The long-term effects of pulmonary rehabilitation in patients with asthma and chronic obstructive pulmonary disease: a research synthesis

Authors' objectives
To evaluate the long-term effects of pulmonary rehabilitation in patients with asthma and chronic obstructive pulmonary disease.

Searching
Index Medicus and MEDLINE were searched over the last 45 years using the following keywords: "pulmonary"; "obstructive"; "rehabilitation"; and "exercise". Current Contents was searched routinely. Cross-referencing in studies and reviews was examined. Articles not written in English, Dutch or German and abstracts were excluded.

Study selection
Study designs of evaluations included in the review
Controlled intervention studies that examined the effects of pulmonary rehabilitation programmes on patients aged over 18 years with asthma and/or COPD were included if they fulfilled the following criteria: at least one treatment group received exercise training (defined as including at least one of the following modalities: walking, cycling, stepping exercise or stair climbing); at least one control group received no exercise; and sufficient data were reported to calculate an effect size. Reasons are given for the exclusion of some identified studies.

Specific interventions included in the review
Interventions studied included the following modes of exercise training: stairs, walking, cycling, treadmill, stepping, upper limb, rowing, arm cycling and swimming. Other programme components included education, psychological support, breathing exercises, relaxation exercises, or inspiratory muscle training. Control groups were subjected to no intervention; ventilatory muscle training or education. Exercise sessions lasted from 2 minutes to more than 30 minutes, and were conducted at a frequency ranging from daily to less than twice a week. The duration of the programmes ranged from 6 weeks to 10 months, with sessions conducted at home and in out-patient departments.

Participants included in the review
Patients aged over 18 years with asthma and/or chronic obstructive pulmonary disease (COPD) were studied. The average age of patients ranged from 43 years to 72 years. Average forced expiratory volume in 1 second (FEV) ranged from 0.7 Litres to 2.4 Litres.

Outcomes assessed in the review
Measures of exercise capacity and health-related quality of life (HRQL) were assessed. Exercise capacity was measured using maximal exercise capacity (maximal workload or power during cycling, maximal speed and slope during walking on a treadmill); endurance time (time a sub-maximal workload could be tolerated during cycling on an ergometer or walking on a treadmill); and walking distance (over 4, 6 and 12 minutes). The following instruments assessed HRQL: disease specific questionnaires (such as CRQ baseline/transitional dyspnoea index (BDI/TDI), and medico psychological questionnaires for lung patients (MPQL); generic questionnaires such as quality of well-being scale (QWB), Bandura scale; disease specific questionnaires (shortness of breath questionnaires); and self-constructed questionnaires.

How were decisions on the relevance of primary studies made?
Inclusion criteria were applied by two reviewers with disagreements being resolved by a third reviewer.

Assessment of study quality
Methodological quality was assessed using the following criteria: allocation procedure; matching procedure; blinding; drop-out and intention-to treat analysis; reliability and validity of measurement instruments; confounding; description of the programme; and comparability of groups at baseline. Quality criteria were scored by two reviewers on a
dichotomous scale and each study awarded a total score. Disagreements were resolved by a third reviewer.

**Data extraction**
The following data were extracted: reference (author, date); sample size; allocation procedure; setting; average FEV and average age of participants; components of interventions by allocated group; programme duration; session frequency; duration of sessions; exercise intensity; mode of exercise during the programme and during assessment; and quality of life/activities of daily living instrument. The number of reviewers performing the data extraction was not stated.

**Methods of synthesis**
How were the studies combined?
Unbiased estimate of effect sizes were combined to obtain a weighted summary effect size and 95% confidence intervals according to the fixed-effect model described by Hedges and Olkin (see Other Publications of Related Interest). Outcome measures expressed as raw mean differences were combined using methods described by Cooper and Hedges (see Other Publications of Related Interest).

How were differences between studies investigated?
Heterogeneity (Q) was assessed according to methods described by Hedges and Olkin or Cooper and Hedges (see Other Publications of Related Interest). The influence of successively leaving out the results from each treatment group where more than one treatment group per study was initially included was assessed. Fixed-effect models were compared with random-effects models when heterogeneity was present. Measures of HRQL were derived from studies using the dimensions of the CRQ and these were compared with a composite measure derived from all questionnaires. The following subgroup analyses were conducted with heterogeneity being assessed both within and among groups of studies: comparison of randomised vs non-randomised; COPD vs asthma and COPD; FE1< 50th centile vs FEV1> 50th centile; community based vs outpatients or inpatients; no intervention in control group vs intervention in control group. A summary effect size was calculated using a weighting factor for methodological quality for each study.

**Results of the review**
Eighteen studies were included (N = 674 patients).

Methodological quality score ranged from 11% to 63% of the maximum possible score. Agreement on methodological scoring Kappa = 0.8. In all 18 studies one or more reliable instruments measuring exercise capacity were lacking.

Overall effect size:
Maximal exercise capacity (12 studies): 0.4 (95%CI: 0.2, 0.6; P < 0.0001), heterogeneity not significant (NS).
Endurance time (7 studies): 1.2 (95%CI: 0.9, 1.5; P < 0.0001), heterogeneity P< 0.0001.
Endurance time using random-effects model (7 studies): 1.0 (95%CI: 0.04, 2.1; P = 0.02).
Walking distance (15 studies): 0.5 (95%CI: 0.3, 0.7; P < 0.0001), heterogeneity NS.
HRQL. Dyspnoea (5 studies): 0.7 (95%CI: 0.4, 1.0; P < 0.0001), heterogeneity NS.
Total score (7 studies): 0.6 (95%CI: 0.4, 0.8; P < 0.0001), heterogeneity NS.
Fatigue (4 studies): 0.6 (95%CI: 0.3, 0.9; P = 0.0001), heterogeneity NS.
Emotion (4 studies): 0.5 (95%CI: 0.2, 0.7; P = 0.001), heterogeneity NS.
Mastery (4 studies): 0.6 (95%CI: 0.3, 0.9; P < 0.0001), heterogeneity NS.
Total score (11 studies): 0.6 (95%CI: 0.5, 0.7; P < 0.0001), heterogeneity NS.
Subgroup analysis: FEV < 50th centile vs FEV > 50th centile (Q- within < 0.0001; Q-between NS). All other subgroups, Q-between was insignificant.

Effect size using a weighting factor for methodological quality: identical summary effect sizes and CI for maximal exercise capacity and walking distance.

Long term effect size of rehabilitation: Maximal exercise capacity (6 studies) 0.3 (95%CI: 0.1, 0.5; P < 0.003 ), heterogeneity NS.

Walking distance (5 studies): 0.4 (95%CI: 0.1, 0.7; P < 0.005 ), heterogeneity NS.

Authors' conclusions
Exercise capacity and health-related quality of life in patients with asthma and chronic obstructive pulmonary disease improves with pulmonary rehabilitation.

CRD commentary
The aims, inclusion criteria and validity criteria were stated. Articles in more than one language were considered. Details are given of methods used to select primary studies and assess validity. Relevant details of the included studies were presented in tabular format. Heterogeneity was assessed statistically and sensitivity analysis undertaken. Sensitivity analysis included investigation of the effect of weighting by study quality on the results. The discussion included consideration of the following factors: the major shortcomings found in the methodological quality of the majority of primary studies; with the exception of tests measuring walking distance, the lack of demonstration of validity and reliability of instruments measuring exercise capacity; and publication bias.

No dates are given for searching of the databases. No definitions of criteria for the diagnosis of asthma or COPD were given. Several experimental groups were subjected to multi-component interventions which may have contributed to the improvement seen in these groups. Many of the studies had very small sample sizes (ranged from 3 to 62 patients per treatment group). The time interval referred to as 'long-term' (effects of rehabilitation) is not clear.

Without a clear definition of asthma and COPD, it is not possible to define the group of patients who may benefit from rehabilitation and without evaluation of other concurrent interventions it is not possible to determine the intervention responsible for improvement. These factors together with the lack of demonstration of validity and reliability of instruments measuring exercise capacity greatly weaken the strength of evidence available.

Implications of the review for practice and research
Practice: The authors do not state any clinical implications.

Research: The authors consider that further research should address the relative efficacy of components of the rehabilitation programme; the appropriate setting for rehabilitation and the minimally required intensity and frequency of maintenance training sessions; and the prognostic value of (potential) determinants of the outcome of rehabilitation. The development of reliable, valid and sensitive estimates of clinically relevant improvements is required to substantiate whether or not improvements in exercise capacity and HRQL are really meaningful for individual patients.

Bibliographic details

PubMedID
9915381

Other publications of related interest

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Subject indexing assigned by NLM

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**Record Status**
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.