A meta-analysis of the effect of exercise training on left ventricular remodeling in heart failure patients: the benefit depends on the type of training performed
Haykowsky M J, Liang Y, Pechter D, Jones L W, McAlister F A, Clark A M

CRD summary
This review investigated the impact of exercise training on left ventricular remodeling in patients with clinically stable heart failure. Aerobic training, but not strength training combined with aerobic training, showed benefits. The included studies were generally low quality, participants were primarily male and usual care varied greatly across studies, making the generalisability and reliability of the conclusions uncertain.

Authors' objectives
To determine the effect of exercise training on left ventricular remodeling in patients with clinically stable heart failure.

Searching
MEDLINE, CINAHL and EMBASE (from inception to 2006), the Cochrane Central Register of Controlled Trials (Issue 3, 2006) and references of identified studies and reviews were searched for English-language studies. Search terms were reported.

Study selection
Randomised controlled trials (RCTs) of parallel design that evaluated exercise training compared to usual care in patients with heart failure that had been clinically stable for at least one month were eligible for inclusion if they reported on ejection fraction or left ventricular volumes. Studies of cross-over design or in which patients received a concurrent pharmacological treatment as part of the intervention were excluded. The duration of interventions ranged from two to 14 months. The mean age of participants ranged from 52 to 69 years. The proportion of males was 67 to 100 per cent. Most participants were NYHA (New York Heart Association) functional class II or III, although patients from all four grades of heart failure were included in the review. Ejection fraction was primarily measured using echocardiography. Two reviewers independently selected studies for inclusion.

Assessment of study quality
Study quality was assessed using the Jadad scale, which assesses randomisation, blinding and withdrawals; it was unclear whether this assessment was conducted in duplicate.

Data extraction
Changes from baseline were extracted for each arm of the trials. Two reviewers independently extracted data. Trial investigators were contacted when clarification of data was required.

Methods of synthesis
Pooled weighted mean differences and 95% confidence intervals (CI) were calculated using a random-effects model. Heterogeneity was assessed using the I² statistic. Subgroup analyses were planned a priori for the different types of exercise training. Sensitivity analyses were conducted by calculating the standardised mean difference for left ventricular volume and to investigate the impact of outcome assessor blinding. Publication bias was assessed using a funnel plot, the Begg adjusted-rank correlation test and the Egger regression asymmetry test.

Results of the review
Fourteen RCTs were included in the review (n=832). None of the trials were double blind. Only four reported blinding outcome assessors. Out of a possible quality score of 5, seven studies scored 1, five scored 2 and two scored 3.

Overall, exercise training significantly improved ejection fraction (weighted mean difference was 1.83; 95% CI: 0.45 to 3.21; 14 trials). Significant heterogeneity was observed in this analysis (I²=49.2%). When grouped by type of exercise, aerobic training alone significantly improved ejection fraction (weighted mean difference was 2.59; 95% CI: 1.44 to 3.74; nine trials), but strength training alone (one trial) or in combination with aerobic training (four trials) did not. There was no significant heterogeneity in the analyses where studies were pooled in these subgroups.
Overall, exercise training was associated with a significant reduction in end diastolic volume (weighted mean difference was -9.75 mL, 95% CI: -16.64 to -2.86; seven trials) and end systolic volume (weighted mean difference was -12.31 mL, 95% CI: -17.12 to -7.49; seven trials) as was aerobic training alone for end diastolic volume (weighted mean difference -11.94 mL, 95% CI: -19.95 to -3.02; five trials) and end systolic volume (weighted mean difference was -12.87 mL, 95% CI: -17.80 to -7.93; five trials), but not strength training in combination with aerobic training (two trials). None of these analyses were reported to show significant heterogeneity between studies.

Results for sensitivity analyses were reported. There was no evidence of publication bias.

**Authors’ conclusions**
Aerobic training reversed left ventricular remodeling in patients with clinically stable heart failure, but strength training in combination with aerobic training did not show these benefits.

**CRD commentary**
The authors addressed a clear review question and used prespecified inclusion criteria. A number of relevant databases were searched. Publication bias was investigated. Only English language studies were included, so language bias may have been present. Study selection and data extraction were conducted in duplicate, but it was unclear whether similar steps to avoid error or bias were used during the quality assessment. Appropriate methods of analysis were used and heterogeneity investigated. Most of the included studies were of low quality (recruited few participants and did not use blinded assessment of outcomes). In addition, the overall population was primarily male and the proportion of patients receiving the different types of medication as part of their usual care varied greatly across studies. These factors make the reliability and generalisability of the review's conclusions uncertain.

**Implications of the review for practice and research**
**Practice:** The authors did not state implications for practice.

**Research:** The authors stated that future trials of the impact of exercise training on left ventricular remodeling should incorporate blinded outcome assessment.

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