	26	19	91	19	25	31.7%	-15.00 [-28.86 , -1.14]
AVANTE-HEMO 2020	90.28	19.5	13	96.43	9.4	9	40.6%	-6.15 [-18.40 , 6.10]
Subtotal (95% CI)			**63**			**63**	**100.0%**	**-9.28 [-17.08 , -1.47]**
Heterogeneity: Tau² = 0.00; Chi² = 1.55, df = 3 (P = 0.67); I² = 0%								
Test for overall effect: Z = 2.33 (P = 0.02)								
3.3.9 Symptoms								
AVANTE-HEMO 2020	76.87	13.4	13	83.94	12.5	9	29.5%	-7.07 [-18.01 , 3.87]
Martin-Alemany 2016	70.1	16.6	19	76.6	14.8	17	33.6%	-6.50 [-16.76 , 3.76]
Pellizzaro 2013	0	13.2288	14	13.5	13.2288	14	36.8%	-13.50 [-23.30 , -3.70]
Subtotal (95% CI)			**46**			**40**	**100.0%**	**-9.25 [-15.19 , -3.30]**
Heterogeneity: Tau² = 0.00; Chi² = 1.15, df = 2 (P = 0.56); I² = 0%								
Test for overall effect: Z = 3.05 (P = 0.002)								
3.3.10 Effects of kidney disease								
AVANTE-HEMO 2020	64.59	18.1	13	76.79	23.8	9	40.9%	-12.20 [-30.60 , 6.20]
Martin-Alemany 2016	70.2	21.1	19	70	25	17	59.1%	0.20 [-15.01 , 15.41]
Subtotal (95% CI)			**32**			**26**	**100.0%**	**-4.87 [-16.82 , 7.08]**
Heterogeneity: Tau² = 2.71; Chi² = 1.04, df = 1 (P = 0.31); I² = 4%								
Test for overall effect: Z = 0.80 (P = 0.42)								
3.3.11 Burden of kidney disease								
Martin-Alemany 2016	44.3	26.4	19	44.5	30.8	17	43.3%	-0.20 [-19.05 , 18.65]
AVANTE-HEMO 2020	56.96	19.6	13	50.9	19.2	9	56.7%	6.06 [-10.40 , 22.52]
Subtotal (95% CI)			**32**			**26**	**100.0%**	**3.35 [-9.05 , 15.75]**
Heterogeneity: Tau² = 0.00; Chi² = 0.24, df = 1 (P = 0.62); I² = 0%								
Test for overall effect: Z = 0.53 (P = 0.60)								
3.3.12 Work status								
AVANTE-HEMO 2020	50	35.4	13	42.86	34.4	9	42.5%	7.14 [-22.45 , 36.73]
Martin-Alemany 2016	27.5	41.2	19	25.3	36.7	17	57.5%	2.20 [-23.25 , 27.65]
Subtotal (95% CI)			**32**			**26**	**100.0%**	**4.30 [-14.99 , 23.59]**
Heterogeneity: Tau² = 0.00; Chi² = 0.06, df = 1 (P = 0.80); I² = 0%								
Test for overall effect: Z = 0.44 (P = 0.66)								
3.3.13 Cognitive function								
AVANTE-HEMO 2020	24.46	27.3	13	20	21.4	9	41.0%	4.46 [-15.93 , 24.85]
Martin-Alemany 2016	33	20.5	19	25.4	30	17	59.0%	7.60 [-9.38 , 24.58]
Subtotal (95% CI)			**32**			**26**	**100.0%**	**6.31 [-6.73 , 19.36]**
Heterogeneity: Tau² = 0.00; Chi² = 0.05, df = 1 (P = 0.82); I² = 0%								
Test for overall effect: Z = 0.95 (P = 0.34)								
3.3.14 Quality of social interactions								
AVANTE-HEMO 2020	25.92	25.3	13	11.43	13.8	9	49.6%	14.49 [-1.95 , 30.93]
Martin-Alemany 2016	33	22	19	30.8	27.3	17	50.4%	2.20 [-14.12 , 18.52]
Subtotal (95% CI)			**32**			**26**	**100.0%**	**8.30 [-3.74 , 20.34]**
Heterogeneity: Tau² = 5.67; Chi² = 1.08, df = 1 (P = 0.30); I² = 8%								
Test for overall effect: Z = 1.35 (P = 0.18)								
3.3.15 Sexual function								
AVANTE-HEMO 2020	8.33	25	13	41.07	51.4	9	25.8%	-32.74 [-68.97 , 3.49]
Martin-Alemany 2016	88.3	23.3	19	96	12.7	17	74.2%	-7.70 [-19.79 , 4.39]
Subtotal (95% CI)			**32**			**26**	**100.0%**	**-14.16 [-35.63 , 7.31]**
Heterogeneity: Tau² = 123.66; Chi² = 1.65, df = 1 (P = 0.20); I² = 39%								
Test for overall effect: Z = 1.29 (P = 0.20)								
3.3.16 Sleep								



Analysis 3.3. (Continued)

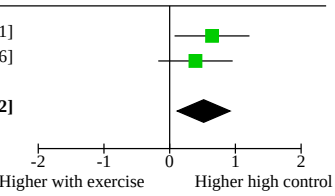


3.3.16 Sleep								
Pellizzaro 2013	-15	20.2665	14	8.5	20.2665	14	26.8%	-23.50 [-38.51 , -8.49]
Martin-Alemany 2016	63.9	25	19	67	19.5	17	27.7%	-3.10 [-17.67 , 11.47]
AVANTE-HEMO 2020	69.72	6.9	13	77.5	10.7	9	45.5%	-7.78 [-15.71 , 0.15]
Subtotal (95% CI)			**46**			**40**	**100.0%**	**-10.70 [-20.99 , -0.40]**
Heterogeneity: Tau² = 44.28; Chi² = 4.26, df = 2 (P = 0.12); I² = 53%								
Test for overall effect: Z = 2.04 (P = 0.04)								
3.3.17 Social support								
Martin-Alemany 2016	70	21.3	19	68.7	26.4	17	36.2%	1.30 [-14.49 , 17.09]
AVANTE-HEMO 2020	68.53	10	13	76.19	16.2	9	63.8%	-7.66 [-19.56 , 4.24]
Subtotal (95% CI)			**32**			**26**	**100.0%**	**-4.41 [-13.92 , 5.09]**
Heterogeneity: Tau² = 0.00; Chi² = 0.79, df = 1 (P = 0.37); I² = 0%								
Test for overall effect: Z = 0.91 (P = 0.36)								
3.3.18 Dialysis staff encouragement								
AVANTE-HEMO 2020	80.56	12.6	13	83.93	15.7	9	38.1%	-3.37 [-15.70 , 8.96]
Martin-Alemany 2016	80	17.4	19	79.7	12	17	61.9%	0.30 [-9.38 , 9.98]
Subtotal (95% CI)			**32**			**26**	**100.0%**	**-1.10 [-8.72 , 6.52]**
Heterogeneity: Tau² = 0.00; Chi² = 0.21, df = 1 (P = 0.65); I² = 0%								
Test for overall effect: Z = 0.28 (P = 0.78)								
3.3.19 Patient satisfaction								
Martin-Alemany 2016	66.7	21.7	19	63.5	21.3	17	47.4%	3.20 [-10.86 , 17.26]
AVANTE-HEMO 2020	52.22	13.4	13	57.14	17.1	9	52.6%	-4.92 [-18.26 , 8.42]
Subtotal (95% CI)			**32**			**26**	**100.0%**	**-1.07 [-10.75 , 8.60]**
Heterogeneity: Tau² = 0.00; Chi² = 0.67, df = 1 (P = 0.41); I² = 0%								
Test for overall effect: Z = 0.22 (P = 0.83)								

Footnotes

(1) Factorial design, two intervention arms pooled together in the exercise group and two control arms pooled together in the control group

Analysis 3.4. Comparison 3: Resistance exercise versus control (no exercise/placebo exercise), Outcome 4: Depression

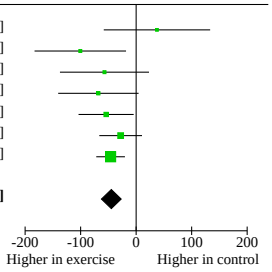


	Control			Exercise				Std. Mean Difference	Std. Mean Difference
Study or Subgroup	**Mean**	**SD**	**Total**	**Mean**	**SD**	**Total**	**Weight**	**IV, Random, 95% CI**	**IV, Random, 95% CI**
Rahimimoghadam 2017	10.4	2.4	25	8.6	3.06	25	49.7%	0.64 [0.07 , 1.21]	
PEAK 2006	1	2.9	25	-0.3	3.6	24	50.3%	0.39 [-0.17 , 0.96]	
Total (95% CI)			**50**			**49**	**100.0%**	**0.52 [0.12 , 0.92]**	
Heterogeneity: Tau² = 0.00; Chi² = 0.38, df = 1 (P = 0.54); I² = 0%									
Test for overall effect: Z = 2.53 (P = 0.01)									
Test for subgroup differences: Not applicable									

Analysis 3.5. Comparison 3: Resistance exercise versus control (no exercise/placebo exercise), Outcome 5: 6MWT

Study or Subgroup	Control Mean [metres]	Control SD [metres]	Control Total	Exercise Mean [metres]	Exercise SD [metres]	Exercise Total	Weight	Mean Difference IV, Random, 95% CI [metres]
Martins do Valle 2020	494.8	66.9	12	457.3	155.6	12	3.4%	37.50 [-58.33 , 133.33]
PEAK 2006	414.3	127.3	25	514.9	163.9	24	4.6%	-100.60 [-183.00 , -18.20]
Rosa 2018	469.42	162.93	24	526.45	126.15	28	4.9%	-57.03 [-137.23 , 23.17]
Pellizzaro 2013	407	116.7	14	475	74.1	14	6.0%	-68.00 [-140.41 , 4.41]
DIALY-SIZE 2016	0.8	44	8	54.9	52.9	7	12.7%	-54.10 [-103.75 , -4.45]
Segura-Orti 2009	20.6	36.6	8	48.5	60.8	17	21.2%	-27.90 [-66.35 , 10.55]
Cho 2018	-26	41	13	20	21	10	47.1%	-46.00 [-71.81 , -20.19]
Total (95% CI)			**104**			**112**	**100.0%**	**-44.71 [-62.43 , -27.00]**

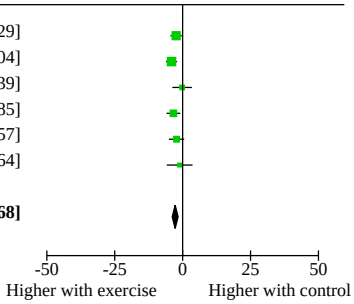
Heterogeneity: Tau² = 0.00; Chi² = 5.96, df = 6 (P = 0.43); I² = 0%
Test for overall effect: Z = 4.95 (P < 0.00001)
Test for subgroup differences: Not applicable



Analysis 3.6. Comparison 3: Resistance exercise versus control (no exercise/placebo exercise), Outcome 6: Sit-To-Stand test [N reps/30 sec]

Study or Subgroup	Control Mean	Control SD	Control Total	Exercise Mean	Exercise SD	Exercise Total	Weight	Mean Difference IV, Random, 95% CI
Bennett 2013 (1)	7.8	3.1177	12	10.2	3.17	29	26.0%	-2.40 [-4.51 , -0.29]
Cho 2018	-0.5	2.2	13	3.6	2.7	10	27.3%	-4.10 [-6.16 , -2.04]
DIALY-SIZE 2016	1.4	4.3	8	1.6	2.7	7	9.0%	-0.20 [-3.79 , 3.39]
Rosa 2018	11.79	2.93	24	15.18	6.07	28	18.0%	-3.39 [-5.93 , -0.85]
Segura-Orti 2009	0.3	3.55	8	2.55	2.9	17	14.5%	-2.25 [-5.07 , 0.57]
Song 2012a	7.1	7.6	20	8.2	7.7	20	5.1%	-1.10 [-5.84 , 3.64]
Total (95% CI)			**85**			**111**	**100.0%**	**-2.76 [-3.83 , -1.68]**

Heterogeneity: Tau² = 0.00; Chi² = 4.53, df = 5 (P = 0.48); I² = 0%
Test for overall effect: Z = 5.02 (P < 0.00001)
Test for subgroup differences: Not applicable



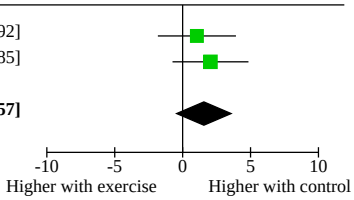
Footnotes

(1) results from group 1 (24 weeks of intervention) and group 2 (12 weeks of intervention) were pooled together in the exercise group. The number of participants was correcte

Analysis 3.7. Comparison 3: Resistance exercise versus control (no exercise/placebo exercise), Outcome 7: Sit-To-Stand test [N reps/30 sec]

Study or Subgroup	Control Mean	Control SD	Control Total	Exercise Mean	Exercise SD	Exercise Total	Weight	Mean Difference IV, Random, 95% CI
Johansen 2006 (1)	15.1	5.41	33	14.05	6.65	35	48.6%	1.05 [-1.82 , 3.92]
Segura-Orti 2009	-0.65	1.75	8	-2.7	5.3	17	51.4%	2.05 [-0.75 , 4.85]
Total (95% CI)			**41**			**52**	**100.0%**	**1.56 [-0.44 , 3.57]**

Heterogeneity: Tau² = 0.00; Chi² = 0.24, df = 1 (P = 0.62); I² = 0%
Test for overall effect: Z = 1.53 (P = 0.13)
Test for subgroup differences: Not applicable



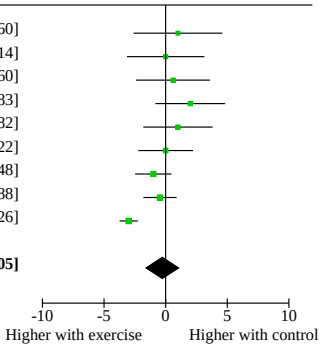
Footnotes

(1) Factorial design, two intervention arms pooled together in the exercise group and two control arms pooled together in the control group

Analysis 3.8. Comparison 3: Resistance exercise versus control (no exercise/placebo exercise), Outcome 8: Albumin

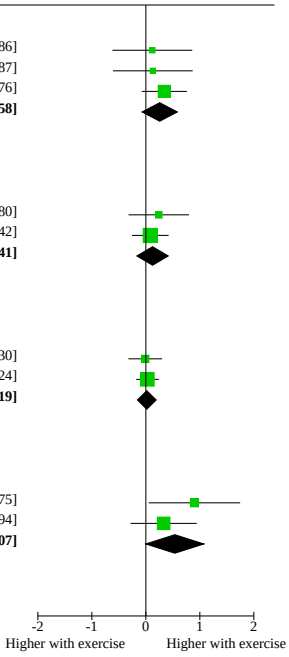
Study or Subgroup	Control Mean [g/L]	Control SD [g/L]	Control Total	Exercise Mean [g/L]	Exercise SD [g/L]	Exercise Total	Weight	Mean Difference IV, Random, 95% CI [g/L]
AVANTE-HEMO 2020	39	4	13	38	4.4	9	7.5%	1.00 [-2.60 , 4.60]
Afshar 2010	40	3	7	40	3	7	8.6%	0.00 [-3.14 , 3.14]
Dong 2011	42.1	2.2	12	41.5	4.4	10	9.0%	0.60 [-2.40 , 3.60]
Martins do Valle 2020	39	3	12	37	4	12	9.5%	2.00 [-0.83 , 4.83]
Kopple 2007	39	3.7417	14	38	4	15	9.6%	1.00 [-1.82 , 3.82]
Martin-Alemany 2016	37	3.5	19	37	3.3	17	11.4%	0.00 [-2.22 , 2.22]
Abreu 2017	42	2	19	43	3	25	13.9%	-1.00 [-2.48 , 0.48]
PEAK 2006	-0.16	2.4	25	0.3	2.4	24	14.4%	-0.46 [-1.80 , 0.88]
Pellizzaro 2013	-2	1	14	1	1	14	16.0%	-3.00 [-3.74 , -2.26]
Total (95% CI)			**135**			**133**	**100.0%**	**-0.27 [-1.59 , 1.05]**

Heterogeneity: Tau² = 2.70; Chi² = 33.66, df = 8 (P < 0.0001); I² = 76%
Test for overall effect: Z = 0.40 (P = 0.69)
Test for subgroup differences: Not applicable



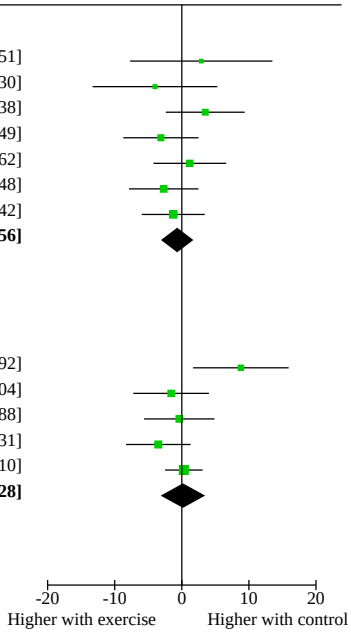
Analysis 3.9. Comparison 3: Resistance exercise versus control (no exercise/placebo exercise), Outcome 9: Blood lipids

Study or Subgroup	Control Mean [mmol/L]	Control SD [mmol/L]	Control Total	Exercise Mean [mmol/L]	Exercise SD [mmol/L]	Exercise Total	Weight	Mean Difference IV, Random, 95% CI [mmol/L]
3.9.1 Total cholesterol [mmol/L]								
Afshar 2010	3.4	0.812	7	3.28	0.58	7	19.5%	0.12 [-0.62 , 0.86]
Dong 2011	4.49	1.1	12	4.36	0.64	10	19.5%	0.13 [-0.61 , 0.87]
Song 2012a	4.192	0.67	20	3.85	0.678	20	61.0%	0.34 [-0.08 , 0.76]
Subtotal (95% CI)			**39**			**37**	**100.0%**	**0.26 [-0.07 , 0.58]**
Heterogeneity: Tau² = 0.00; Chi² = 0.40, df = 2 (P = 0.82); I² = 0%								
Test for overall effect: Z = 1.55 (P = 0.12)								
3.9.2 LDL cholesterol [mmol/L]								
Afshar 2010	1.56	0.33	7	1.32	0.68	7	26.9%	0.24 [-0.32 , 0.80]
Song 2012a	2.102	0.55	20	2.02	0.54564	20	73.1%	0.08 [-0.26 , 0.42]
Subtotal (95% CI)			**27**			**27**	**100.0%**	**0.12 [-0.17 , 0.41]**
Heterogeneity: Tau² = 0.00; Chi² = 0.22, df = 1 (P = 0.64); I² = 0%								
Test for overall effect: Z = 0.84 (P = 0.40)								
3.9.3 HDL cholesterol [mmol/L]								
Afshar 2010	0.82	0.332	7	0.83	0.26	7	30.9%	-0.01 [-0.32 , 0.30]
Song 2012a	1.1	0.4	20	1.07	0.26	20	69.1%	0.03 [-0.18 , 0.24]
Subtotal (95% CI)			**27**			**27**	**100.0%**	**0.02 [-0.16 , 0.19]**
Heterogeneity: Tau² = 0.00; Chi² = 0.04, df = 1 (P = 0.83); I² = 0%								
Test for overall effect: Z = 0.20 (P = 0.84)								
3.9.4 Triglycerides [mmol/L]								
Afshar 2010	2.55	0.903	7	1.65	0.7	7	36.3%	0.90 [0.05 , 1.75]
Song 2012a	1.6699	1.2	20	1.34	0.71469	20	63.7%	0.33 [-0.28 , 0.94]
Subtotal (95% CI)			**27**			**27**	**100.0%**	**0.54 [-0.00 , 1.07]**
Heterogeneity: Tau² = 0.02; Chi² = 1.14, df = 1 (P = 0.28); I² = 13%								
Test for overall effect: Z = 1.96 (P = 0.05)								



Analysis 3.10. Comparison 3: Resistance exercise versus control (no exercise/placebo exercise), Outcome 10: Body composition

Study or Subgroup	Control Mean	Control SD	Control Total	Exercise Mean	Exercise SD	Exercise Total	Weight	Mean Difference IV, Random, 95% CI
3.10.1 Fat mass [kg]								
Dong 2011	27.6	14.8	12	24.7	10.5	10	4.5%	2.90 [-7.71 , 13.51]
Kopple 2007	19.1	2.4	14	23.1	18.2	15	5.9%	-4.00 [-13.30 , 5.30]
Chen 2010	33.1	10.1	22	29.6	9.8	22	14.6%	3.50 [-2.38 , 9.38]
Johansen 2006 (1)	18.68	13.21	33	21.8	10.08	35	16.1%	-3.12 [-8.73 , 2.49]
Song 2012a	27.2	8.9	20	26	8.6	20	17.2%	1.20 [-4.22 , 6.62]
Martin-Alemany 2016	17.6	6.5	19	20.3	9	17	18.8%	-2.70 [-7.88 , 2.48]
Rosa 2018	21.92	8.81	24	23.2	8.4	28	22.9%	-1.28 [-5.98 , 3.42]
Subtotal (95% CI)			**144**			**147**	**100.0%**	**-0.69 [-2.94 , 1.56]**
Heterogeneity: Tau² = 0.00; Chi² = 4.70, df = 6 (P = 0.58); I² = 0%								
Test for overall effect: Z = 0.60 (P = 0.55)								
3.10.2 Lean mass [kg]								
Dong 2011	56.2	9.9	12	47.4	7.1	10	13.0%	8.80 [1.68 , 15.92]
Chen 2010	46.3	8.7	21	47.9	9.9	21	17.4%	-1.60 [-7.24 , 4.04]
Johansen 2006 (1)	48.1	8.76	33	48.47	13.01	35	18.8%	-0.37 [-5.62 , 4.88]
Rosa 2018	44.04	8.23	24	47.55	9.49	28	20.5%	-3.51 [-8.33 , 1.31]
Song 2012a	22.5	5.2	20	22.2	3.7	20	30.4%	0.30 [-2.50 , 3.10]
Subtotal (95% CI)			**110**			**114**	**100.0%**	**0.16 [-2.95 , 3.28]**
Heterogeneity: Tau² = 6.27; Chi² = 8.28, df = 4 (P = 0.08); I² = 52%								
Test for overall effect: Z = 0.10 (P = 0.92)								
Test for subgroup differences: Chi² = 0.19, df = 1 (P = 0.66), I² = 0%								

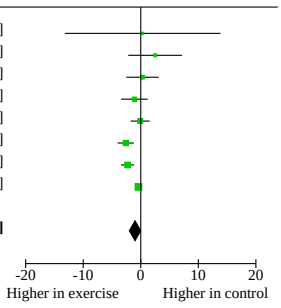


Footnotes

(1) Factorial design, two intervention arms pooled together in the exercise group and two control arms pooled together in the control group

Analysis 3.11. Comparison 3: Resistance exercise versus control (no exercise/placebo exercise), Outcome 11: Body mass index

Study or Subgroup	Control Mean [kg/m²]	Control SD [kg/m²]	Control Total	Exercise Mean [kg/m²]	Exercise SD [kg/m²]	Exercise Total	Weight	Mean Difference IV, Random, 95% CI [kg/m²]
Marinho 2016 (1)	29.13	10.655	7	28.8	13.73	6	0.5%	0.33 [-13.20 , 13.86]
Dong 2011	29.3	6.8	12	26.8	4.3	10	3.8%	2.50 [-2.18 , 7.18]
Abreu 2017	24.1	4.9	19	23.8	4.5	25	8.3%	0.30 [-2.52 , 3.12]
Rosa 2018	25.51	4.03	24	26.61	4.44	28	10.8%	-1.10 [-3.40 , 1.20]
Martin-Alemany 2016 (1)	21.2	1.698	17	21.3	3.204	19	15.0%	-0.10 [-1.75 , 1.55]
Kopple 2007	25.1	1.2	14	27.7	2.5	15	16.9%	-2.60 [-4.01 , -1.19]
AVANTE-HEMO 2020	19.8	1.7	13	22.1	1	9	19.3%	-2.30 [-3.43 , -1.17]
PEAK 2006	-0.1	0.5	25	0.3	0.5	24	25.4%	-0.40 [-0.68 , -0.12]
Total (95% CI)			**131**			**136**	**100.0%**	**-1.00 [-1.98 , -0.01]**
Heterogeneity: Tau² = 0.98; Chi² = 20.87, df = 7 (P = 0.004); I² = 66%								
Test for overall effect: Z = 1.98 (P = 0.05)								
Test for subgroup differences: Not applicable								



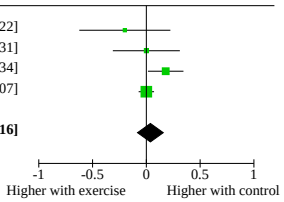
Footnotes

(1) mean and standard deviation estimated from the median and interquartile range

Analysis 3.12. Comparison 3: Resistance exercise versus control (no exercise/placebo exercise), Outcome 12: Calcium

Study or Subgroup	Control Mean [mmol/L]	Control SD [mmol/L]	Control Total	Exercise Mean [mmol/L]	Exercise SD [mmol/L]	Exercise Total	Weight	Mean Difference IV, Random, 95% CI [mmol/L]
de Lima 2013	2.32	0.22	11	2.52	0.65	10	7.1%	-0.20 [-0.62 , 0.22]
Marinho 2016 (1)	2.2	0.367	7	2.2	0.19	6	12.0%	0.00 [-0.31 , 0.31]
Martins do Valle 2020	2.4	0.15	12	2.22	0.25	12	28.8%	0.18 [0.02 , 0.34]
Abreu 2017	2.22	0.12	19	2.22	0.12	25	52.1%	0.00 [-0.07 , 0.07]
Total (95% CI)			**49**			**53**	**100.0%**	**0.04 [-0.08 , 0.16]**

Heterogeneity: Tau² = 0.01; Chi² = 4.96, df = 3 (P = 0.17); I² = 40%
Test for overall effect: Z = 0.62 (P = 0.54)
Test for subgroup differences: Not applicable

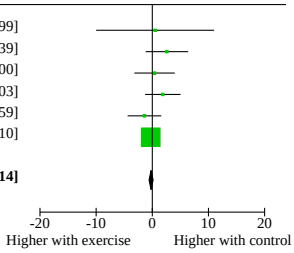


Footnotes
(1) mean and standard deviation estimated from the median and the interquartile range

Analysis 3.13. Comparison 3: Resistance exercise versus control (no exercise/placebo exercise), Outcome 13: CRP

Study or Subgroup	Control Mean [mg/dL]	Control SD [mg/dL]	Control Total	Exercise Mean [mg/dL]	Exercise SD [mg/dL]	Exercise Total	Weight	Mean Difference IV, Random, 95% CI [mg/dL]
Marinho 2016 (1)	6.43	11.298	7	5.93	7.91	6	0.1%	0.50 [-9.99 , 10.99]
Abreu 2017	8.4	7.5	19	5.8	4.4	25	0.9%	2.60 [-1.19 , 6.39]
Pellizzaro 2013 (1)	2.67	4.86	14	2.267	4.86	14	1.0%	0.40 [-3.20 , 4.00]
Afshar 2010	4.14	3.87	7	2.27	1.79	7	1.3%	1.87 [-1.29 , 5.03]
Kopple 2007	2.8	2.9933	14	4.2	5.52	18	1.4%	-1.40 [-4.39 , 1.59]
AVANTE-HEMO 2020 (2)	0.38	0.349	13	0.643	0.48	9	95.3%	-0.26 [-0.63 , 0.10]
Total (95% CI)			**74**			**79**	**100.0%**	**-0.22 [-0.58 , 0.14]**

Heterogeneity: Tau² = 0.00; Chi² = 4.59, df = 5 (P = 0.47); I² = 0%
Test for overall effect: Z = 1.20 (P = 0.23)
Test for subgroup differences: Not applicable

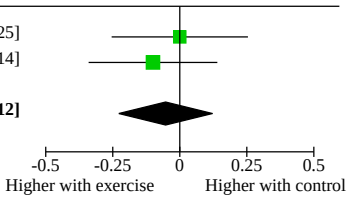


Footnotes
(1) mean and standard deviation estimated from the median and the interquartile range
(2) Mean and standard deviation estimated from the median and the interquartile range

Analysis 3.14. Comparison 3: Resistance exercise versus control (no exercise/placebo exercise), Outcome 14: Dialysis adequacy: Kt/V

Study or Subgroup	Control Mean	Control SD	Control Total	Exercise Mean	Exercise SD	Exercise Total	Weight	Mean Difference IV, Random, 95% CI
PEAK 2006	0.1	0.4	25	0.1	0.5	24	47.1%	0.00 [-0.25 , 0.25]
Martins do Valle 2020	1.6	0.3	12	1.7	0.3	12	52.9%	-0.10 [-0.34 , 0.14]
Total (95% CI)			**37**			**36**	**100.0%**	**-0.05 [-0.23 , 0.12]**

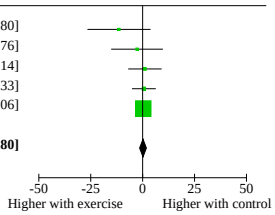
Heterogeneity: Tau² = 0.00; Chi² = 0.31, df = 1 (P = 0.58); I² = 0%
Test for overall effect: Z = 0.59 (P = 0.55)
Test for subgroup differences: Not applicable



Analysis 3.15. Comparison 3: Resistance exercise versus control (no exercise/placebo exercise), Outcome 15: Energy intake

Study or Subgroup	Control Mean [kCal/kg/d]	Control SD [kCal/kg/d]	Control Total	Exercise Mean [kCal/kg/d]	Exercise SD [kCal/kg/d]	Exercise Total	Weight	Mean Difference IV, Random, 95% CI [kCal/kg/d]
PEAK 2006	30.05	8.57	25	41.44	37.04	24	1.1%	-11.39 [-26.58 , 3.80]
Kopple 2007	24.2	7.8575	14	26.9	25.46	18	1.7%	-2.70 [-15.16 , 9.76]
Dong 2011	27.6	11.9	12	26.5	7.1	10	4.1%	1.10 [-6.94 , 9.14]
Olvera-Soto 2016 (1)	23.77	13	31	23.17	9.65	30	8.0%	0.60 [-5.13 , 6.33]
Abreu 2017	30.9	3	19	30.6	2.9	25	85.0%	0.30 [-1.46 , 2.06]
Total (95% CI)			**101**			**107**	**100.0%**	**0.17 [-1.45 , 1.80]**

Heterogeneity: Tau² = 0.00; Chi² = 2.52, df = 4 (P = 0.64); I² = 0%
Test for overall effect: Z = 0.21 (P = 0.84)
Test for subgroup differences: Not applicable

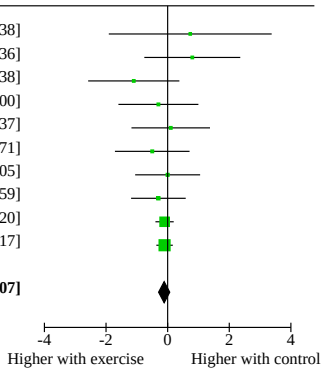


Footnotes
(1) mean and standard deviation estimated from the median and interquartile range

Analysis 3.16. Comparison 3: Resistance exercise versus control (no exercise/placebo exercise), Outcome 16: Haemoglobin

Study or Subgroup	Control Mean [g/L]	Control SD [g/L]	Control Total	Exercise Mean [g/L]	Exercise SD [g/L]	Exercise Total	Weight	Mean Difference IV, Random, 95% CI [g/L]
Marinho 2016 (1)	11.2	2.756	7	10.467	2.098	6	0.5%	0.73 [-1.91 , 3.38]
Dong 2011	12.2	1.8	12	11.4	1.9	10	1.4%	0.80 [-0.76 , 2.36]
AVANTE-HEMO 2020	10.6	1.8	13	11.7	1.7	9	1.5%	-1.10 [-2.58 , 0.38]
Martin-Alemany 2016 (1)	8.6	2.102	17	8.9	1.842	19	1.9%	-0.30 [-1.60 , 1.00]
Abreu 2017	10.6	2.3	19	10.5	1.9	25	2.0%	0.10 [-1.17 , 1.37]
Martins do Valle 2020	10.3	1.3	12	10.8	1.7	12	2.2%	-0.50 [-1.71 , 0.71]
Kopple 2007	12.5	1.87	14	12.5	0.77	15	3.0%	0.00 [-1.05 , 1.05]
de Lima 2013	11.1	1.2	11	11.4	0.9	11	4.2%	-0.30 [-1.19 , 0.59]
Pellizzaro 2013	0.5	0.4	14	0.6	0.4	14	37.4%	-0.10 [-0.40 , 0.20]
Afshar 2010	10.2	0.3	7	10.3	0.2	7	46.0%	-0.10 [-0.37 , 0.17]
Total (95% CI)			**126**			**128**	**100.0%**	**-0.11 [-0.29 , 0.07]**

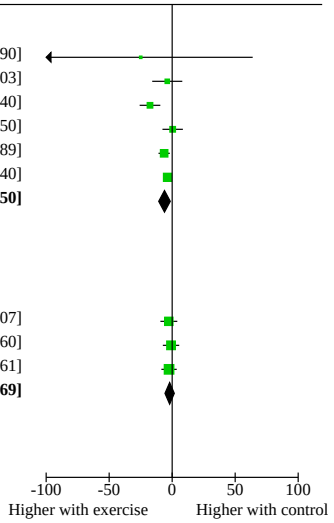
Heterogeneity: Tau² = 0.00; Chi² = 4.23, df = 9 (P = 0.90); I² = 0%
Test for overall effect: Z = 1.22 (P = 0.22)
Test for subgroup differences: Not applicable



Footnotes
(1) mean and standard deviation estimated from the median and interquartile range

Analysis 3.17. Comparison 3: Resistance exercise versus control (no exercise/placebo exercise), Outcome 17: Muscular strength

Study or Subgroup	Control Mean [kg]	Control SD [kg]	Control Total	Exercise Mean [kg]	Exercise SD [kg]	Exercise Total	Weight	Mean Difference IV, Random, 95% CI [kg]
3.17.1 knee extension								
Dong 2011	239.04	139	12	263.99	66.69	10	0.3%	-24.95 [-113.80 , 63.90]
Song 2012a	33.4	19.5	20	37.3	19	20	10.4%	-3.90 [-15.83 , 8.03]
PEAK 2006	-2.4	13.8	25	15.2	15.4	24	16.5%	-17.60 [-25.80 , -9.40]
DIALY-SIZE 2016	9.3	10.1	8	8.9	5.5	7	16.8%	0.40 [-7.70 , 8.50]
Johansen 2006 (1)	17.28	8.63	33	23.65	10.18	35	26.3%	-6.37 [-10.85 , -1.89]
Chen 2010	12.1	6.1	22	15.8	5	22	29.7%	-3.70 [-7.00 , -0.40]
Subtotal (95% CI)			**120**			**118**	**100.0%**	**-6.09 [-10.68 , -1.50]**
Heterogeneity: Tau² = 15.62; Chi² = 11.91, df = 5 (P = 0.04); I² = 58%								
Test for overall effect: Z = 2.60 (P = 0.009)								
3.17.2 handgrip								
Martin-Alemany 2016 (2)	20.867	9.701	17	23.5	10.813	19	30.5%	-2.63 [-9.33 , 4.07]
Song 2012a	27.8	11.8	20	28.7	9	20	32.4%	-0.90 [-7.40 , 5.60]
Olvera-Soto 2016 (2)	19.6	8.56	31	22.07	14.77	30	37.0%	-2.47 [-8.55 , 3.61]
Subtotal (95% CI)			**68**			**69**	**100.0%**	**-2.01 [-5.71 , 1.69]**
Heterogeneity: Tau² = 0.00; Chi² = 0.17, df = 2 (P = 0.92); I² = 0%								
Test for overall effect: Z = 1.06 (P = 0.29)								



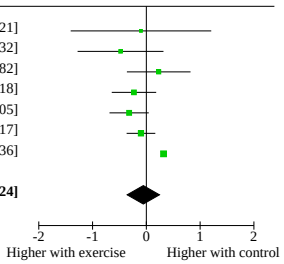
Footnotes

(1) Factorial design, two intervention arms pooled together in the exercise group and two control arms pooled together in the control group

(2) mean and standard deviation estimated from the median and interquartile range

Analysis 3.18. Comparison 3: Resistance exercise versus control (no exercise/placebo exercise), Outcome 18: Phosphate

Study or Subgroup	Control Mean [mmol/L]	Control SD [mmol/L]	Control Total	Exercise Mean [mmol/L]	Exercise SD [mmol/L]	Exercise Total	Weight	Mean Difference IV, Random, 95% CI [mmol/L]
Marinho 2016 (1)	1.367	1.653	7	1.467	0.57	6	4.3%	-0.10 [-1.41 , 1.21]
AVANTE-HEMO 2020 (2)	1.86	1.15	13	2.34	0.76	9	8.7%	-0.48 [-1.28 , 0.32]
Martins do Valle 2020	1.84	0.39	12	1.61	0.97	12	12.1%	0.23 [-0.36 , 0.82]
Martin-Alemany 2016	1.84	0.61	19	2.07	0.65	17	15.9%	-0.23 [-0.64 , 0.18]
de Lima 2013	1.81	0.29	11	2.13	0.52	10	17.0%	-0.32 [-0.69 , 0.05]
Abreu 2017	2.1	0.42	19	2.2	0.48	25	19.3%	-0.10 [-0.37 , 0.17]
Pellizzaro 2013	0.19	0.06	14	-0.13	0.06	14	22.6%	0.32 [0.28 , 0.36]
Total (95% CI)			**95**			**93**	**100.0%**	**-0.06 [-0.36 , 0.24]**
Heterogeneity: Tau² = 0.10; Chi² = 30.74, df = 6 (P < 0.0001); I² = 80%								
Test for overall effect: Z = 0.37 (P = 0.71)								
Test for subgroup differences: Not applicable								



Footnotes

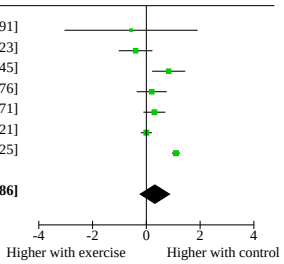
(1) mean and standard deviation estimated from the median and interquartile range

(2) mean and standard deviation estimated from the median and the interquartile range

Analysis 3.19. Comparison 3: Resistance exercise versus control (no exercise/placebo exercise), Outcome 19: Potassium

Study or Subgroup	Control Mean [mmol/L]	Control SD [mmol/L]	Control Total	Exercise Mean [mmol/L]	Exercise SD [mmol/L]	Exercise Total	Weight	Mean Difference IV, Random, 95% CI [mmol/L]
Marinho 2016 (1)	4.5	2.848	7	5.067	1.62	6	3.8%	-0.57 [-3.04 , 1.91]
AVANTE-HEMO 2020	5.2	0.92	13	5.6	0.58	9	14.6%	-0.40 [-1.03 , 0.23]
Martin-Alemany 2016 (1)	5.93	1.213	17	5.1	0.481	19	14.7%	0.83 [0.21 , 1.45]
de Lima 2013	5.8	0.6	11	5.6	0.7	10	15.2%	0.20 [-0.36 , 0.76]
Martins do Valle 2020	5.3	0.4	12	5	0.6	12	16.4%	0.30 [-0.11 , 0.71]
Abreu 2017	4.7	0.3	19	4.7	0.4	25	17.6%	0.00 [-0.21 , 0.21]
Pellizzaro 2013	0.6	0.2	14	-0.5	0.2	14	17.8%	1.10 [0.95 , 1.25]
Total (95% CI)			**93**			**95**	**100.0%**	**0.32 [-0.23 , 0.86]**

Heterogeneity: Tau² = 0.43; Chi² = 90.68, df = 6 (P < 0.00001); I² = 93%
Test for overall effect: Z = 1.14 (P = 0.25)
Test for subgroup differences: Not applicable

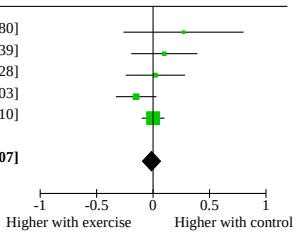


Footnotes
(1) mean and standard deviation estimated from the median and interquartile range

Analysis 3.20. Comparison 3: Resistance exercise versus control (no exercise/placebo exercise), Outcome 20: Protein intake

Study or Subgroup	Control Mean [g/kg/d]	Control SD [g/kg/d]	Control Total	Exercise Mean [g/kg/d]	Exercise SD [g/kg/d]	Exercise Total	Weight	Mean Difference IV, Random, 95% CI [g/kg/d]
Kopple 2007	1.35	0.5987	14	1.08	0.93	18	2.3%	0.27 [-0.26 , 0.80]
Dong 2011	1.1	0.4	12	1	0.3	10	7.4%	0.10 [-0.19 , 0.39]
Olvera-Soto 2016 (1)	1.03	0.4	31	1.01	0.62	30	9.2%	0.02 [-0.24 , 0.28]
PEAK 2006	1.36	0.38	25	1.51	0.25	24	19.6%	-0.15 [-0.33 , 0.03]
Abreu 2017	1.2	0.14	19	1.2	0.2	25	61.5%	0.00 [-0.10 , 0.10]
Total (95% CI)			**101**			**107**	**100.0%**	**-0.01 [-0.09 , 0.07]**

Heterogeneity: Tau² = 0.00; Chi² = 4.02, df = 4 (P = 0.40); I² = 1%
Test for overall effect: Z = 0.35 (P = 0.73)
Test for subgroup differences: Not applicable

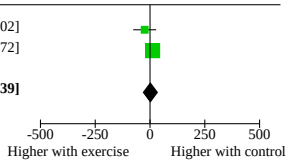


Footnotes
(1) mean and standard deviation estimated from the median and interquartile range

Analysis 3.21. Comparison 3: Resistance exercise versus control (no exercise/placebo exercise), Outcome 21: PTH

Study or Subgroup	Control Mean [pmol/L]	Control SD [pmol/L]	Control Total	Exercise Mean [pmol/L]	Exercise SD [pmol/L]	Exercise Total	Weight	Mean Difference IV, Random, 95% CI [pmol/L]
Martins do Valle 2020	56.28	37.28	12	80.64	84.74	12	28.3%	-24.36 [-76.74 , 28.02]
Marinho 2016 (1)	28.11	28.06	7	16.37	14.93	6	71.7%	11.74 [-12.24 , 35.72]
Total (95% CI)			**19**			**18**	**100.0%**	**1.51 [-30.38 , 33.39]**

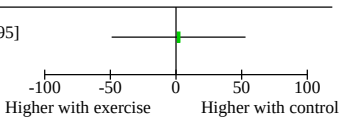
Heterogeneity: Tau² = 219.68; Chi² = 1.51, df = 1 (P = 0.22); I² = 34%
Test for overall effect: Z = 0.09 (P = 0.93)
Test for subgroup differences: Not applicable



Footnotes
(1) mean and standard deviation estimated from the median and interquartile range

Analysis 3.22. Comparison 3: Resistance exercise versus control (no exercise/placebo exercise), Outcome 22: Timed up-and-go test

Study or Subgroup	Control Mean [sec]	Control SD [sec]	Control Total	Exercise Mean [sec]	Exercise SD [sec]	Exercise Total	Mean Difference IV, Random, 95% CI [sec]
Bennett 2013 (1)	11.7	79.3115	12	9.73	65.329	28	1.97 [-49.01 , 52.95]



Footnotes
(1) results from group 1 (24 weeks of intervention) and group 2 (12 weeks of intervention) were pooled together in the exercise group. The number of participants was corrected to a

Comparison 4. Combined aerobic and resistance exercise versus control (no exercise/placebo exercise)

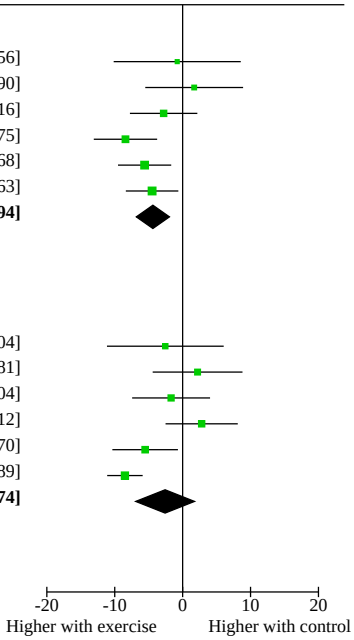
Outcome or subgroup title	No. of studies	No. of participants	Statistical method	Effect size
4.1 HRQoL: Summary component scores	6		Mean Difference (IV, Random, 95% CI)	Subtotals only
4.1.1 Physical Component Score	6	228	Mean Difference (IV, Random, 95% CI)	-4.38 [-6.82, -1.94]
4.1.2 Mental Component Score	6	228	Mean Difference (IV, Random, 95% CI)	-2.58 [-6.91, 1.74]
4.2 HRQoL: Individual domains	3		Mean Difference (IV, Random, 95% CI)	Subtotals only
4.2.1 Physical Functioning	3	161	Mean Difference (IV, Random, 95% CI)	-4.07 [-10.60, 2.47]
4.2.2 Role-physical	3	160	Mean Difference (IV, Random, 95% CI)	-3.86 [-14.38, 6.66]
4.2.3 Pain	3	161	Mean Difference (IV, Random, 95% CI)	-3.98 [-10.46, 2.49]
4.2.4 General health perceptions	3	161	Mean Difference (IV, Random, 95% CI)	-3.67 [-9.24, 1.90]
4.2.5 Emotional well-being	3	161	Mean Difference (IV, Random, 95% CI)	1.29 [-3.99, 6.57]
4.2.6 Role-emotional	3	160	Mean Difference (IV, Random, 95% CI)	-10.68 [-20.92, -0.43]
4.2.7 Vitality	3	161	Mean Difference (IV, Random, 95% CI)	-7.88 [-13.48, -2.28]
4.2.8 Social function	3	161	Mean Difference (IV, Random, 95% CI)	1.83 [-4.56, 8.22]
4.2.9 Symptoms	2	143	Mean Difference (IV, Random, 95% CI)	0.17 [-3.20, 3.54]
4.2.10 Effects of kidney disease	1	47	Mean Difference (IV, Random, 95% CI)	-1.70 [-10.27, 6.87]
4.2.11 Burden of kidney disease	1	47	Mean Difference (IV, Random, 95% CI)	-5.70 [-17.40, 6.00]
4.2.12 Cognitive function	1	47	Mean Difference (IV, Random, 95% CI)	2.10 [-3.68, 7.88]
4.2.13 Quality of social interactions	1	47	Mean Difference (IV, Random, 95% CI)	-0.30 [-7.72, 7.12]
4.2.14 Sleep	1	47	Mean Difference (IV, Random, 95% CI)	4.30 [-5.67, 14.27]
4.2.15 Social support	1	47	Mean Difference (IV, Random, 95% CI)	0.30 [-9.88, 10.48]
4.2.16 Dialysis staff encouragement	1	47	Mean Difference (IV, Random, 95% CI)	2.40 [-8.82, 13.62]

Outcome or subgroup title	No. of studies	No. of participants	Statistical method	Effect size
4.2.17 Patient satisfaction	1	47	Mean Difference (IV, Random, 95% CI)	2.80 [-8.88, 14.48]
4.3 Depression	4	214	Std. Mean Difference (IV, Random, 95% CI)	0.97 [0.25, 1.68]
4.4 6MWT	6	138	Mean Difference (IV, Random, 95% CI)	-53.64 [-67.91, -39.36]
4.5 Sit-To-Stand test [N reps/30 sec]	4	97	Mean Difference (IV, Random, 95% CI)	-2.63 [-3.77, -1.49]
4.6 Sit-To-Stand test [sit to 5 reps]	1		Mean Difference (IV, Random, 95% CI)	Totals not selected
4.7 Resting blood pressure	7		Mean Difference (IV, Random, 95% CI)	Subtotals only
4.7.1 Systolic blood pressure	7	288	Mean Difference (IV, Random, 95% CI)	8.69 [3.78, 13.59]
4.7.2 Diastolic blood pressure	7	288	Mean Difference (IV, Random, 95% CI)	4.42 [2.90, 5.94]
4.8 Aerobic capacity (VO2 max or peak)	3	93	Mean Difference (IV, Random, 95% CI)	-4.29 [-8.98, 0.39]
4.9 Albumin	3	116	Mean Difference (IV, Random, 95% CI)	-0.22 [-1.61, 1.16]
4.10 Blood lipids	4		Mean Difference (IV, Random, 95% CI)	Subtotals only
4.10.1 Total cholesterol [mmol/L]	4	204	Mean Difference (IV, Random, 95% CI)	0.03 [-0.21, 0.27]
4.10.2 LDL cholesterol [mmol/L]	2	61	Mean Difference (IV, Random, 95% CI)	0.44 [-0.09, 0.96]
4.10.3 HDL cholesterol [mmol/L]	3	108	Mean Difference (IV, Random, 95% CI)	-0.27 [-0.44, -0.10]
4.10.4 Triglycerides [mmol/L]	3	108	Mean Difference (IV, Random, 95% CI)	-0.11 [-0.86, 0.64]
4.11 Body composition	1		Mean Difference (IV, Random, 95% CI)	Totals not selected
4.11.1 Fat mass [kg]	1		Mean Difference (IV, Random, 95% CI)	Totals not selected
4.12 Body mass index	2	73	Mean Difference (IV, Fixed, 95% CI)	-0.42 [-1.37, 0.53]
4.13 Calcium	4	190	Mean Difference (IV, Random, 95% CI)	0.06 [-0.01, 0.12]
4.14 CRP	3	117	Mean Difference (IV, Random, 95% CI)	0.09 [-0.27, 0.46]
4.15 Dialysis adequacy: Kt/V	1		Mean Difference (IV, Random, 95% CI)	Totals not selected

Outcome or subgroup title	No. of studies	No. of participants	Statistical method	Effect size
4.16 Energy intake	1		Mean Difference (IV, Random, 95% CI)	Totals not selected
4.17 Haemoglobin	5	266	Mean Difference (IV, Random, 95% CI)	-0.02 [-0.24, 0.20]
4.18 Heart rate	5		Mean Difference (IV, Random, 95% CI)	Subtotals only
4.18.1 Resting	4	179	Mean Difference (IV, Random, 95% CI)	3.05 [0.70, 5.40]
4.18.2 Maximum	3	90	Mean Difference (IV, Random, 95% CI)	-5.37 [-11.10, 0.35]
4.19 Muscular strength	3		Mean Difference (IV, Random, 95% CI)	Subtotals only
4.19.1 Knee extension	2	63	Mean Difference (IV, Random, 95% CI)	1.60 [-3.66, 6.87]
4.19.2 Handgrip	2	88	Mean Difference (IV, Random, 95% CI)	-4.55 [-10.23, 1.14]
4.20 Phosphate	4	190	Mean Difference (IV, Random, 95% CI)	-0.04 [-0.15, 0.08]
4.21 Potassium	4	190	Mean Difference (IV, Random, 95% CI)	-0.15 [-0.36, 0.06]
4.22 Protein intake	1		Mean Difference (IV, Random, 95% CI)	Totals not selected
4.23 Timed up-and-go test	1		Mean Difference (IV, Random, 95% CI)	Totals not selected

Analysis 4.1. Comparison 4: Combined aerobic and resistance exercise versus control (no exercise/placebo exercise), Outcome 1: HRQoL: Summary component scores

Study or Subgroup	Control Mean	Control SD	Control Total	Exercise Mean	Exercise SD	Exercise Total	Weight	Mean Difference IV, Random, 95% CI
4.1.1 Physical Component Score								
Molsted 2004 (1)	44.95	10.99	7	45.75	7.44	10	6.1%	-0.80 [-10.16 , 8.56]
DIALY-SIZE 2016	3.4	7.3	8	1.7	7.4	8	9.7%	1.70 [-5.50 , 8.90]
Uchiyama 2019	38.2	9.2	23	41	8.1	24	17.3%	-2.80 [-7.76 , 2.16]
Suhardjono 2019 (2)	-3.45	12.45	38	4.97	7.56	36	18.9%	-8.42 [-13.09 , -3.75]
Ouzouni 2009	38.9	5.8	14	44.5	5.5	19	23.8%	-5.60 [-9.52 , -1.68]
Frih 2017a	51	7	20	55.5	5.5	21	24.2%	-4.50 [-8.37 , -0.63]
Subtotal (95% CI)			**110**			**118**	**100.0%**	**-4.38 [-6.82 , -1.94]**
Heterogeneity: Tau² = 2.51; Chi² = 6.91, df = 5 (P = 0.23); I² = 28%								
Test for overall effect: Z = 3.52 (P = 0.0004)								
4.1.2 Mental Component Score								
Molsted 2004 (1)	51.55	10.26	7	54.1	6.47	10	12.1%	-2.55 [-11.14 , 6.04]
DIALY-SIZE 2016	0.7	7.5	8	-1.5	5.9	8	15.0%	2.20 [-4.41 , 8.81]
Ouzouni 2009	40.1	6.8	14	41.8	10	19	16.4%	-1.70 [-7.44 , 4.04]
Uchiyama 2019	52.6	9	23	49.8	9.6	24	17.1%	2.80 [-2.52 , 8.12]
Suhardjono 2019	-2.85	12	38	2.673	9.05	36	18.0%	-5.52 [-10.35 , -0.70]
Frih 2017a	42.5	4.5	20	51	4	21	21.3%	-8.50 [-11.11 , -5.89]
Subtotal (95% CI)			**110**			**118**	**100.0%**	**-2.58 [-6.91 , 1.74]**
Heterogeneity: Tau² = 21.06; Chi² = 21.33, df = 5 (P = 0.0007); I² = 77%								
Test for overall effect: Z = 1.17 (P = 0.24)								



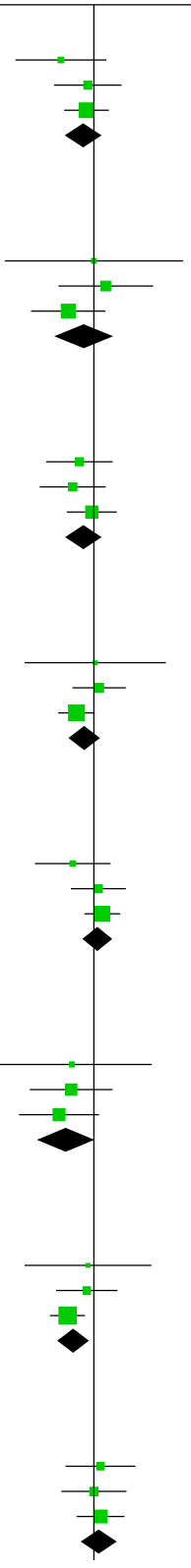
Footnotes

(1) mean and standard deviation estimated from the median and the range

(2) mean and standard deviation estimated from the median and range

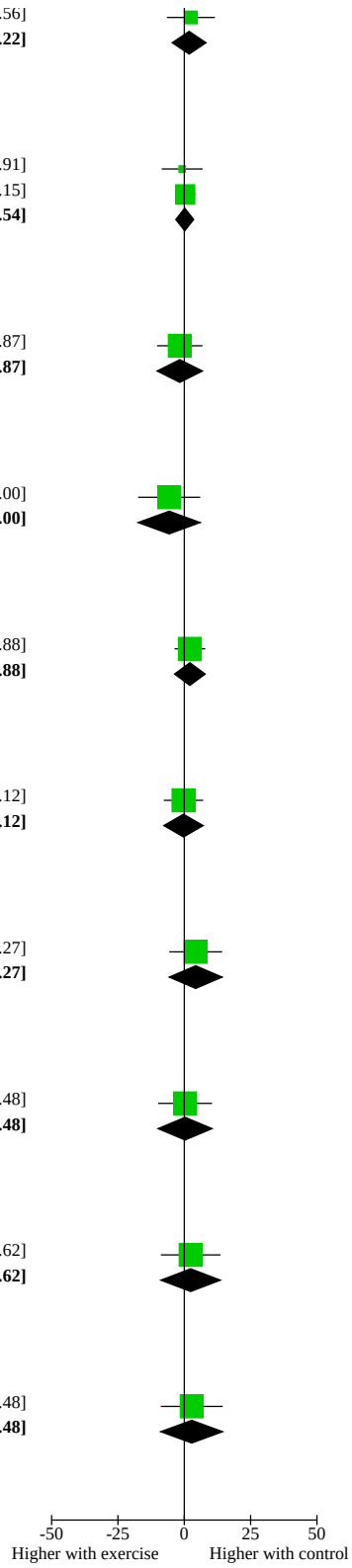
Analysis 4.2. Comparison 4: Combined aerobic and resistance exercise versus control (no exercise/placebo exercise), Outcome 2: HRQoL: Individual domains

Study or Subgroup	Control Mean	Control SD	Control Total	Exercise Mean	Exercise SD	Exercise Total	Weight	Mean Difference IV, Random, 95% CI
4.2.1 Physical Functioning								
Molsted 2004 (1)	70	21.99	7	82.5	9.41	11	14.4%	-12.50 [-29.71 , 4.71]
van Vilsteren 2005	60.2	34.5	43	62.5	28	53	26.1%	-2.30 [-15.07 , 10.47]
Uchiyama 2019	73.2	13.9	23	76	15.7	24	59.5%	-2.80 [-11.27 , 5.67]
Subtotal (95% CI)			**73**			**88**	**100.0%**	**-4.07 [-10.60 , 2.47]**
Heterogeneity: Tau² = 0.00; Chi² = 1.08, df = 2 (P = 0.58); I² = 0%								
Test for overall effect: Z = 1.22 (P = 0.22)								
4.2.2 Role-physical								
Molsted 2004 (1)	62.5	36.64	7	62.5	32.33	10	9.7%	0.00 [-33.74 , 33.74]
van Vilsteren 2005	54.5	45.7	43	50	43	53	34.5%	4.50 [-13.41 , 22.41]
Uchiyama 2019	62.2	26.9	23	71.9	22	24	55.8%	-9.70 [-23.78 , 4.38]
Subtotal (95% CI)			**73**			**87**	**100.0%**	**-3.86 [-14.38 , 6.66]**
Heterogeneity: Tau² = 0.00; Chi² = 1.55, df = 2 (P = 0.46); I² = 0%								
Test for overall effect: Z = 0.72 (P = 0.47)								
4.2.3 Pain								
Uchiyama 2019	67.5	24.4	23	73	19.1	24	26.6%	-5.50 [-18.06 , 7.06]
Molsted 2004 (1)	82.5	13.92	7	90.5	11.93	11	26.9%	-8.00 [-20.49 , 4.49]
van Vilsteren 2005	76.1	25.5	43	76.9	21	53	46.6%	-0.80 [-10.29 , 8.69]
Subtotal (95% CI)			**73**			**88**	**100.0%**	**-3.98 [-10.46 , 2.49]**
Heterogeneity: Tau² = 0.00; Chi² = 0.89, df = 2 (P = 0.64); I² = 0%								
Test for overall effect: Z = 1.21 (P = 0.23)								
4.2.4 General health perceptions								
Molsted 2004 (1)	59	30.05	7	58.5	25.11	11	4.3%	0.50 [-26.25 , 27.25]
Uchiyama 2019	45.7	17.4	23	43.7	17.9	24	30.5%	2.00 [-8.09 , 12.09]
van Vilsteren 2005	45.2	18.1	43	51.8	15.9	53	65.2%	-6.60 [-13.50 , 0.30]
Subtotal (95% CI)			**73**			**88**	**100.0%**	**-3.67 [-9.24 , 1.90]**
Heterogeneity: Tau² = 0.00; Chi² = 2.00, df = 2 (P = 0.37); I² = 0%								
Test for overall effect: Z = 1.29 (P = 0.20)								
4.2.5 Emotional well-being								
Molsted 2004 (1)	76	17.59	7	84	10.04	11	13.6%	-8.00 [-22.32 , 6.32]
Uchiyama 2019	73.2	17.6	23	71.5	18.8	24	25.8%	1.70 [-8.71 , 12.11]
van Vilsteren 2005	79.4	15	43	76.2	18.9	53	60.6%	3.20 [-3.58 , 9.98]
Subtotal (95% CI)			**73**			**88**	**100.0%**	**1.29 [-3.99 , 6.57]**
Heterogeneity: Tau² = 0.00; Chi² = 1.93, df = 2 (P = 0.38); I² = 0%								
Test for overall effect: Z = 0.48 (P = 0.63)								
4.2.6 Role-emotional								
Molsted 2004 (1)	75	36.64	7	83.33	21.55	10	11.5%	-8.33 [-38.58 , 21.92]
van Vilsteren 2005	70.2	41.9	43	78.8	35	53	42.7%	-8.60 [-24.27 , 7.07]
Uchiyama 2019	64.3	31.8	23	77.5	19.4	24	45.8%	-13.20 [-28.34 , 1.94]
Subtotal (95% CI)			**73**			**87**	**100.0%**	**-10.68 [-20.92 , -0.43]**
Heterogeneity: Tau² = 0.00; Chi² = 0.20, df = 2 (P = 0.91); I² = 0%								
Test for overall effect: Z = 2.04 (P = 0.04)								
4.2.7 Vitality								
Molsted 2004 (1)	69	29.32	7	71.25	17.26	11	5.4%	-2.25 [-26.25 , 21.75]
Uchiyama 2019	54.8	20.3	23	57.5	20.3	24	23.3%	-2.70 [-14.31 , 8.91]
van Vilsteren 2005	56.1	17.4	43	66.1	15.3	53	71.3%	-10.00 [-16.63 , -3.37]
Subtotal (95% CI)			**73**			**88**	**100.0%**	**-7.88 [-13.48 , -2.28]**
Heterogeneity: Tau² = 0.00; Chi² = 1.37, df = 2 (P = 0.50); I² = 0%								
Test for overall effect: Z = 2.76 (P = 0.006)								
4.2.8 Social function								
Uchiyama 2019	74.3	26	23	71.8	19.6	24	23.4%	2.50 [-10.71 , 15.71]
Molsted 2004 (1)	90.63	13.74	7	90.63	11.77	11	26.8%	0.00 [-12.33 , 12.33]
van Vilsteren 2005	74.1	25	43	71.6	19	53	49.8%	2.50 [-6.56 , 11.56]
Subtotal (95% CI)			**73**			**88**	**100.0%**	**1.83 [-4.56 , 8.22]**



Analysis 4.2. (Continued)

van Vilsteren 2005	74.1	25	43	71.6	19	53	49.8%	2.50 [-6.56 , 11.56]
Subtotal (95% CI)			**73**			**88**	**100.0%**	**1.83 [-4.56 , 8.22]**
Heterogeneity: Tau² = 0.00; Chi² = 0.12, df = 2 (P = 0.94); I² = 0%								
Test for overall effect: Z = 0.56 (P = 0.57)								
4.2.9 Symptoms								
Uchiyama 2019	78.7	15.2	23	79.5	11.4	24	19.1%	-0.80 [-8.51 , 6.91]
van Vilsteren 2005	23.9	9.5	43	23.5	9.1	53	80.9%	0.40 [-3.35 , 4.15]
Subtotal (95% CI)			**66**			**77**	**100.0%**	**0.17 [-3.20 , 3.54]**
Heterogeneity: Tau² = 0.00; Chi² = 0.08, df = 1 (P = 0.78); I² = 0%								
Test for overall effect: Z = 0.10 (P = 0.92)								
4.2.10 Effects of kidney disease								
Uchiyama 2019	78.1	15.6	23	79.8	14.3	24	100.0%	-1.70 [-10.27 , 6.87]
Subtotal (95% CI)			**23**			**24**	**100.0%**	**-1.70 [-10.27 , 6.87]**
Heterogeneity: Not applicable								
Test for overall effect: Z = 0.39 (P = 0.70)								
4.2.11 Burden of kidney disease								
Uchiyama 2019	42.4	19.2	23	48.1	21.7	24	100.0%	-5.70 [-17.40 , 6.00]
Subtotal (95% CI)			**23**			**24**	**100.0%**	**-5.70 [-17.40 , 6.00]**
Heterogeneity: Not applicable								
Test for overall effect: Z = 0.95 (P = 0.34)								
4.2.12 Cognitive function								
Uchiyama 2019	92.4	9.5	23	90.3	10.7	24	100.0%	2.10 [-3.68 , 7.88]
Subtotal (95% CI)			**23**			**24**	**100.0%**	**2.10 [-3.68 , 7.88]**
Heterogeneity: Not applicable								
Test for overall effect: Z = 0.71 (P = 0.48)								
4.2.13 Quality of social interactions								
Uchiyama 2019	88.1	14.9	23	88.4	10.6	24	100.0%	-0.30 [-7.72 , 7.12]
Subtotal (95% CI)			**23**			**24**	**100.0%**	**-0.30 [-7.72 , 7.12]**
Heterogeneity: Not applicable								
Test for overall effect: Z = 0.08 (P = 0.94)								
4.2.14 Sleep								
Uchiyama 2019	60.9	18.1	23	56.6	16.7	24	100.0%	4.30 [-5.67 , 14.27]
Subtotal (95% CI)			**23**			**24**	**100.0%**	**4.30 [-5.67 , 14.27]**
Heterogeneity: Not applicable								
Test for overall effect: Z = 0.85 (P = 0.40)								
4.2.15 Social support								
Uchiyama 2019	81	16.9	23	80.7	18.7	24	100.0%	0.30 [-9.88 , 10.48]
Subtotal (95% CI)			**23**			**24**	**100.0%**	**0.30 [-9.88 , 10.48]**
Heterogeneity: Not applicable								
Test for overall effect: Z = 0.06 (P = 0.95)								
4.2.16 Dialysis staff encouragement								
Uchiyama 2019	83	17.4	23	80.6	21.7	24	100.0%	2.40 [-8.82 , 13.62]
Subtotal (95% CI)			**23**			**24**	**100.0%**	**2.40 [-8.82 , 13.62]**
Heterogeneity: Not applicable								
Test for overall effect: Z = 0.42 (P = 0.68)								
4.2.17 Patient satisfaction								
Uchiyama 2019	78	22.8	23	75.2	17.6	24	100.0%	2.80 [-8.88 , 14.48]
Subtotal (95% CI)			**23**			**24**	**100.0%**	**2.80 [-8.88 , 14.48]**
Heterogeneity: Not applicable								
Test for overall effect: Z = 0.47 (P = 0.64)								



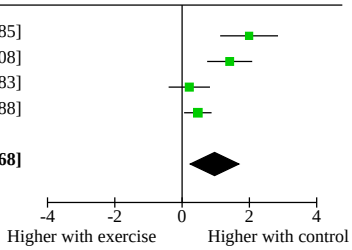
Footnotes

(1) mean and standard deviation estimated from the median and the range

Analysis 4.3. Comparison 4: Combined aerobic and resistance exercise versus control (no exercise/placebo exercise), Outcome 3: Depression

Study or Subgroup	Control Mean	Control SD	Control Total	Exercise Mean	Exercise SD	Exercise Total	Weight	Std. Mean Difference IV, Random, 95% CI
Ouzouni 2009	19.4	4	14	11.7	3.6	19	21.6%	1.99 [1.13 , 2.85]
Kouidi 2010	22.1	6.24	20	14.61	4.15	24	24.6%	1.41 [0.74 , 2.08]
Frih 2017a	13	25.6402	20	8.5	14.2796	21	25.4%	0.21 [-0.40 , 0.83]
van Vilsteren 2005	41.4	9.6	43	37.2	8.3	53	28.4%	0.47 [0.06 , 0.88]
Total (95% CI)			**97**			**117**	**100.0%**	**0.97 [0.25 , 1.68]**

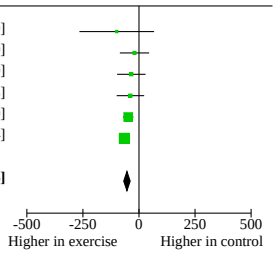
Heterogeneity: Tau² = 0.43; Chi² = 16.56, df = 3 (P = 0.0009); I² = 82%
Test for overall effect: Z = 2.63 (P = 0.009)
Test for subgroup differences: Not applicable



Analysis 4.4. Comparison 4: Combined aerobic and resistance exercise versus control (no exercise/placebo exercise), Outcome 4: 6MWT

Study or Subgroup	Control Mean [metres]	Control SD [metres]	Control Total	Exercise Mean [metres]	Exercise SD [metres]	Exercise Total	Weight	Mean Difference IV, Random, 95% CI [metres]
Marchesan 2016 (1)	399.43	164	8	498.5	164	7	0.7%	-99.07 [-265.43 , 67.29]
Rouchon 2016	400	65.987	4	420	11.9614	8	4.8%	-20.00 [-85.20 , 45.20]
DePaul 2002	430	80	14	464	94	15	5.1%	-34.00 [-97.40 , 29.40]
DIALY-SIZE 2016	0.8	44	8	39	76.8	8	5.4%	-38.20 [-99.53 , 23.13]
Cho 2018	-26	41	13	22	12	12	37.6%	-48.00 [-71.30 , -24.70]
Frih 2017a	415.6	36.3	20	480.5	31.9	21	46.4%	-64.90 [-85.86 , -43.94]
Total (95% CI)			**67**			**71**	**100.0%**	**-53.64 [-67.91 , -39.36]**

Heterogeneity: Tau² = 0.00; Chi² = 3.26, df = 5 (P = 0.66); I² = 0%
Test for overall effect: Z = 7.36 (P < 0.00001)
Test for subgroup differences: Not applicable

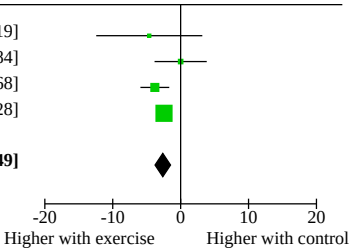


Footnotes
(1) standard deviation imputed from the highest standard deviation of the other included studies

Analysis 4.5. Comparison 4: Combined aerobic and resistance exercise versus control (no exercise/placebo exercise), Outcome 5: Sit-To-Stand test [N reps/30 sec]

Study or Subgroup	Control Mean	Control SD	Control Total	Exercise Mean	Exercise SD	Exercise Total	Weight	Mean Difference IV, Random, 95% CI
Marchesan 2016 (1)	10	7.7	7	14.62	7.7	8	2.1%	-4.62 [-12.43 , 3.19]
DIALY-SIZE 2016	1.4	4.3	8	1.4	3.5	8	8.4%	0.00 [-3.84 , 3.84]
Cho 2018	-0.5	2.2	13	3.3	3.1	12	25.2%	-3.80 [-5.92 , -1.68]
Frih 2017a	10.85	2.05	20	13.3	1.75	21	64.3%	-2.45 [-3.62 , -1.28]
Total (95% CI)			**48**			**49**	**100.0%**	**-2.63 [-3.77 , -1.49]**

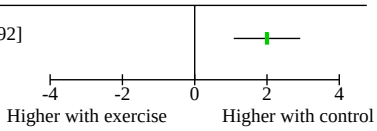
Heterogeneity: Tau² = 0.17; Chi² = 3.31, df = 3 (P = 0.35); I² = 9%
Test for overall effect: Z = 4.52 (P < 0.00001)
Test for subgroup differences: Not applicable



Footnotes
(1) standard deviation imputed from the highest standard deviation of the other included studies

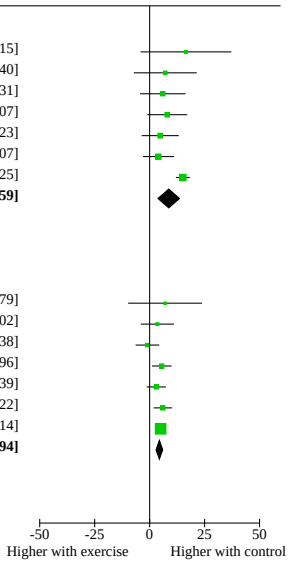
Analysis 4.6. Comparison 4: Combined aerobic and resistance exercise versus control (no exercise/placebo exercise), Outcome 6: Sit-To-Stand test [sit to 5 reps]

Study or Subgroup	Control Mean	Control SD	Control Total	Exercise Mean	Exercise SD	Exercise Total	Mean Difference IV, Random, 95% CI
Frih 2017a	15.5	1.55	20	13.5	1.45	21	2.00 [1.08 , 2.92]



Analysis 4.7. Comparison 4: Combined aerobic and resistance exercise versus control (no exercise/placebo exercise), Outcome 7: Resting blood pressure

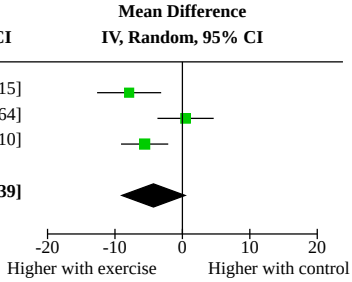
Study or Subgroup	Control Mean [mm Hg]	Control SD [mm Hg]	Control Total	Exercise Mean [mm Hg]	Exercise SD [mm Hg]	Exercise Total	Weight	Mean Difference IV, Random, 95% CI [mm Hg]
4.7.1 Systolic blood pressure								
Molsted 2004 (1)	149	24.75	8	132.5	19.46	11	4.7%	16.50 [-4.15 , 37.15]
DePaul 2002	153.1	20.2	14	146	19	15	8.4%	7.10 [-7.20 , 21.40]
van Vilsteren 2005	146	25	43	140	26.4	53	12.7%	6.00 [-4.31 , 16.31]
Deligiannis 1999a	144	10	12	136	14	15	14.6%	8.00 [-1.07 , 17.07]
Kouidi 2008	133.7	14.9	21	128.9	13.2	22	15.6%	4.80 [-3.63 , 13.23]
Ouzouni 2009	139.3	9.1	14	135.3	11.6	19	18.1%	4.00 [-3.07 , 11.07]
Frih 2017a	149.2	5.1	20	134.1	5.2	21	25.9%	15.10 [11.95 , 18.25]
Subtotal (95% CI)			**132**			**156**	**100.0%**	**8.69 [3.78 , 13.59]**
Heterogeneity: Tau² = 21.66; Chi² = 14.01, df = 6 (P = 0.03); I² = 57%								
Test for overall effect: Z = 3.47 (P = 0.0005)								
4.7.2 Diastolic blood pressure								
Molsted 2004 (1)	86.25	18.83	8	79.25	17.89	11	0.8%	7.00 [-9.79 , 23.79]
DePaul 2002	85.2	11.7	14	81.7	8.6	15	4.1%	3.50 [-4.02 , 11.02]
van Vilsteren 2005	79	12	43	80	14.9	53	8.0%	-1.00 [-6.38 , 4.38]
Kouidi 2008	82.4	7	21	76.9	7.9	22	11.7%	5.50 [1.04 , 9.96]
Deligiannis 1999a	82	3	12	79	8	15	12.0%	3.00 [-1.39 , 7.39]
Ouzouni 2009	85.2	4.6	14	79.2	7.7	19	13.0%	6.00 [1.78 , 10.22]
Frih 2017a	78	3.4	20	73	3.6	21	50.4%	5.00 [2.86 , 7.14]
Subtotal (95% CI)			**132**			**156**	**100.0%**	**4.42 [2.90 , 5.94]**
Heterogeneity: Tau² = 0.00; Chi² = 5.49, df = 6 (P = 0.48); I² = 0%								
Test for overall effect: Z = 5.70 (P < 0.00001)								



Footnotes
(1) mean and standard deviation estimated from the median and range

Analysis 4.8. Comparison 4: Combined aerobic and resistance exercise versus control (no exercise/placebo exercise), Outcome 8: Aerobic capacity (VO2 max or peak)

Study or Subgroup	Control Mean	Control SD	Control Total	Exercise Mean	Exercise SD	Exercise Total	Weight	Mean Difference IV, Random, 95% CI
Deligiannis 1999a	15.8	4.8	12	23.7	7.7	15	30.8%	-7.90 [-12.65 , -3.15]
Molsted 2004 (1)	19.5	3.81	9	19.03	5.12	9	33.2%	0.47 [-3.70 , 4.64]
Konstantinidou 2002 (2)	15.8	4.8	12	21.4	6.76	36	36.0%	-5.60 [-9.10 , -2.10]
Total (95% CI)			**33**			**60**	**100.0%**	**-4.29 [-8.98 , 0.39]**
Heterogeneity: Tau² = 12.67; Chi² = 7.76, df = 2 (P = 0.02); I² = 74%								
Test for overall effect: Z = 1.80 (P = 0.07)								
Test for subgroup differences: Not applicable								

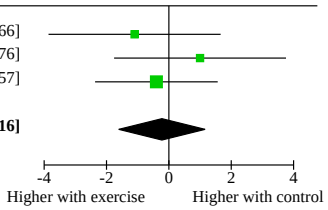


Footnotes
(1) mean and standard deviation estimated from the median and range
(2) three intervention arms pooled together in the exercise group

Analysis 4.9. Comparison 4: Combined aerobic and resistance exercise versus control (no exercise/placebo exercise), Outcome 9: Albumin

Study or Subgroup	Control Mean [g/L]	Control SD [g/L]	Control Total	Exercise Mean [g/L]	Exercise SD [g/L]	Exercise Total	Weight	Mean Difference IV, Random, 95% CI [g/L]
Uchiyama 2019	33.7	5.2	23	34.8	4.4	24	25.2%	-1.10 [-3.86 , 1.66]
Kopple 2007	39	3.7417	14	38	3.7	14	25.2%	1.00 [-1.76 , 3.76]
Frih 2017a	40	2.6	21	40.4	3.7	20	49.6%	-0.40 [-2.37 , 1.57]
Total (95% CI)			**58**			**58**	**100.0%**	**-0.22 [-1.61 , 1.16]**

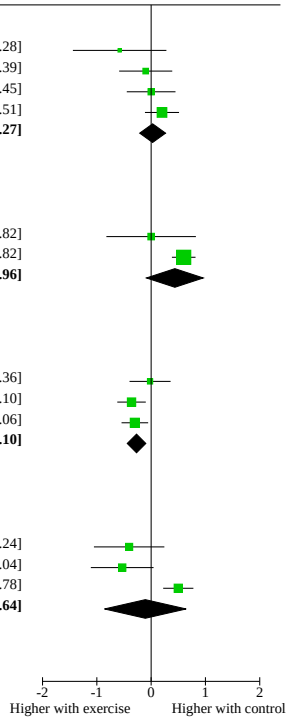
Heterogeneity: Tau² = 0.00; Chi² = 1.18, df = 2 (P = 0.56); I² = 0%
Test for overall effect: Z = 0.32 (P = 0.75)
Test for subgroup differences: Not applicable



Analysis 4.10. Comparison 4: Combined aerobic and resistance exercise versus control (no exercise/placebo exercise), Outcome 10: Blood lipids

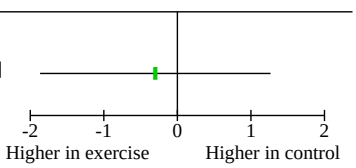
Study or Subgroup	Control Mean [mmol/L]	Control SD [mmol/L]	Control Total	Exercise Mean [mmol/L]	Exercise SD [mmol/L]	Exercise Total	Weight	Mean Difference IV, Random, 95% CI [mmol/L]
4.10.1 Total cholesterol [mmol/L]								
Molsted 2004 (1)	4.25	1.07	9	4.83	0.85	11	7.4%	-0.58 [-1.44 , 0.28]
Uchiyama 2019	4.4	0.812	23	4.5	0.897	24	21.5%	-0.10 [-0.59 , 0.39]
van Vilsteren 2005	4.6	1.2	43	4.6	1	53	25.1%	0.00 [-0.45 , 0.45]
Frih 2017a	4.1	0.6	20	3.9	0.4	21	46.0%	0.20 [-0.11 , 0.51]
Subtotal (95% CI)			**95**			**109**	**100.0%**	**0.03 [-0.21 , 0.27]**
Heterogeneity: Tau² = 0.01; Chi² = 3.34, df = 3 (P = 0.34); I² = 10%								
Test for overall effect: Z = 0.23 (P = 0.82)								
4.10.2 LDL cholesterol [mmol/L]								
Molsted 2004 (1)	2.33	0.7	9	2.33	1.16	11	27.2%	0.00 [-0.82 , 0.82]
Frih 2017a	2.5	0.4	20	1.9	0.3	21	72.8%	0.60 [0.38 , 0.82]
Subtotal (95% CI)			**29**			**32**	**100.0%**	**0.44 [-0.09 , 0.96]**
Heterogeneity: Tau² = 0.09; Chi² = 1.90, df = 1 (P = 0.17); I² = 47%								
Test for overall effect: Z = 1.64 (P = 0.10)								
4.10.3 HDL cholesterol [mmol/L]								
Molsted 2004 (1)	1.33	0.42	9	1.35	0.44	11	19.3%	-0.02 [-0.40 , 0.36]
Uchiyama 2019	1.182	0.367	23	1.543	0.538	24	37.9%	-0.36 [-0.62 , -0.10]
Frih 2017a	1.4	0.4	20	1.7	0.4	21	42.8%	-0.30 [-0.54 , -0.06]
Subtotal (95% CI)			**52**			**56**	**100.0%**	**-0.27 [-0.44 , -0.10]**
Heterogeneity: Tau² = 0.00; Chi² = 2.20, df = 2 (P = 0.33); I² = 9%								
Test for overall effect: Z = 3.08 (P = 0.002)								
4.10.4 Triglycerides [mmol/L]								
Molsted 2004 (1)	1.135	0.428	9	1.54	0.99	11	30.5%	-0.41 [-1.05 , 0.24]
Uchiyama 2019	1.305	1.009	23	1.838	1.0105	24	32.0%	-0.53 [-1.11 , 0.04]
Frih 2017a	1.9	0.5	20	1.4	0.4	21	37.5%	0.50 [0.22 , 0.78]
Subtotal (95% CI)			**52**			**56**	**100.0%**	**-0.11 [-0.86 , 0.64]**
Heterogeneity: Tau² = 0.37; Chi² = 13.99, df = 2 (P = 0.0009); I² = 86%								
Test for overall effect: Z = 0.28 (P = 0.78)								

Footnotes
(1) mean and standard error estimated from the median and the range



Analysis 4.11. Comparison 4: Combined aerobic and resistance exercise versus control (no exercise/placebo exercise), Outcome 11: Body composition

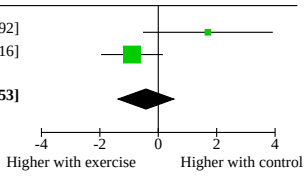
Study or Subgroup	Control Mean	Control SD	Control Total	Exercise Mean	Exercise SD	Exercise Total	Mean Difference IV, Random, 95% CI
4.11.1 Fat mass [kg]							
Kopple 2007	19.1	2.4	14	19.4	2.9	37	-0.30 [-1.87 , 1.27]



Analysis 4.12. Comparison 4: Combined aerobic and resistance exercise versus control (no exercise/placebo exercise), Outcome 12: Body mass index

Study or Subgroup	Control Mean [kg/m²]	Control SD [kg/m²]	Control Total	Exercise Mean [kg/m²]	Exercise SD [kg/m²]	Exercise Total	Weight	Mean Difference IV, Fixed, 95% CI [kg/m²]
Uchiyama 2019	24.5	4.3	23	22.8	3.4	24	18.4%	1.70 [-0.52 , 3.92]
Kopple 2007	25.1	1.2	14	26	1.5	12	81.6%	-0.90 [-1.96 , 0.16]
Total (95% CI)			**37**			**36**	**100.0%**	**-0.42 [-1.37 , 0.53]**

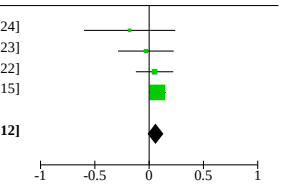
Heterogeneity: Chi² = 4.29, df = 1 (P = 0.04); I² = 77%
Test for overall effect: Z = 0.86 (P = 0.39)
Test for subgroup differences: Not applicable



Analysis 4.13. Comparison 4: Combined aerobic and resistance exercise versus control (no exercise/placebo exercise), Outcome 13: Calcium

Study or Subgroup	Control Mean [mmol/L]	Control SD [mmol/L]	Control Total	Exercise Mean [mmol/L]	Exercise SD [mmol/L]	Exercise Total	Weight	Mean Difference IV, Random, 95% CI [mmol/L]
Deligiannis 1999a	2.02	0.2	12	2.2	0.8	15	2.5%	-0.18 [-0.60 , 0.24]
Deligiannis 1999	2.17	0.15	30	2.2	0.7	30	6.8%	-0.03 [-0.29 , 0.23]
Kouidi 2010	2.22	0.32	20	2.17	0.25	24	15.0%	0.05 [-0.12 , 0.22]
Kouidi 2008	2.1457	0.15	29	2.07	0.15	30	75.8%	0.08 [-0.00 , 0.15]
Total (95% CI)			**91**			**99**	**100.0%**	**0.06 [-0.01 , 0.12]**

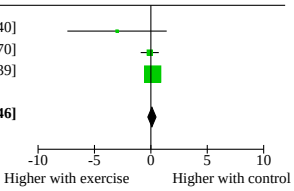
Heterogeneity: Tau² = 0.00; Chi² = 1.90, df = 3 (P = 0.59); I² = 0%
Test for overall effect: Z = 1.71 (P = 0.09)
Test for subgroup differences: Not applicable



Analysis 4.14. Comparison 4: Combined aerobic and resistance exercise versus control (no exercise/placebo exercise), Outcome 14: CRP

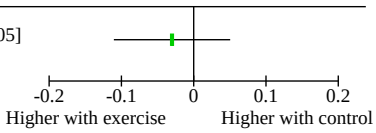
Study or Subgroup	Control Mean [mg/dL]	Control SD [mg/dL]	Control Total	Exercise Mean [mg/dL]	Exercise SD [mg/dL]	Exercise Total	Weight	Mean Difference IV, Random, 95% CI [mg/dL]
Kopple 2007	2.8	2.9933	14	5.8	8.13	15	0.7%	-3.00 [-7.40 , 1.40]
Frih 2017a	4	1.4	20	4.1	1.2	21	17.5%	-0.10 [-0.90 , 0.70]
Uchiyama 2019	0.3	0.5	23	0.14	0.25	24	81.8%	0.16 [-0.07 , 0.39]
Total (95% CI)			**57**			**60**	**100.0%**	**0.09 [-0.27 , 0.46]**

Heterogeneity: Tau² = 0.03; Chi² = 2.33, df = 2 (P = 0.31); I² = 14%
Test for overall effect: Z = 0.50 (P = 0.61)
Test for subgroup differences: Not applicable



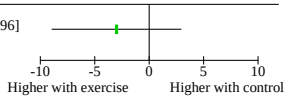
Analysis 4.15. Comparison 4: Combined aerobic and resistance exercise versus control (no exercise/placebo exercise), Outcome 15: Dialysis adequacy: Kt/V

Study or Subgroup	Control Mean	Control SD	Control Total	Exercise Mean	Exercise SD	Exercise Total	Mean Difference IV, Random, 95% CI
van Vilsteren 2005	1.23	0.2	43	1.26	0.2	53	-0.03 [-0.11 , 0.05]



Analysis 4.16. Comparison 4: Combined aerobic and resistance exercise versus control (no exercise/placebo exercise), Outcome 16: Energy intake

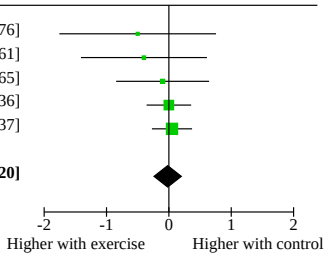
Study or Subgroup	Control Mean [kCal/kg/d]	Control SD [kCal/kg/d]	Control Total	Exercise Mean [kCal/kg/d]	Exercise SD [kCal/kg/d]	Exercise Total	Mean Difference IV, Random, 95% CI [kCal/kg/d]
Kopple 2007	24.2	7.8575	14	27.2	8.52	15	-3.00 [-8.96 , 2.96]



Analysis 4.17. Comparison 4: Combined aerobic and resistance exercise versus control (no exercise/placebo exercise), Outcome 17: Haemoglobin

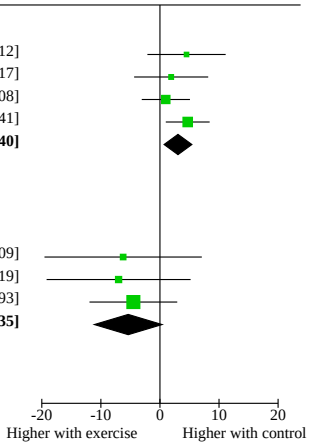
Study or Subgroup	Control Mean [g/L]	Control SD [g/L]	Control Total	Exercise Mean [g/L]	Exercise SD [g/L]	Exercise Total	Weight	Mean Difference IV, Random, 95% CI [g/L]
Kopple 2007	12.5	1.87	14	13	1.39	12	3.0%	-0.50 [-1.76 , 0.76]
Frih 2017a	10	1.6	20	10.4	1.7	21	4.7%	-0.40 [-1.41 , 0.61]
Kouidi 2010	11.2	1.3	20	11.3	1.2	24	8.6%	-0.10 [-0.85 , 0.65]
Kouidi 2008	11	0.7	29	11	0.7	30	37.5%	0.00 [-0.36 , 0.36]
van Vilsteren 2005	7.57	0.8	43	7.52	0.8	53	46.2%	0.05 [-0.27 , 0.37]
Total (95% CI)			**126**			**140**	**100.0%**	**-0.02 [-0.24 , 0.20]**

Heterogeneity: Tau² = 0.00; Chi² = 1.34, df = 4 (P = 0.85); I² = 0%
Test for overall effect: Z = 0.17 (P = 0.86)
Test for subgroup differences: Not applicable



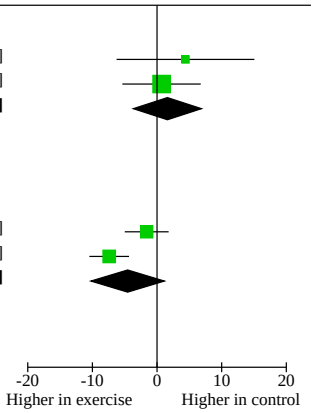
Analysis 4.18. Comparison 4: Combined aerobic and resistance exercise versus control (no exercise/placebo exercise), Outcome 18: Heart rate

Study or Subgroup	Control Mean [bpm]	Control SD [bpm]	Control Total	Exercise Mean [bpm]	Exercise SD [bpm]	Exercise Total	Weight	Mean Difference IV, Random, 95% CI [bpm]
4.18.1 Resting								
Deligiannis 1999a	81.8	8.5	12	77.3	9	15	12.6%	4.50 [-2.12 , 11.12]
Ouzouni 2009	78.2	10.3	14	76.3	7.1	19	14.1%	1.90 [-4.37 , 8.17]
Deligiannis 1999	76	7	30	75	9	30	33.2%	1.00 [-3.08 , 5.08]
Kouidi 2008	78.4	8.1	29	73.7	6.3	30	40.1%	4.70 [0.99 , 8.41]
Subtotal (95% CI)			**85**			**94**	**100.0%**	**3.05 [0.70 , 5.40]**
Heterogeneity: Tau² = 0.00; Chi² = 2.04, df = 3 (P = 0.56); I² = 0%								
Test for overall effect: Z = 2.54 (P = 0.01)								
4.18.2 Maximum								
Konstantinidou 2002	139	12	4	145.23	16.26	26	18.5%	-6.23 [-19.55 , 7.09]
Deligiannis 1999a	139	12	12	146	20	15	22.1%	-7.00 [-19.19 , 5.19]
Ouzouni 2009	139.6	7.1	14	144.1	14.3	19	59.4%	-4.50 [-11.93 , 2.93]
Subtotal (95% CI)			**30**			**60**	**100.0%**	**-5.37 [-11.10 , 0.35]**
Heterogeneity: Tau² = 0.00; Chi² = 0.14, df = 2 (P = 0.93); I² = 0%								
Test for overall effect: Z = 1.84 (P = 0.07)								



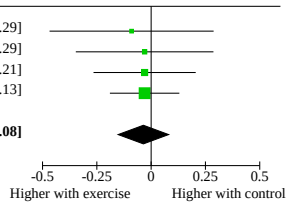
Analysis 4.19. Comparison 4: Combined aerobic and resistance exercise versus control (no exercise/placebo exercise), Outcome 19: Muscular strength

Study or Subgroup	Control Mean [kg]	Control SD [kg]	Control Total	Exercise Mean [kg]	Exercise SD [kg]	Exercise Total	Weight	Mean Difference IV, Random, 95% CI [kg]
4.19.1 Knee extension								
DIALY-SIZE 2016	9.3	10.1	8	4.9	11.6	8	24.4%	4.40 [-6.26 , 15.06]
Uchiyama 2019	24.9	10.5	23	24.2	10.7	24	75.6%	0.70 [-5.36 , 6.76]
Subtotal (95% CI)			**31**			**32**	**100.0%**	**1.60 [-3.66 , 6.87]**
Heterogeneity: Tau² = 0.00; Chi² = 0.35, df = 1 (P = 0.55); I² = 0%								
Test for overall effect: Z = 0.60 (P = 0.55)								
4.19.2 Handgrip								
Uchiyama 2019	25.7	6.4	23	27.3	5.4	24	49.2%	-1.60 [-4.99 , 1.79]
Frih 2017a	30	5.2	20	37.4	4.8	21	50.8%	-7.40 [-10.47 , -4.33]
Subtotal (95% CI)			**43**			**45**	**100.0%**	**-4.55 [-10.23 , 1.14]**
Heterogeneity: Tau² = 14.10; Chi² = 6.18, df = 1 (P = 0.01); I² = 84%								
Test for overall effect: Z = 1.57 (P = 0.12)								



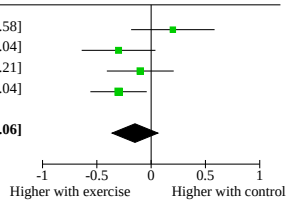
Analysis 4.20. Comparison 4: Combined aerobic and resistance exercise versus control (no exercise/placebo exercise), Outcome 20: Phosphate

Study or Subgroup	Control Mean [mmol/L]	Control SD [mmol/L]	Control Total	Exercise Mean [mmol/L]	Exercise SD [mmol/L]	Exercise Total	Weight	Mean Difference IV, Random, 95% CI [mmol/L]
Deligiannis 1999a	1.94	0.42	12	2.03	0.58	15	9.5%	-0.09 [-0.47 , 0.29]
Kouidi 2010	2.1	0.52	20	2.13	0.55	24	13.4%	-0.03 [-0.35 , 0.29]
Deligiannis 1999	1.97	0.36	30	2	0.55	30	24.4%	-0.03 [-0.27 , 0.21]
Kouidi 2008	1.97	0.26	29	2	0.36	30	52.8%	-0.03 [-0.19 , 0.13]
Total (95% CI)			**91**			**99**	**100.0%**	**-0.04 [-0.15 , 0.08]**
Heterogeneity: Tau² = 0.00; Chi² = 0.09, df = 3 (P = 0.99); I² = 0%								
Test for overall effect: Z = 0.60 (P = 0.55)								
Test for subgroup differences: Not applicable								



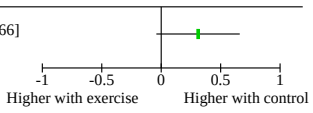
Analysis 4.21. Comparison 4: Combined aerobic and resistance exercise versus control (no exercise/placebo exercise), Outcome 21: Potassium

Study or Subgroup	Control Mean [mmol/L]	Control SD [mmol/L]	Control Total	Exercise Mean [mmol/L]	Exercise SD [mmol/L]	Exercise Total	Weight	Mean Difference IV, Random, 95% CI [mmol/L]
Kouidi 2010	5.8	0.6	20	5.6	0.7	24	19.9%	0.20 [-0.18 , 0.58]
Deligiannis 1999a	5.4	0.4	12	5.7	0.5	15	23.2%	-0.30 [-0.64 , 0.04]
Deligiannis 1999	5.7	0.7	30	5.8	0.5	30	26.0%	-0.10 [-0.41 , 0.21]
Kouidi 2008	5.3	0.4	29	5.6	0.6	30	30.9%	-0.30 [-0.56 , -0.04]
Total (95% CI)			**91**			**99**	**100.0%**	**-0.15 [-0.36 , 0.06]**
Heterogeneity: Tau² = 0.02; Chi² = 5.29, df = 3 (P = 0.15); I² = 43%								
Test for overall effect: Z = 1.38 (P = 0.17)								
Test for subgroup differences: Not applicable								

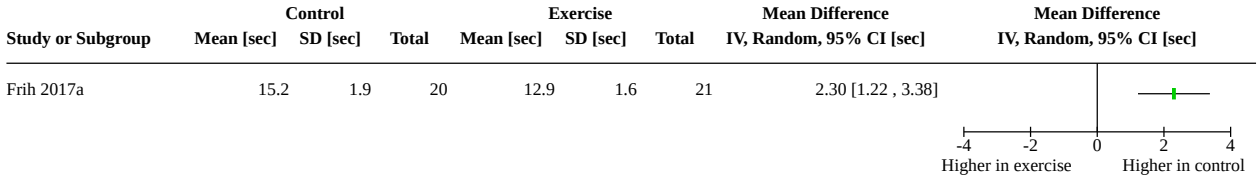


Analysis 4.22. Comparison 4: Combined aerobic and resistance exercise versus control (no exercise/placebo exercise), Outcome 22: Protein intake

Study or Subgroup	Control Mean [g/kg/d]	Control SD [g/kg/d]	Control Total	Exercise Mean [g/kg/d]	Exercise SD [g/kg/d]	Exercise Total	Mean Difference IV, Random, 95% CI [g/kg/d]
Kopple 2007	1.35	0.5987	14	1.04	0.31	15	0.31 [-0.04 , 0.66]



Analysis 4.23. Comparison 4: Combined aerobic and resistance exercise versus control (no exercise/placebo exercise), Outcome 23: Timed up-and-go test



APPENDICES

Appendix 1. Electronic search strategies

Database	Search terms
CENTRAL	1. exercise:ti,ab,kw 2. (physical next (training or activity or fitness or rehabilitation)):ti,ab,kw 3. (resistance next (training or program*)):ti,ab,kw 4. (strength* and (muscle* or program* or training)):ti,ab,kw 5. kinesiotherapy:ti,ab,kw 6. {or #1-#5} 7. (uremi* or uraemi*):ti,ab,kw 8. renal replacement therapy:ti,ab,kw 9. dialysis:ti,ab,kw 10.(hemodialysis or haemodialysis):ti,ab,kw 11.(kidney transplant* or renal transplant*):ti,ab,kw 12.(predialysis or pre-dialysis):ti,ab,kw 13.renal insufficiency:ti,ab,kw 14.MeSH descriptor: [Renal Insufficiency, Chronic] explode all trees 15.((kidney or renal) next (failure or disease)):ti,ab,kw 16.(CKD or CKF or CRD or CRF or ESRD or ESKD or ESRF or ESKF):ti,ab,kw 17.{or #7-#16} 18.{and #6, #17}
MEDLINE	1. exp Exercise/ 2. Physical Exertion/ 3. exp Physical Fitness/ 4. exp Exercise Therapy/ 5. Exercise Test/ 6. exp Exercise Movement Techniques/ 7. exercise.tw. 8. (resistance training or resistance program$).tw. 9. (physical fitness or physical rehabilitation).tw. 10.(strength$ and (muscle or program$ or training)).tw. 11.or/1-10 12.Kidney Diseases/ 13.exp Renal Replacement Therapy/ 14.Renal Insufficiency/ 15.exp Renal Insufficiency, Chronic/

(Continued)

	16.Diabetic Nephropathies/ 17.exp Hypertension, Renal/ 18.dialysis.tw. 19.(hemodialysis or haemodialysis).tw. 20.(hemofiltration or haemofiltration).tw. 21.(hemodiafiltration or haemodiafiltration).tw. 22.(kidney disease* or renal disease* or kidney failure or renal failure).tw. 23.(ESRF or ESKF or ESRD or ESKD).tw. 24.(CKF or CKD or CRF or CRD).tw. 25.(CAPD or CCPD or APD).tw. 26.(predialysis or pre-dialysis).tw. 27.or/12-26 28.and/11,27
EMBASE	1. exp exercise/ 2. exp "physical activity, capacity and performance"/ 3. exp kinesiotherapy/ 4. exp exercise test/ 5. exercise.tw. 6. (resistance training or resistance program$).tw. 7. (physical fitness or physical rehabilitation).tw. 8. (strength$ and (muscle or program$ or training)).tw. 9. or/1-8 10.exp renal replacement therapy/ 11.kidney disease/ 12.chronic kidney disease/ 13.kidney failure/ 14.chronic kidney failure/ 15.mild renal impairment/ 16.stage 1 kidney disease/ 17.moderate renal impairment/ 18.severe renal impairment/ 19.end stage renal disease/ 20.renal replacement therapy-dependent renal disease/ 21.diabetic nephropathy/ 22.kidney transplantation/ 23.renovascular hypertension/ 24.(hemodialysis or haemodialysis).tw. 25.(hemofiltration or haemofiltration).tw. 26.(hemodiafiltration or haemodiafiltration).tw. 27.dialysis.tw. 28.(CAPD or CCPD or APD).tw. 29.(kidney disease* or renal disease* or kidney failure or renal failure).tw. 30.(CKF or CKD or CRF or CRD).tw. 31.(ESRF or ESKF or ESRD or ESKD).tw. 32.(predialysis or pre-dialysis).tw. 33.((kidney or renal) adj (transplant* or graft* or allograft*)).tw. 34.or/10-33 35.and/9,34

Appendix 2. Risk of bias assessment tool

Potential source of bias	Assessment criteria
Random sequence generation Selection bias (biased allocation to interventions) due to inadequate generation of a randomised sequence	*Low risk of bias:* Random number table; computer random number generator; coin tossing; shuffling cards or envelopes; throwing dice; drawing of lots; minimisation (minimisation may be implemented without a random element, and this is considered to be equivalent to being random).
	High risk of bias: Sequence generated by odd or even date of birth; date (or day) of admission; sequence generated by hospital or clinic record number; allocation by judgement of the clinician; by preference of the participant; based on the results of a laboratory test or a series of tests; by availability of the intervention.
	Unclear: Insufficient information about the sequence generation process to permit judgement.
Allocation concealment Selection bias (biased allocation to interventions) due to inadequate concealment of allocations prior to assignment	*Low risk of bias:* Randomisation method described that would not allow investigator/participant to know or influence intervention group before eligible participant entered in the study (e.g. central allocation, including telephone, web-based, and pharmacy-controlled, randomisation; sequentially numbered drug containers of identical appearance; sequentially numbered, opaque, sealed envelopes).
	High risk of bias: Using an open random allocation schedule (e.g. a list of random numbers); assignment envelopes were used without appropriate safeguards (e.g. if envelopes were unsealed or non-opaque or not sequentially numbered); alternation or rotation; date of birth; case record number; any other explicitly unconcealed procedure.
	Unclear: Randomisation stated but no information on method used is available.
Blinding of participants and personnel Performance bias due to knowledge of the allocated interventions by participants and personnel during the study	*Low risk of bias*: No blinding or incomplete blinding, but the review authors judge that the outcome is not likely to be influenced by lack of blinding; blinding of participants and key study personnel ensured, and unlikely that the blinding could have been broken.
	High risk of bias: No blinding or incomplete blinding, and the outcome is likely to be influenced by lack of blinding; blinding of key study participants and personnel attempted, but likely that the blinding could have been broken, and the outcome is likely to be influenced by lack of blinding.
	Unclear: Insufficient information to permit judgement
Blinding of outcome assessment Detection bias due to knowledge of the allocated interventions by outcome assessors.	*Low risk of bias:* No blinding of outcome assessment, but the review authors judge that the outcome measurement is not likely to be influenced by lack of blinding; blinding of outcome assessment ensured, and unlikely that the blinding could have been broken.
	High risk of bias: No blinding of outcome assessment, and the outcome measurement is likely to be influenced by lack of blinding; blinding of outcome assessment, but likely that the blinding could have been broken, and the outcome measurement is likely to be influenced by lack of blinding.
	Unclear: Insufficient information to permit judgement
Incomplete outcome data Attrition bias due to amount, nature or handling of incomplete outcome data.	*Low risk of bias:* No missing outcome data; reasons for missing outcome data unlikely to be related to true outcome (for survival data, censoring unlikely to be introducing bias); missing outcome data balanced in numbers across intervention groups, with similar reasons for missing data across groups; for dichotomous outcome data, the proportion of missing outcomes compared with observed event risk not enough to have a clinically relevant impact on the intervention effect estimate; for continuous outcome data, plausible effect size (difference in means or standardised difference in means) among missing outcomes not enough to have a clinically relevant impact on observed effect size; missing data have been imputed using appropriate methods.

(Continued)

	High risk of bias: Reason for missing outcome data likely to be related to true outcome, with either imbalance in numbers or reasons for missing data across intervention groups; for dichotomous outcome data, the proportion of missing outcomes compared with observed event risk enough to induce clinically relevant bias in intervention effect estimate; for continuous outcome data, plausible effect size (difference in means or standardized difference in means) among missing outcomes enough to induce clinically relevant bias in observed effect size; 'as-treated' analysis done with substantial departure of the intervention received from that assigned at randomisation; potentially inappropriate application of simple imputation.
	Unclear: Insufficient information to permit judgement
Selective reporting Reporting bias due to selective outcome reporting	*Low risk of bias:* The study protocol is available and all of the study's pre-specified (primary and secondary) outcomes that are of interest in the review have been reported in the pre-specified way; the study protocol is not available but it is clear that the published reports include all expected outcomes, including those that were pre-specified (convincing text of this nature may be uncommon).
	High risk of bias: Not all of the study's pre-specified primary outcomes have been reported; one or more primary outcomes is reported using measurements, analysis methods or subsets of the data (e.g. sub-scales) that were not pre-specified; one or more reported primary outcomes were not pre-specified (unless clear justification for their reporting is provided, such as an unexpected adverse effect); one or more outcomes of interest in the review are reported incompletely so that they cannot be entered in a meta-analysis; the study report fails to include results for a key outcome that would be expected to have been reported for such a study.
	Unclear: Insufficient information to permit judgement
Other bias Bias due to problems not covered elsewhere in the table	*Low risk of bias:* The study appears to be free of other sources of bias.
	High risk of bias: Had a potential source of bias related to the specific study design used; stopped early due to some data-dependent process (including a formal-stopping rule); had extreme baseline imbalance; has been claimed to have been fraudulent; had some other problem.
	Unclear: Insufficient information to assess whether an important risk of bias exists; insufficient rationale or evidence that an identified problem will introduce bias.

Appendix 3. Characteristics of included interventions

Trial name	Type of exercise	Description of exercise	Materials	Intensity class	Who provided/supervised	Maximum duration	Frequency (time/week)	Timing in relation to HD sessions	Duration of intervention (week)
Abreu 2017	resistance	lower limbs exercises	ankle weights and resistance bands	moderate	physiotherapist	30	3	during	12
Abundis Mora 2017	aerobic	stationary cycling	ergometer	moderate	not reported	135/week	not reported	during	35
ACTINUT 2013	aerobic	stationary cycling	ergometer	moderate	physician, nurse, exercise physiologist	35	3	during	24
Afshar 2010 (A)	resistance	lower limbs exercises	ankle weights	moderate to vigorous	physician	40	3	during	8
Afshar 2010 (B)	aerobic	stationary cycling	ergometer	moderate to vigorous	not reported	40	3	during	8
Afshar 2011	aerobic	stationary cycling	ergometer	moderate to vigorous	not reported	40	3	during	8
Akiba 1995	aerobic	stationary cycling	ergometer	moderate	not reported	30	3	during	12
Amini 2016	aerobic	not reported	not reported	not reported	researcher	not reported	not reported	not reported	8
AVANTE-HEMO 2020 (A)	aerobic	stationary cycling	ergometer	moderate	not reported	30	3	during	12
AVANTE-HEMO 2020 (B)	resistance	upper and lower limbs exercises	resistance bands	moderate	not reported	40	3	during	12
Bennett 2013	resistance	lower body exercises	resistance bands and tubing	not reported	exercise physiologist	varied	3	during	12

(Continued)

Burrows 2018	combined	stationary cycling and total body resistance and balance exercises	ergometer + resistance bands	moderate	not reported	30 min intraHD + home sessions	5	during	24
Carmack 1995	aerobic	stationary cycling	ergometer	not reported	not reported	30	3	during	10
CHAIR 2015	aerobic	chair-stand exercise	chair	not reported	physician and physiotherapist	15	3	just before	12
Chang 2010	aerobic	stationary cycling	ergometer	moderate	not reported	35	3	during	8
Chen 2010	resistance	lower body exercises	ankle weights	moderate	supervised not further defined	not reported	2	during	26
Cho 2018 (A)	aerobic	stationary cycling	ergometer	not reported	not reported	30	3	during	12
Cho 2018 (B)	resistance	upper and lower limbs exercises	resistance bands and soft weights	not reported	not reported	not reported	3	during	12
Cho 2018 (C)	combined	combination of A and B	ergometer, resistance bands and soft weights	not reported	not reported	not reported	3	during	12
Cooke 2018	aerobic	stationary cycling	ergometer	moderate to vigorous	not reported	varied	3	during	16
CYCLE-HD 2016	aerobic	stationary cycling	ergometer	moderate to vigorous	not reported	30	3	during	26
Dashtidehkordi 2019	aerobic	stationary cycling	ergometer	not reported	not reported	60	3	during	8
de Lima 2013 (A)	resistance	lower limbs exercises	not reported	not reported	not reported	not reported	3	during	8
de Lima 2013 (B)	aerobic	stationary cycling	ergometer	light to moderate	not reported	20	3	during	8
Deligiannis 1999	combined	bicycling and/or walking, callisthenics, steps, swimming, or ball games fol-	not reported	moderate	physician, exercise physiologist,	90	3-4	on non-HD days	26

(Continued)

		lowed by resistance program			and physical education instructor				
Deligiannis 1999a (A)	combined	stationary cycling, callisthenics, steps and flexibility exercises	ergometer or treadmill	moderate	physician and physical education teachers	90	3	on non-HD days	26
Deligiannis 1999a (B)	aerobic	stationary cycling and extension exercises	ergometer	moderate	physician and physical education teachers	30	5	not during	26
DePaul 2002	combined	stationary cycling and lower limbs strength training	ergometer and Response Seated Leg Curl Thigh Extension pulley weight system	moderate	kinesiologist	varied	3	during and just before or after	12
DIALY-SIZE 2016(A)	aerobic	stationary cycling	ergometer	moderate	kinesiologist	53	3	during	12
DIALY-SIZE 2016 (B)	resistance	lower limbs exercises	ankle weights and resistance bands	moderate	kinesiologist	varied	3	during	12
DIALY-SIZE 2016 (C)	combined	all of (A) and (B)	A + B	moderate	kinesiologist	varied	3	during	12
Dobsak 2012	aerobic	stationary cycling	ergometer	light to moderate	not reported	50	3	during	20
Dong 2011	resistance	lower limbs exercises	pneumatic leg press machine	moderate	study personnel	varied	3	just before	20
EXCITE 2014	aerobic	walking	-	light to moderate	not supervised	varied	3	on non-HD days	26
Fernandes 2019	aerobic	stationary cycling	ergometer	moderate	not reported	50	3	during (1 hour after commencement of dialysis)	8

(Continued)

Frey 1999	aerobic	stationary cycling	multigym	moderate to vigorous	not reported	55	3	during	8
Frih 2017a	combined	upper and lower limbs exercises and stationary cycling and walking	ergometer, treadmill, multigym	moderate	physiotherapist and trainer	60	4	on non-HD days	16
Giannaki 2013a	aerobic	stationary cycling	ergometer	moderate	not reported	not reported	3	during	26
Goldberg 1983	aerobic	cycling or walking	ergometer, running track	moderate	not reported	80	3	on non-HD days	52 ± 16
Harter 1985	aerobic	cycling or walking	ergometer, running track	moderate	physician, nurse, exercise physiologist	45	not reported	on non-HD days	52
Groussard 2015	aerobic	stationary cycling	ergometer	moderate	"professional team with expertise in physical activity"	40	3	during	12
IHOPE 2019	aerobic	stationary cycling	ergometer	moderate	research staff	45	3	during	52
Johansen 2006	resistance	lower limbs exercises	ankle weights	moderate	study personnel	varied	3	during	12
Koh 2009 (A)	aerobic	stationary cycling	ergometer	moderate	supervised not further defined	45	3	during	24
Koh 2009 (B)	aerobic	walking	-	moderate	unsupervised	45	3	not reported	24
Konstantinidou 2002 (A)	combined	Calisthenics, steps, flexibility, stretching and resistance exercises	ergometer	moderate	Sports physician, physical education instructor	40	3	On non-HD days	26
Konstantinidou 2002 (B)	combined	Stationary cycling and lower limbs exercises	ergometer, resistance bands and weights	moderate to vigorous	sports physician, physical education instructor	20 aerobic + resistance	3	during	26

(Continued)

Konstantinidou 2002 (C)	combined	stationary cycling	ergometer	moderate	not supervised	30 aerobic+resistance	5	not reported	26
Kopple 2007 (A)	aerobic	stationary cycling	ergometer	moderate	investigator	70	3	during	20
Kopple 2007 (B)	resistance	lower limbs exercises	leg extension/leg curl and leg press/ calf extension apparatus	moderate	investigator	not reported	3	just before	20
Kopple 2007 (C)	combined	50% of (A) and 50% of (B)	A + B	moderate	investigator	not reported	3	just before and during	20
Koufaki 2003	aerobic	stationary cycling	ergometer	moderate to vigorous	not reported	40	3	during	12
Kouidi 1997	aerobic	stationary cycling, walking or jogging, callisthenics, aerobics, swimming and/or game sports	not reported	moderate	physician, exercise physiologist, trainer	90	3-4	on non-HD days	26
Kouidi 2003	aerobic	stationary cycling	not reported	not reported	supervised not further defined	not reported	3	during	52
Kouidi 2004a	aerobic	stationary cycling	not reported	not reported	supervised not further defined	not reported	3	during	26
Kouidi 2005	aerobic	stationary cycling	not reported	not reported	supervised not further defined	not reported	3	during	43.4
Kouidi 2008	combined	stationary cycling and abdominal and lower limbs exercises	ergometer, weights and elastic bands	moderate to vigorous	exercise trainers, physician	110	3	during	43.4
Kouidi 2010	combined	stationary cycling and lower limbs exercises	ergometer, free weights and resistance bands	not reported	exercise trainers, physician	100	3	during	52
Lee 2001	aerobic	stationary cycling and walking	ergometer, treadmill	moderate	not reported	40	2-4	just prior	12

(Continued)

Liao 2016	aerobic	stationary cycling	ergometer	moderate to vigorous	physician and nurse	30	3	during	12
Ma 2018	combined	aerobics, resistance, and flexibility training not further defined	not reported	not reported	not reported	20	3	during	104
Makhlough 2012	range of movement	rotating the wrist, wrist up and down, ankle twisting motion	-	light to moderate	not reported	15	3	during	8
Marchesan 2016	combined	stationary cycling and upper and lower limbs, thorax and abdominal exercises	ergometer and step	moderate	not reported	45+resistance	3	during	24
Marinho 2016	resistance	lower limbs exercises	resistance bands and ankle cuffs	moderate	physical education teacher	varied	3	during	8
Martin-Alemany 2016	resistance	upper and lower limbs exercises	ankle weights and resistance springs	moderate	not reported	40	2	during	12
Martins do Valle 2020	resistance	lower and upper limbs exercises	ankle weights and dumbbells	moderate to vigorous	supervised not further defined	varied	3	during	12
Matsumoto 2007	aerobic	stationary cycling	ergometer	moderate	research assistants	20	3	just before	52
McAdams-DeMarco 2018	aerobic	stationary cycling	ergometer	not reported	research assistants	varied	3	during	12
McGregor 2018	aerobic	stationary cycling	ergometer	moderate	exercise physiologists	70	3	during	10
Mitsiou 2015	not reported	not reported	not reported	not reported	not reported	not reported	not reported	during	26
Miura 2015	aerobic	stationary cycling	ergometer	light to moderate	not reported	60	3	during	12
Molsted 2004	combined	step and circuit training and stationary cycling	ergometer, step	moderate to vigorous	physiotherapist	70	2	not reported	21.7

(Continued)

Momeni 2014	aerobic	stationary cycling	mini bike	not reported	not reported	30	3	during	12
Mortazavi 2013	aerobic	stationary cycling	ergometer	light to moderate	not reported	30	3	during	16
Olvera-Soto 2016	resistance	upper and lower limbs exercises	weights and resistance bands	not reported	supervised not further defined	50	2	during	12
Ouzouni 2009	combined	stationary cycling and abdominal and lower limbs exercises	ergometer, weights and resistance bands	not reported	physician and exercise physiologist	20 aerobic + resistance	3	during	43.4
Painter 2002a	aerobic	stationary cycling	ergometer	moderate to vigorous	research assistants	40	3	during	21.7
Paluchamy 2018	aerobic	stationary cycling	ergometer	not reported	not reported	20	3	during	12
Parsons 2004	aerobic	stationary cycling	ergometer	light to moderate	not reported	45	3	during	12
PEAK 2006	resistance	upper and lower limbs exercises	ankle and free-weights dumbbells	moderate to vigorous	exercise physiologist	45	3	prior and during	12
Pellizzaro 2013	resistance	knee extensions	free leg weights	moderate	not reported	varied	3	during	10
Rahimi-moghadam 2017	resistance	modified pilates	not reported	not reported	pilates professional	45	3	on non-HD days	8
Reboredo 2010	aerobic	stationary cycling	horizontal ergometer	moderate	supervised not further defined	50	3	during	12
Rezaei 2015	range of movement	joints warming actions, stretching, lower back and abdominal exercises, and deep breathing exercises.	not reported	light to moderate	unsupervised	35	3	not during, home-based	10
Rosa 2018	resistance	upper and lower limbs exercises	weights and resistance bands	not reported	exercise physiologist	50	3	prior and during	12

(Continued)

Rouchon 2016	combined	stationary cycling and upper and lower limbs exercises	ergometer, weights	not reported	not reported	35	2	not applicable,PD patients only	12
Samara 2016	aerobic	swimming	pool, foam tubes, buoyancy belts, paddles	moderate	trainer	60	3	on non-HD days	16
Segura-Orti 2009	resistance	lower limbs exercises	ankle weights	moderate	physiotherapist	35	3	during	24
Sheshadri 2020	aerobic	walking and weekly activity goals	pedometer	not applicable	unsupervised	not applicable	not applicable	not during	12
Soliman 2015	range of movement	range of motion exercises	not reported	light to moderate	not reported	15	3	during	8
Song 2012a	resistance	upper and lower limbs exercises	ankle weights and resistance bands	moderate	investigator and research assistant	30	3	not during	12
Suhardjono 2019 (A)	aerobic	stationary cycling	ergometer	moderate	physician	30	2	during	12
Suhardjono 2019 (B)	combined	stationary cycling and lower limbs exercises	ankle weights	light to moderate	physicians	not reported	2	during	12
Toussaint 2008	aerobic	stationary cycling	ergometer	not reported	unsupervised	30	3	during	12
Tsuyuki 2003	aerobic	cycling, walking and jogging	ergometer	moderate	physician	30	2-3	on non-HD days	20
Uchiyama 2019	combined	walking, upper and lower limbs exercises	resistance bands	moderate	unsupervised	30	3	not applicable, PD patients only	12
van Vilsteren 2005	combined	stationary cycling, callisthenics, steps and flexibility and resistance exercises	multi-trainer	moderate	not reported	60	3	during and prior to HD	12

(Continued)

Wilund 2010	aerobic	stationary cycling	ergometer	moderate	research assistants	45	3	during	16
Wu 2014d	aerobic	stationary cycling	ergometer	moderate to vigorous	not reported	20	3	during	12
Yurtkuran 2007	yoga	modified yoga exercise	not reported	not reported	not reported	30	2	not reported	12
Zhao 2017	aerobic	road cycling	bicycle, road	not reported	not reported	70	6	after	18

Appendix 4. 2011 search strategies

The search strategies below were created by the authors of the initial review. These strategies have not been updated and were not used for the 2021 update.

DATABASE	Search terms
CINAHL	1. exertion/ 2. therapeutic exercise/ 3. exercise test/ 4. physical fitness/ 5. or/1-4 6. exercise.tw. 7. (resistance training or resistance program$).tw. 8. (physical fitness or physical rehabilitation).tw. 9. (strength$ and (muscle$ or program$ or training)).tw. 10.or/6-9 11.or/5,10 12.uremia/ 13.ur?emi$.tw. 14.12 or 13 15.(hemodialysis or haemodialysis).tw. 16.dialysis.tw. 17.renal replacement therapy/ 18.kidney failure chronic/ 19.(kidney failure or renal failure or kidney disease or renal disease).tw. 20.(CKD or CKF or CRD or CRF or ESKD or ESKF or ESRD or ESRF).tw. 21.or/15-20 22.or/14,21 23.and/11,22
Webscience (Science citation index and Social science citation index)	1. (exertion OR exercise therapy OR physical education and training OR physical fitness OR exercise program* OR exercise training) AND (uremia OR ur?emia OR hemodialysis OR haemodialysis OR peritoneal dialysis OR renal* OR kidney*) 2. (excertion OR exercise* OR motion therapy* OR physical educ* OR physical train* OR physical fitness*) AND (uremia OR ur?emia OR hemodialysis OR haemodialysis OR peritoneal dialysis OR renal* OR kidney*) AND (controlled clinical trial* OR CCT OR clinical trial* OR CT OR Randomized controlled trial* OR RCT)
BIOSIS	1. exertion.mp. 2. exercise therapy.mp. 3. exercise test.mp. 4. (physical education and training).mp. [mp=title, book title (english), original language book title (non-english), abstract, concept codes, biosystematic codes, chemicals & biochemicals, diseases, major concepts, methods & equipment, organisms, parts, structures & systems of organisms, sequence data, super taxa, taxa notes, time, geopolitical locations, gene name, miscellaneous descriptors] 5. physical fitness.mp. 6. 1 or 2 or 3 or 4 or 5 7. exercise program$.mp. 8. exercise training.mp. 9. 7 or 8 10.6 or 9

(Continued)

	11.uremia.mp. 12.ur?emia.mp. 13.11 or 12 14.renal replacement therapy.mp. 15.haemodialysis.mp. 16.hemodialysis.mp. 17.renal transplant$.mp. 18.peritoneal dialysis.mp. 19.14 or 15 or 16 or 17 or 18 20.kidney failure chronic.mp. 21.chronic kidney failure.mp. 22.chronic renal failure.mp. 23.20 or 21 or 22 24.13 or 19 or 23 25.10 and 24
PEDRO	1. abstract & Title: renal 2. Therapy: fitness training
AMED	1. exp Exertion/ 2. exercise therapy.mp. or Treatment group Exercise therapy/ 3. exp Exercise testing/ or exercise test.mp. 4. (physical education and training).mp. 5. exp Physical fitness/ 6. 1 or 2 or 3 or 4 or 5 7. exercise program?.mp. 8. exercise training.mp. 9. 7 or 8 10.6 or 9 11.uremia.mp. 12.ur?emia.mp. 13.11 or 12 (9) 14.renal replacement therapy.mp. 15.haemodialysis.mp. 16.renal transplant?.mp. 17.peritoneal dialysis.mp. 18.hemodialysis.mp. or exp Hemodialysis/ 19.14 or 15 or 16 or 17 or 18 20.exp Kidney failure chronic/ 21.chronic kidney failure.mp. 22.chronic renal failure.mp. 23.20 or 21 or 22 24.13 or 19 or 23 25.10 and 24
PsycINFO	1. exp EXERCISE/ or exercise.mp. 2. exp Dialysis/ or Kidney Diseases/ or Organ Transplantation/ or Kidneys/ 3. 1 AND 2 4. limit 3 to human
AGELINE	1. Exercise OR Exertion OR Fitness OR Training 2. uremia OR renal OR kidney OR hemodialysis OR peritoneal dialysis

(Continued)

	3. Combine with AND 4. Limit to Research/Academic and Professional/Provider
KoreaMed	1. exercise [ALL] AND nephrol [ALL] 2. exercise [ALL] AND kidney [ALL]

HISTORY

Date	Event	Description
22 May 2017	Amended	Updated search strategies for MEDLINE, EMBASE & CENTRAL

CONTRIBUTIONS OF AUTHORS

- Amelie Bernier-Jean designed the new features of the systematic review and meta-analyses from the previous version, coordinated the review process, screened all the search results, assessed all the studies for quality, extracted data for all studies, analysed data, conducted the meta-analysis, and had the primary role in writing the manuscript.
- Nadim Berudi screened search results, assessed studies for quality, extracted data, conducted the independent double verification of all results provided in the manuscript and reviewed the final manuscript.
- Nicola Bondonno screened search results, assessed studies for quality, extracted data and reviewed the final manuscript.
- Gabrielle Williams screened search results, assessed studies for quality, extracted data and reviewed the final manuscript.
- Jonathan Craig contributed to the design of the new features of the systematic review and meta-analyses from the previous version and reviewed the final manuscript.
- Germaine Wong contributed to the design of the new features of the systematic review and meta-analyses from the previous version and reviewed the final manuscript.

DECLARATIONS OF INTEREST

- Amelie Bernier-Jean has declared that they have no conflict of interest
- Nadim A Beruni has declared that they have no conflict of interest
- Nicola Patricia P Bondonno has declared that they have no conflict of interest
- Gabrielle Williams has declared that they have no conflict of interest
- Armando Teixeira-Pinto has declared that they have no conflict of interest
- Jonathan C Craig has declared that they have no conflict of interest
- Germaine Wong has declared that they have no conflict of interest

SOURCES OF SUPPORT

Internal sources

- No sources of support provided

External sources

- NHMRC, Australia

  Postgraduate Scholarship Scheme (GNT1151246)

DIFFERENCES BETWEEN PROTOCOL AND REVIEW

Types of participants

The protocol and the original review published in Heiwe 2011 included adults at all stages of CKD, including those not undergoing dialysis and kidney transplant recipients. The current reviews included only adults undergoing maintenance dialysis. Adults with CKD not undergoing dialysis and kidney transplant recipients will be the subject of separate reviews.

Types of outcome measures

All the outcomes selected in the protocol and in Heiwe 2011 were updated. However, only the outcomes that are important to patients, their caregivers and health professionals were reported in the text of the review. Whenever appropriate, we conducted exploratory meta-analyses of the remaining outcomes.

Statistical assessment

All meta-analyses were random-effects meta-analyses. As in Heiwe 2011, in this update we did not adjust for the degree of anaemia, the degree of glomerular filtration rate, the duration of uraemia and dialysis adequacy as the protocol initially intended it.

INDEX TERMS

Medical Subject Headings (MeSH)

Exercise; Fatigue [etiology]; Quality of Life; *Renal Dialysis; *Resistance Training

MeSH check words

Adult; Humans