How should COPD patients exercise during respiratory rehabilitation: comparison of exercise modalities and intensities to treat skeletal muscle dysfunction

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CRD summary
This good-quality systematic review compared different exercise protocols for patients with chronic obstructive pulmonary disease. The authors concluded that strength exercise tends to improve health-related quality of life more than endurance exercise. However, more research is needed to compare interval exercise with continuous exercise and to define optimal exercise intensity. The authors’ conclusions are likely to be reliable.

Authors’ objectives
To compare the effectiveness of different exercise protocols for patients with chronic obstructive pulmonary disease (COPD) in terms of exercise capacity and health-related quality of life.

Searching
The authors searched MEDLINE (from inception to May 2004), EMBASE (from inception to November 2003), PEDro (November 2003), the Cochrane CENTRAL Register (Issue 1, 2004) and the Science Citation Index. They also used the ‘related articles’ function of PubMed by entering all previously identified studies that met their inclusion criteria. In addition, they handsearched the reference lists of included studies and relevant reviews and the proceedings of the International Conferences of the American Thoracic Society and the congress of the European Respiratory Society. No language restrictions were applied. The search terms were not reported, although the authors stated that these were available upon request. The authors also stated that they contacted study authors. Studies only reported as abstracts, where no further information was available from their authors, were excluded.

Study selection
Study designs of evaluations included in the review
Randomised controlled trials (RCTs) were eligible for inclusion.

Specific interventions included in the review
Studies that compared different exercise modalities and intensities or combinations thereof, and that followed standardised exercise protocols for patients with COPD, were eligible for inclusion. Standardised exercise protocols were defined as the use of an identical exercise activity for all patients at measurable exercise intensity. Full details of the exercise and rehabilitation programmes were presented.

Participants included in the review
Studies in which over 90% of the patients had COPD were eligible for inclusion. The patients had to have had their COPD defined by the following criteria: a clinical diagnosis of COPD; irreversible airways obstruction; and either a best recorded FEV1/FVC ratio (forced expiratory volume in 1 second/forced vital capacity) of individual patients of less than 0.7, or a best recorded FEV1 of individual patients less than 70% of predicted value. Where stated, the majority of trials included more men than women and the mean age of the participants ranged from 51 to 71 years.

Outcomes assessed in the review
Studies that assessed health-related quality of life (as measured by generic or disease-specific questionnaires), symptom scales, functional exercise capacity (as measured by a 2-, 4-, 6-, 12-minute walk test or a shuttle walk test), or maximum exercise capacity (as measured by incremental or constant work rate exercise tests on cycle ergometers or treadmills) were eligible for inclusion. The authors assessed exercise tolerance and physiological parameters documenting training effects for studies where no clinical outcomes were available.

How were decisions on the relevance of primary studies made?
Two reviewers independently assessed studies for inclusion. Any disagreements were resolved by discussion until a
consensus decision was reached, or by third party arbitration. The level of agreement was assessed.

**Assessment of study quality**
The validity of the included studies was assessed, based on the following criteria: similarity of study population, pre-stratification, randomisation procedure, concealment of treatment allocation, reporting of losses to follow-up, reporting of cointerventions, blinding of the outcome assessors, and whether the success of blinding had been assessed. Two reviewers independently assessed the quality of the included studies. The level of agreement between reviewers was assessed using the kappa statistic.

**Data extraction**
One reviewer extracted the data into a predefined, piloted, data extraction form; the data extraction was checked by a second reviewer. The authors of the studies were contacted for missing information.

**Methods of synthesis**
How were the studies combined?
Forest plots were used to compare the results across trials. The studies were pooled by calculating the weighted mean difference (WMD), using both random-effects and fixed-effect models. The authors stated that since the results from both models were the same, only the results from fixed-effect models were presented. The studies were not pooled where significant heterogeneity (P<0.1) was present.

When possible, estimates and confidence intervals (CIs) were related to the minimal important difference for each outcome.

How were differences between studies investigated?
Heterogeneity was assessed using the Q statistic. Sources of heterogeneity were explored using meta-regression analyses, using a priori defined clinical and methodological items.

**Results of the review**
Fifteen RCTs (n=504) were included in the review.

One trial was not quality assessed as it was only available as an abstract and provided little detail on internal validity. Agreement between reviewers for the quality assessment exercise was 90.7% (kappa statistic 0.72) for all items. The quality of the 14 trials that were assessed was generally poor, with only 3 trials properly or partially describing the randomisation procedure, and only 2 studies partially addressing concealment of treatment allocation. Only one study blinded the outcome assessors and only one study partially reported cointerventions. The majority of studies adequately or partially described a prognostically homogeneous study population and adequately reported patients lost to follow-up.

Endurance exercise versus strength exercise (4 RCTs).

Three studies assessed outcomes using the Chronic Respiratory Questionnaire (CRQ) and were pooled. The pooled results showed statistically significantly larger improvements with strength exercise than endurance exercise in terms of emotional function (WMD -0.38, 95% CI: -0.74, -0.01) and the CRQ total score (WMD -0.27, 95% CI: -0.52, -0.02), but not for the domains dyspnoea, fatigue or mastery. There was no evidence of significant statistical heterogeneity. The number of patients not completing the exercise programme was similar in both the endurance exercise and strength exercise groups.

Endurance exercise versus endurance and strength exercise (7 RCTs).

Five trials had similar exercise protocols for both treatment groups. There were no significant differences between groups in terms of health-related quality of life or functional and maximum exercise capacity improvements, despite 3 trials reporting larger improvements in muscle strength in the groups undertaking endurance exercise plus strength exercise.
Continuous versus interval exercise (3 RCTs).

There were no statistically significant differences between groups undertaking continuous exercise and groups undertaking interval exercise.

High-versus low-intensity exercise (1 RCT).

A small trial of patients with mild COPD found that high-intensity exercise at 80% of maximum exercise capacity yielded statistically significantly greater physiological response in terms of reductions in exercise-induced lactate acidosis and ventilation, and longer endurance time.

Authors' conclusions
Strength exercise tends to improve health-related quality of life more than endurance exercise. However, more research is needed to assess the benefits and disadvantages of interval exercise compared with continuous exercise and to define optimal exercise intensity for patients with COPD.

CRD commentary
The review question was clear in terms of the study design, participants, interventions and outcomes of interest. The authors searched several relevant electronic databases to identify studies, and also handsearched proceedings of relevant meetings and contacted authors. In addition, no language restrictions were applied. Therefore, the potential for publication bias and language bias was reduced. The study selection, quality assessment and data extraction processes were all carried out in duplicate, thus reducing the potential for reviewer bias and error.

Adequate details of the included studies were presented and the full results of the quality assessment exercise were reported. The quality of the included studies was generally poor, which the authors acknowledged. Appropriate measures of effect were calculated and statistical heterogeneity was assessed; the authors planned to investigate heterogeneity had it been found. This was a good-quality systematic review and the authors' conclusions are likely to be reliable.

Implications of the review for practice and research
Practice: The authors stated that strength exercise should be routinely incorporated into respiratory rehabilitation for patients with COPD. They stated that there is insufficient evidence to recommend high-intensity exercise.

Research: The authors stated that trials with rigorous methodology and outcomes are needed to compare the effectiveness and tolerance of interval exercise with continuous exercise and to define optimal exercise intensity for patients with COPD, also exploring the influence of baseline disease severity.

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