Effects of inspiratory muscle training in cystic fibrosis: a systematic review
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CRD summary
This review reported that the supporting evidence for the benefits of inspiratory muscle training in adolescents and adults with cystic fibrosis was weak and that further research was required. This was a well-conducted review, but the authors' recommendation for further research should be interpreted with some caution due to the possibility of language and publication biases.

Authors' objectives
To determine the effects of inspiratory muscle training on inspiratory muscle strength and endurance, exercise capacity, dyspnoea and quality of life for adolescents and adults living with cystic fibrosis.

Searching
MEDLINE, EMBASE and CINAHL were searched up to January 2008 for publications in English. Search terms were reported. References of relevant articles and journals were searched manually.

Study selection
Randomised controlled trials (RCTs) or crossover trials with adequate wash-out periods that compared inspiratory muscle training to sham, no intervention or an active comparator were eligible for inclusion. Eligible studies were of patients aged over 13 years with cystic fibrosis and that reported on measures of inspiratory muscle strength and endurance (such as forced expiratory volume in one second (FEV₁) and forced vital capacity (FVC)), exercise capacity, dyspnoea and quality of life.

The included studies compared inspiratory muscle training (intensity progressing from 20% to 40%) or low-intensity (20% of maximum inspiratory effort) and high-intensity (80% of maximum inspiratory effort) inspiratory muscle training against a control group. Mean ages ranged from 17 to 24.8 years. Training consisting of three or five sessions per week and lasted for eight or six weeks. Training was either unsupervised or supervised at home.

Two reviewers independently screened studies for inclusion. Disagreements were resolved by discussion.

Assessment of study quality
Two reviewers assessed the quality of the included studies according to the Jadad scale (included items on randomisation, blinding and withdrawals). The reviewers assessed studies for comparability at baseline and whether intention-to-treat analysis was undertaken. Disagreements were resolved by discussion.

Data extraction
Two reviewers independently extracted baseline scores and endpoint scores on the outcomes of interest to calculate mean changes in scores. Disagreements were resolved by consensus. Authors were contacted for further data or clarification of information, where necessary.

Methods of synthesis
Where possible, weighted mean differences (WMDs) were calculated using a random-effects model. Otherwise, outcomes were reported as a narrative synthesis.

Results of the review
Two RCTs (n=45) were eligible for inclusion. Sample sizes per treatment group ranged from eight to 10 participants. Both RCTs reported group similarities at baseline and were both assumed to use intention-to-treat analysis. The remaining quality assessment items were addressed only by one or the other RCT.

There were no statistically significant differences in FEV₁ and FVC between patients who received inspiratory muscle training and control groups. Individual study results were inconclusive for inspiratory muscle strength, but showed some
improvement for inspiratory muscle endurance in the inspiratory muscle training group compared to sham group.

Exercise capacity outcomes of workload and exercise duration significantly increased in the high-intensity intervention group (80%), but not in the low-intensity group (one RCT). The second RCT found no significant changes in exercise capacity.

There were no significant changes in dyspnoea in the intervention or sham group (one RCT). Quality of life outcomes indicated significant improvement in the Hospital Anxiety and Depression Scale in the high-intensity intervention group; no significant changes were reported in the low-intensity intervention group or controls. Only one adverse event was reported in the inspiratory muscle training group.

**Authors’ conclusions**
Evidence to support the benefits of inspiratory muscle training on inspiratory muscle function in adolescents and adults with cystic fibrosis was weak. The effects on exercise capacity, dyspnoea and quality of life were not clear. Further research was required.

**CRD commentary**
The review question was clear and was supported by appropriate inclusion criteria. The literature search was satisfactory and included three electronic databases and other appropriate sources. The review was limited to studies published in English, which meant there was potential that language and publication biases may have been introduced. Validity was assessed using an accepted tool and the quality of the studies was somewhat limited. Each stage of the review was undertaken in duplicate, which reduced the potential for reviewer error and bias. Appropriate measures were used to combine data, given the differences in methodologies. Evidence was limited and sample sizes were small, as acknowledged by the authors. This was a generally well-conducted review, but the authors’ conclusions and recommendations for further research should be interpreted with some caution due to the possibility of language and publication biases.

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

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

**Research**: The authors stated that large multicentre RCTs that evaluated specific measures of inspiratory muscle strength and endurance, in addition to more comprehensive measures of exercise capacity, dyspnoea, functional status and quality of life, were required to clarify the effects of inspiratory muscle training and the population that would gain most benefit.

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