CRD summary
The authors concluded that the current peer-reviewed evidence seemed inadequate to generally recommend incorporation of moderate-to-high intensity resistance training into exercise-based rehabilitation programmes for patients with chronic heart failure. The authors’ conclusion is appropriately cautious and represents the evidence presented, but its reliability is unclear given the small number of included trials, their small sample sizes and poor quality.

Authors’ objectives
To determine the effects of supervised moderate-to-high intensity resistance training in patients with chronic heart failure.

Searching
PubMed, Science Citation Index Expanded, Social Sciences Citation Index, and Arts & Humanities Citation Index were searched up to August 2008, for relevant articles with an English language title. Search terms were reported. Reference lists and citations of original articles were searched and authors of trials were contacted in order to identify additional studies. Details of the review methods were reported in a separate online appendix (see URL for Additional Data).

Study selection
Eligible for inclusion in the review were randomised and non-randomised controlled trials that compared supervised moderate-to-high resistance training to placebo, another exercise modality, resistance training combined with another exercise modality, or a usual care, in patients with chronic heart failure. Trials with nutrition and/or hormone modulation or that had resistance-training programmes using cycle ergometers, whole-body vibration or single leg training were excluded from the review. Details of the review methods were reported in a separate online appendix (see URL for Additional Data).

Moderate to high intensity resistance exercise was defined, using the American Heart Association definition, as an exercise modality in which skeletal muscle groups of upper and/or lower limbs are trained by repetitive lifting (maximum two to four series of 15 repetitions) of relatively heavy weights (over 60% or increasing to over 60% of the one-repetition maximum). Additionally, resistance training had to be performed in a rhythmical manner preferably at moderate to slow controlled speed.

Outcome measures, which were not specified a priori, included indices of cardiovascular function, skeletal muscle function, body composition, functional exercise capacity, peak exercise capacity and disease-specific quality of life. Adverse events were also reported in the review.

Trials included in the review compared: resistance training versus usual care, low intensity stretching, endurance training plus resistance training, and endurance training versus usual care; resistance training plus endurance training versus endurance training only (where reported). Training frequencies were twice per week for 10 to 20 weeks, or three times per week for eight to 23 weeks. The mean age of participants ranged from 50 to 77 years. Most trials were of men only and excluded patients with comorbidities such as diabetes. Included patients had a New York Heart Association (NYHA) classification of I, II or III (where reported).

The authors did not state how many reviewers performed study selection.

Assessment of study quality
Trial quality was assessed using the nine-item Delphi list, which assessed randomisation, allocation concealment, similarity of groups at baseline, specification of eligibility criteria, blinding of outcome assessors, blinding of care
provider, blinding of patients, point estimates and variability for the primary outcomes, and the use of intention-to-treat analyses. Trials of the highest quality could score a maximum of 9 points.

The authors did not state how many reviewers performed study quality assessment.

**Data extraction**
Data were extracted into a pre-specified form. Data were checked independently by two individuals who did not participate in the the initial data collection. Any disagreements were resolved by discussion.

**Methods of synthesis**
Due to the heterogeneity between trial design and outcomes, a narrative synthesis was used. Data were presented in tables.

**Results of the review**
Nine trials were included in the review (seven RCTs and two non-RCTs; 260 participants; sample sizes ranged from 15 to 60 patients). One trial scored 8 on the Delphi list and four scored 3 or below. The average score was 4.3 points, which was regarded as poor quality. Where reported, mean compliance rate was from 75% to 100%.

**Resistance training** (four trials: three RCTs, one non-RCT): There was no statistically significant difference between resistance training and usual care or low intensity stretching in left ventricular contractile function or on myocardial deterioration. Whilst some trials showed a significant difference in favour of resistance training for mean change in peripheral muscle strength and endurance, submaximal exercise capacity, peak aerobic capacity and disease specific quality of life, others did not.

**Resistance training plus endurance training** (five trials: four RCTs, one non-RCT): There were no statistically significant difference between resistance training in combination with endurance training versus endurance training alone on left ventricular contractile function, or on myocardial deterioration, cardiac function, NYHA classification, disease-specific quality of life, body composition, peripheral muscle strength and peak aerobic capacity.

**Adverse events**: One trial reported adverse events as a pre-defined secondary outcome, and reported no adverse events. Nine trials did not pre-define adverse events as an outcome measure. However, two trials reported adverse events in the resistance training group (hospitalisation due to severe asthma attack in one participant; assigned one week rest due to low back pain that could not be related to intervention in one participant); five of these trials reported a serious adverse event in the endurance training group (a period of severe hypotension in one patient; withdrawal due to worsening chronic heart failure in one patient; unable to make time commitment to study in two patients; and drop-out due to hospitalisation for rapid rate atrial fibrillation in one patient). In the combined resistance and endurance training group, two patients dropped out due to lymphoma and ischialgia in one trial.

**Authors' conclusions**
Even though moderate-to-high intensity resistance training did not seem to be harmful for patients with chronic heart failure, the current peer-reviewed evidence seemed inadequate to generally recommend incorporation of resistance training into exercise-based rehabilitation programmes for patients with chronic heart failure.

**CRD commentary**
The review addressed a clear research question and had adequate inclusion criteria. However, outcome measures were not specified a priori and were chosen based on what outcomes were reported in the included trials. The search strategy was adequate, but it was unclear whether there were language restrictions, so the risk of language bias was unclear. The authors did not report how many reviewers performed study selection and study quality assessment, so it was unclear whether these two review process were subject to reviewer error or bias.

Given the heterogeneity between studies in terms of trial design and outcome measures, it was appropriate that a narrative synthesis was used.

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given the small number of included trials, their small sample sizes and poor quality.

**Implications of the review for practice and research**

**Practice**: The authors did not state any implications for practice.

**Research**: The authors stated that there is a need for appropriately designed new RCTs to quantify the effects of moderate-to-high intensity resistance training, which have: a larger sample of clinically stable chronic heart failure patients; short- and long-term follow-up; and clinically relevant outcomes of left ventricular remodelling, submaximal exercise parameters, skeletal muscle endurance and patient-centred outcomes (like daily physical activity level using validated accelerometers). They also stated that it may be worth assessing the effects of a multidisciplinary approach in which cardiologists and physiotherapist collaborate with specialised nurses, psychosocial counsellors, occupational therapists and dieticians. Authors should report more carefully on the safety of resistance training as well as the actual training load over time of individual chronic heart failure patients to make continuous evaluation possible.

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This is a critical abstract of a systematic review that meets the criteria for inclusion on DARE. Each critical abstract contains a brief summary of the review methods, results and conclusions followed by a detailed critical assessment on the reliability of the review and the conclusions drawn.