Progressive resistance exercise improves muscle strength and may improve elements of performance of daily activities for people with COPD: a systematic review

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CRD summary
The authors concluded that short-term progressive resistance exercise can appreciably increase muscle strength in people with chronic obstructive pulmonary disease and this may carry over into daily activities. Evidence appeared to support the authors’ conclusions about muscle strength, but there was little evidence about daily activities. The multitude of outcomes made it difficult to interpret findings.

Authors' objectives
To evaluate current evidence on the effects of progressive resistance exercise in people with chronic obstructive pulmonary disease (COPD).

Searching
Search methods were based on those used in a previous review (see Other Publications of Related Interest). In the previous review (published 2004) PubMed, EMBASE, CINAHL, AMED, AMI, InfoTrac, Sports Discus, Ausport Med, DARE and The Cochrane Library were searched from inception. Search terms were reported. Reference lists were screened. For this review the search dates were from March 2003 to April 2008. No language restrictions were applied.

Study selection
Randomised and non-randomised controlled trials in patients with COPD (diagnosed with specified criteria) were eligible if they evaluated peripheral progressive resistance exercise programmes that lasted at least six weeks and conformed to American College of Sports Medicine Guidelines. Studies had to assess at least one measure that met International Classification of Functioning, Disability and Health definitions in the domains of body structure and function, activity or participation. Pre- and post-test studies were excluded.

Most studies evaluated progressive resistance exercise programmes using machine weights in outpatient departments; training durations range from six to 26 weeks (mode 12 weeks). Sessions included a median of five resistance exercises involving arms, legs and trunk muscles. Most sessions were conducted two to three times per week. About half of the studies used no intervention as the control; other studies used aerobic training as the control and some studies compared progressive resistance exercise plus aerobic training with aerobic training alone. Mean age of patients was 64 years (range 49 to 72). Most of the patients were men (66%). Mean forced expiratory volume in one second was 46% of predicted (range 36 to 78%), which represented severe obstructive limitations. Most studies excluded patients with comorbidities.

Two reviewers independently selected studies from the updated search.

Assessment of study quality
Two reviewers independently assessed the validity of studies identified by the updated search using the PEDro scale of allocation and blinding and combined results with data from the original review. The maximum possible score was 10 points.

Data extraction
Weighted mean changes from baseline were extracted.

The authors did not state how data were extracted for the review.

Methods of synthesis
Where studies were sufficiently similar, pooled standardised mean differences (SMD, d) and 95% confidence intervals...
(CI) were calculated from post-intervention means using a random effects model. Heterogeneity was assessed using the Q statistic. Effect sizes (d) were interpreted as small (d=0.2), medium (d=0.5) or large (d≥0.8). Results were also presented in forest plots. Sensitivity analyses were used to examine the influence of study quality by exclusion of lower quality studies (PEDro<5) from analyses. Some subgroup analyses were conducted to examine the influence of the type of control.

**Results of the review**

Eighteen studies were included (n=736): 14 randomised controlled trials and four controlled trials. PEDro scores ranged from 3 to 7 out of 10 (median 5). Six studies reported allocation concealment, five reported blinding of assessors for some outcomes, two studies reported intention-to-treat analysis and three studies reported no withdrawals. Mean dropout rate was 21% across 16 studies (range zero to 38%). Attendance at interventions sessions was about 88% (10 studies). None of the studies reported withdrawals due to adverse effects of the programme.

Follow-up duration ranged from 12 weeks to 12 months after completion of the intervention (five studies).

**Body structure and function**: Progressive resistance exercise was associated with a medium statistically significant improvement in knee extensor strength (d=0.52, 95% CI 0.30 to 0.74; 10 studies), a large significant effect of leg press strength (d=0.96, 95% CI 0.26 to 1.66; five studies) and a small significant increase in latissimus dorsi strength (d=0.43, 95% CI 0.07 to 0.8; four studies). There was no statistically significant effect on biceps strength, pectoral strength (among homogeneous studies) or quadriceps cross-sectional area.

**Activity**: Progressive resistance exercise was associated with a significant improvement in submaximal cycling endurance compared to no intervention (d=0.87, 95% CI 0.29 to 1.44; five studies) and large significant effects on timed stair climbing (d=1.31, 95% CI 0.48 to 2.13; two studies) and timed stand-to sit performance (d=1.07, 95% CI 0.22 to 1.92; three studies). Aerobic exercise was associated with a significant improvement in submaximal cycling endurance compared to progressive resistance exercise (d=-0.89, 95% CI -1.42 to -0.37; two studies). There was no statistically significant effect on walking distance when analysed by control or arm elevation tasks.

**Participation**: Intervention effects remained unclear (three studies).

**Long-term effects**: There were no statistically significant differences between interventions at follow-up (three studies).

**Authors' conclusions**

Short-term progressive resistance exercise can appreciably increase muscle strength in people with COPD and this may carry over into daily activities. Further research is required.

**CRD commentary**

The review question was clearly stated and inclusion criteria appropriately defined. Several relevant sources were searched. No language restrictions were applied. No attempts were made to minimise publication bias. Methods were used to minimise reviewer errors and bias in the study selection and validity assessment; it was unclear whether similar steps were taken during data extraction. Study validity was assessed and taken into account in the synthesis. Appropriate methods were used for the meta-analyses. Heterogeneity was assessed. Various subgroup and sensitivity analyses were conducted. The multitude of outcome measures in individual studies meant it was possible that positive treatment effects could be found merely by chance. Evidence appeared to support the authors' conclusions about muscle strength, but there was little evidence about daily activities. The multitude of outcomes made it difficult to interpret the findings.

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

**Practice**: The authors recommend that progressive resistance exercise programmes should be individually targeted.

**Research**: The authors stated that future research should assess long-term effects of progressive resistance exercise on activity and levels of participation and evaluate methods for maintaining outcomes in patients with COPD. Research should evaluate different types of equipment in a range of settings. Studies should be longer-term, designed to minimise risk of bias and encourage maintenance of improvements and assess measures of activity and participation that were relevant to patients.
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