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Physical training for bronchiectasis (Review)

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TABLE OF CONTENTS

HEADER	1
ABSTRACT	1
PLAIN LANGUAGE SUMMARY	2
BACKGROUND	3
OBJECTIVES	3
METHODS	3
RESULTS	4
DISCUSSION	6
AUTHORS' CONCLUSIONS	6
ACKNOWLEDGEMENTS	6
REFERENCES	7
CHARACTERISTICS OF STUDIES	7
DATA AND ANALYSES	9
Analysis 1.1. Comparison 1: Pulmonary Rehabilitation and sham inspiratory muscle training versus no intervention (change from baseline), Outcome 1: Endurance (metres)	10
Analysis 1.2. Comparison 1: Pulmonary Rehabilitation and sham inspiratory muscle training versus no intervention (change from baseline), Outcome 2: Incremental shuttle walking test (metres)	11
Analysis 1.3. Comparison 1: Pulmonary Rehabilitation and sham inspiratory muscle training versus no intervention (change from baseline), Outcome 3: Health Status (CRDQ score)	11
Analysis 1.4. Comparison 1: Pulmonary Rehabilitation and sham inspiratory muscle training versus no intervention (change from baseline), Outcome 4: Pi Max (cms of water)	12
Analysis 2.1. Comparison 2: Inspiratory Muscle Training v Sham or no intervention (post treatment results), Outcome 1: Endurance (metres)	13
Analysis 2.2. Comparison 2: Inspiratory Muscle Training v Sham or no intervention (post treatment results), Outcome 2: Incremental shuttle walking test (metres)	14
Analysis 2.3. Comparison 2: Inspiratory Muscle Training v Sham or no intervention (post treatment results), Outcome 3: Health Status (CRDQ score)	14
Analysis 2.4. Comparison 2: Inspiratory Muscle Training v Sham or no intervention (post treatment results), Outcome 4: Pi Max (cms of water)	15
Analysis 2.5. Comparison 2: Inspiratory Muscle Training v Sham or no intervention (post treatment results), Outcome 5: 24hour sputum volume	15
WHAT'S NEW	15
HISTORY	15
CONTRIBUTIONS OF AUTHORS	16
DECLARATIONS OF INTEREST	16
SOURCES OF SUPPORT	16
INDEX TERMS	16

[Intervention Review]

Physical training for bronchiectasis

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ABSTRACT

Background

This review is no longer being updated. It has been replaced with a new review with the following citation. Lee AL, Gordon CS, Osadnik CR. Exercise training for bronchiectasis. *Cochrane Database of Systematic Reviews* 2021, Issue 3. Art. No.: CD013110. DOI: [10.1002/14651858.CD013110.pub2](https://doi.org/10.1002/14651858.CD013110.pub2).

The pathophysiology of bronchiectasis may result in the development of dyspnoea and decreased exercise tolerance, both of which can impact on a patient's quality of life and ability to perform activities of daily living. There is little information regarding the benefits of physical training in bronchiectasis: however it is probable that the benefits of physical training in bronchiectasis are at least comparable to benefits demonstrated in other respiratory conditions. There is also no information regarding the effects of non-adherence to prescribed physical training in bronchiectasis. However as in patients with COPD non-adherence may contribute to a deterioration in the patient's condition and conceivably the long term prognosis.

Objectives

The objective of this review is to determine whether a prescribed regime of physical training produces improvements or prevents deterioration in physiological and clinical outcomes in bronchiectasis compared to no physical training.

Search methods

We searched the Cochrane Airways Group trials register and the Cochrane Central Register of Controlled Trials. Searches are current to February 2009.

Selection criteria

Randomised or quasi randomised controlled trials in which a prescribed regimen of physical training is compared to no physical training in patients with bronchiectasis.

Data collection and analysis

One study (data reported in full text publication), and two abstracts met the inclusion criteria for this review.

Main results

Results from the full text publication showed that pulmonary rehabilitation (PR), with or without inspiratory muscle training (PR-IMT or PR-SHAM) resulted in significant increases in the incremental shuttle walking test of 96.7m (95% CI 59.6-133.7) and 124.5m (95% CI 63.2-185.9) respectively, and in endurance exercise capacity of 174.9% (95% CI 34.7- 426.1) and 205.7% (95% CI 31.6-310.6) respectively. There were

no statistically significant differences in the improvements in exercise between the two groups. Significant improvements in inspiratory muscle strength were also observed both in the PR-IMT group (21.4 cmH₂O increase, 95% CI 9.3- 33.4, p=0.008) and the PR-SHAM group (12.0 cmH₂O increase, 95% CI 1.1- 22.9, p=0.04).

Authors' conclusions

This review only provides evidence of the benefits of inspiratory muscle training and provides no evidence of the effect of other types of physical training (including pulmonary rehabilitation) in bronchiectasis.

PLAIN LANGUAGE SUMMARY**Breathing muscle training for people with bronchiectasis**

A search for controlled trials of physical training in bronchiectasis only identified one full text publication which contains data from the 2 earlier abstracts, including 43 patients in total. These suggest some benefits of inspiratory muscle training on exercise capacity, quality of life and respiratory muscle function at eight weeks, but further research is needed to confirm these findings in larger numbers of people with bronchiectasis. Further research is also needed to assess the benefit of other types of physical training and pulmonary rehabilitation in bronchiectasis.

BACKGROUND

Bronchiectasis can be defined as a disease that results in an abnormal dilatation of one or more bronchi. The primary cause of bronchiectasis is an insult to the respiratory tract e.g. severe pneumonia, viral infection or aspiration of a foreign body. Genetic diseases such as cystic fibrosis (CF), primary ciliary dyskinesia (including Kartagener's syndrome) and immunodeficiency can also result in bronchiectasis. Any one of these conditions predisposes the airways to lower respiratory colonisation by bacteria such as *Haemophilus influenzae* or *Pseudomonas aeruginosa*.

Although infection and obstruction are implicated in the development of bronchiectasis, the inflammatory response may also be important in disease progression: the host's response to infection may fail to completely eradicate the infecting organism and chronic colonisation is established. A vicious cycle of microbial colonisation/ infection has been proposed whereby bacteria elaborate substances toxic to the mucociliary escalator and perpetuates the failure to eliminate the organisms. The inflammatory response leads to further damage of the bronchial tree and lung parenchyma and is usually associated with excessive secretions and the development of airflow obstruction.

The consequences of this may include the development of chronic respiratory symptoms including cough, excessive purulent sputum, haemoptysis, breathlessness and decreased exercise tolerance. The causes of breathlessness and decreased exercise tolerance are multifactorial and may include altered pulmonary mechanics, inefficient gas exchange, decreased muscle bulk and confounding psychological morbidity. All of these factors initiate a cyclical phenomenon whereby decreased exercise tolerance leads to progressive detraining which in turn results in further reductions in exercise tolerance.

Physical training is defined as participation in a programme of regular vigorous physical activity designed to improve physical performance, and/or cardiovascular function and/or muscle strength (Shepherd 1994). Physical training has been shown to improve exercise tolerance and reduce symptoms of breathlessness in many patient populations including CF and chronic obstructive pulmonary disease (COPD; Goldstein 2005). There is also little information on the role of respiratory muscle training and as summarised by Goldstein (2005), many clinicians have refrained from including it in exercise rehabilitation programmes as it is unclear whether training-induced changes in inspiratory muscle pressure translate into meaningful clinical improvements. There is little information regarding the benefits of physical training in bronchiectasis: however it is probable that the benefits of physical training in bronchiectasis are at least comparable to benefits demonstrated in other respiratory conditions (Morgan 1997). One retrospective study examining if a sub-group of participants with bronchiectasis would demonstrate comparable benefits from pulmonary rehabilitation to COPD patients found a significant increase in ambulation distance (as an objective measure of functional status), indicating that this improvement is similar to that obtained by COPD patients (Foster 1990). There is also no information regarding the effects of non-adherence to prescribed physical training in bronchiectasis. However as in patients with COPD non-adherence may contribute to a deterioration in the patient's condition and conceivably the long term prognosis.

This review will aim to determine the evidence base benefit for the use of physical training programmes in the management of patients with bronchiectasis.

OBJECTIVES

The objective of this review is to determine whether a prescribed regime of physical training in bronchiectasis produces improvements or prevents deterioration in physiological and clinical outcomes in bronchiectasis compared to no physical training.

METHODS

Criteria for considering studies for this review

Types of studies

Only randomised or quasi-randomised controlled trials in which a prescribed regimen of physical training is compared to no physical training in patients with bronchiectasis will be considered for this review. Single blind and open studies will be considered for inclusion.

Types of participants

We will include patients (adults and children) with stable bronchiectasis. Patients with cystic fibrosis will be excluded. Diagnosis will be based on symptoms and appropriate imaging (bronchography or high resolution CT scanning).

Types of interventions

We will consider any type of prescribed physical training including pulmonary rehabilitation. We will record, wherever possible, the precise nature of the training (intensity, frequency and duration) will be recorded. We will exclude any studies which do not include a prescribed physical training component. Important alterations in patient management such as airway clearance techniques or medication must be controlled for.

Types of outcome measures

The most appropriate outcome measure in bronchiectasis has not been defined. The assessment of impairment, disability and handicap is necessary to provide a comprehensive evaluation of treatment outcome.

PRIMARY OUTCOME

(1) Exercise tolerance: Objective change in exercise tolerance (maximal oxygen uptake (VO₂ max), peak oxygen uptake (VO₂ peak), maximal ventilation (V_e max), heart rate, subjective assessment of dyspnoea) as measured during formal exercise tests or field exercise tests.

SECONDARY OUTCOMES

(2) Measures of specific indices of respiratory muscle strength: peak inspiratory pressure (P_Imax), peak expiratory strength (PEMax). Other measures of muscle strength, mass, effort and general fatigue will be included.

(3) Pulmonary function tests: forced expiratory volume in one second (FEV₁), forced vital capacity (FVC), forced expiratory flow at 25 to 75% of FVC (FEF₂₅₋₇₅), peak expiratory flow (PEF), total lung capacity (TLC) and fixed respiratory capacity (FRC): change in % predicted or and absolute change from baseline compared to

control will be assessed. Peak inspiratory If other parameters are used, they will be considered.

(4) Dyspnoea: All measures of dyspnoea used will be considered.

(5) Quality of life: Change in quality of life as measured by generic or disease - specific quality of life instruments, or by subjective perception of well-being. All quality of life instruments used will be considered.

(6) Weight: Absolute weight change, change in % ideal body weight, or weight standard deviation score or change in body composition will be assessed.

(7) Expectorated secretions: Dry or wet weight or volume.

(8) Changes in physical symptoms such as cough and wheeze

(9) Number of acute exacerbations, duration, hospitalisation, IV antibiotic courses and time off work will be considered.

(10) Oxygen saturation measured by pulsed or transcutaneous oximetry.

(11) Compliance with physical training will be recorded in detail.

(12) Compliance with other treatment, such as airway clearance techniques, nutritional regimes if measured. Methods of assessing compliance will be recorded in detail.

(13) Adverse effects including fractures, skeletal muscle injuries and death will be recorded.

(14) Cost evaluation.

If outcomes have been measured more than once in a study, we will record the outcome measured most distant from the commencement of physical training.

Search methods for identification of studies

We carried out a search using the Cochrane Airways Group trials register and the Cochrane Central Register of Controlled Trials. This database is comprised of systematic MEDLINE, CINAHL and EMBASE searches.

We searched these registers using the search terms;

Bronchiectasis AND training OR physical training OR physical fitness OR physical activity OR physical rehabilitation OR physical therapy OR exercise training OR exercise rehabilitation OR exercise therapy OR exercise OR pulmonary rehabilitation OR physiotherapy

We searched the reference lists of each RCT for additional studies. We also contacted authors of RCTs for information on other published and unpublished studies.

Data collection and analysis

Selection of studies

Two reviewers independently selected the trials to be included in the review. Disagreement did not arise on the suitability of a trial for inclusion in the review or in its quality however if this occurs for future updates of this review a consensus will be reached by the two reviewers.

Data extraction and management

Data from the trials was independently extracted by two reviewers (JB, FM) using standard data extraction forms.

Assessment of risk of bias in included studies

The risk of bias was assessed for each study according to the recommendations described in the Cochrane VI Handbook. Risk of bias was assessed using the following criteria:

1. Sequence generation
2. Allocation concealment
3. Blinding
4. Incomplete reporting of outcomes
5. Selective reporting and other relevant bias.

These were summarised into risk of bias tables and figures.

Meta-analysis

For binary outcome measures, we sought data on the number of participants with each outcome event, by allocated treated group, (irrespective of compliance or subsequent eligibility) to allow an intention-to-treat analysis. Dichotomous variables were analysed with a fixed effect risk ratio (RR). For continuous outcomes, we aimed to record either mean change from baseline for each group or mean post treatment / intervention values and the standard deviation (SD) or standard error (standard error will be converted to SD), combining data with a fixed effect weighted mean difference.

RESULTS

Description of studies

Electronic searches yielded a total of 38 references. Three of these were identified as potentially relevant. One was excluded ([Choe 1996](#)), for details see "Excluded studies table". Searches conducted to February 2007 identified the full-text publication of a study from which data from abstracts that were already included in the review ([Newall 2005](#)). New data from this article have now been entered in the review. A further search in February 2009 identified no further studies.

Study design

One full text publication met the inclusion criteria for this review. The participants were randomly allocated into one of three groups: (1) pulmonary rehabilitation plus sham inspiratory muscle training (IMT) (PR-SHAM, n=11); (2) Pulmonary rehabilitation plus targeted IMT (PR-IMT, n=12); and (3) a control group with no intervention (n=9).

Participants

There were 32 participants in this study. The mean age in each of the intervention groups ranged from 57 to 63. Mean FEV₁ values (% predicted) ranged from 54 to 69 in the three intervention groups.

Intervention

Patients in the PR-SHAM and PR-IMT groups completed an 8 week hospital based outpatient programme of high intensity exercise training. Exercise training sessions were performed three times weekly, and consisted of two sessions within the hospital and

one at home. The duration of each exercise training session was 45 minutes, and patients were required to exercise at 80% of the peak heart rate achieved on a previous maximal incremental exercise test. Exercise training consisted of treadmill walking, cycle ergometry and stair climbing.

IMT was performed using a pressure threshold device. In the PR-IMT group, inspiratory pressures was increased weekly to achieve a sub-maximal training intensity. In the PR-SHAM group training was performed at a very low load, which has been shown to have no effect on patients with COPD. IMT was performed for 15 minutes twice daily at home for 8 weeks. Patients in the control group did not undergo inspiratory muscle training.

Exercise tests

Two exercise tests were used, a submaximal exercise test, and the incremental shuttle walking test (ISWT). The submaximal exercise test was performed on a treadmill at 85% of peak oxygen uptake achieved on a previously performed test. Exercise test conditions were standardised for time of day, medication administration, test instruction, and degree of coaching. The endurance exercise test and the ISWT were performed on separate days.

Outcomes

Exercise tolerance was measured (VO_2 max, endurance exercise distance); P_I max; $\text{P}_{E\text{max}}$; PFT's; QoL; and expectorated sputum volume.

Risk of bias in included studies

Risk of bias in included study

Risk of bias was assessed using the following criteria; sequence generation, allocation concealment, blinding, incomplete reporting of outcomes, selective reporting and other relevant bias. These were summarised into risk of bias tables.

Adequate sequence generation

This study described the method used for generation of the randomisation sequence, and it was judged to be adequate leading to a low risk of bias for this study. This study did not give any details of the method of allocation concealment and is deemed to have an unclear risk of bias.

Blinding

In this study, there were no details given as to whether participants were blinded to all outcome measures, and it was thought to have an unclear risk of bias. This study did not blind investigators to all outcome measures, and was therefore thought to have a high risk of bias.

Incomplete outcome data

This study gave a clear description and details about dropouts, therefore it was considered to have a low risk of bias.

Selective reporting

In this study, all outcomes detailed in the methods were reported in results and data reported for all timepoints. This study was judged to have a low risk of bias.

Other potential sources of bias

This study was deemed to have a low risk of bias with regards to other potential sources of bias.

Effects of interventions

EXERCISE TOLERANCE

Maximal exercise capacity (ISWT) showed a significant increase in distance from baseline: PR-SHAM 96.7 metres (95% CI 59.6 to 133.7) and PR-IMT 124.5 metres (95% CI 63.2 to 185.9). Endurance exercise capacity also showed significant increases compared to the control group: PR-SHAM 392.8 metres (95% CI 251.7 to 534) and PR-IMT 607.3 metres (436 to 778.7). Maximal inspiratory pressures increased significantly in both intervention groups compared to the control group: PR-SHAM 12.0 cmH_2O (95% CI 1.1 to 22.9) and PR-IMT 21.4 cmH_2O (9.3 to 33.4). No significant changes in peak oxygen uptake were observed at the end of the 8 week period in any of the three groups: PR-SHAM VO_2 1.96 ml/min/kg (-1.8 to 5.7), PR-IMT VO_2 0.35 ml/min/kg (-2.4 to 3.1), and control VO_2 -1.91 ml/min/kg (-4.6 to 0.8).

QUALITY OF LIFE

The pooled results of the two studies indicate an increase in the quality of life following treatment compared to baseline in the inspiratory muscle training group versus sham or no inspiratory muscle training WMD 12.4 units on the CRQ scale (95% CI 2.38 to 22.48). Again the larger treatment effects shown in the post treatment scores relate to the higher baseline quality of life in the treatment groups. SGRQ data from Newall 2005 also indicated a significant treatment effect in favour of PR ($P=0.05$). The PR-IMT group showed a significant increase in the SGRT, both immediately after the exercise training regime (mean change -7.7, 95% CI -16.6 to 1.1), and three months later (mean change -10.0, 95% CI -21.3 to 1.3). There were no significant changes in the PR-SHAM group compared to the control group (mean change 2.3, 95% CI -2.9 to 7.4), $P=0.422$ compared to control.

PULMONARY FUNCTION

Pooled results from the two trials showed significant increases in maximal inspiratory pressure (PiMax) from baseline following treatment compared to baseline in the inspiratory muscle training group versus sham or no inspiratory muscle training (mean difference: 16 cms of water (95% CI 1.92 to 30 cms). Post treatment analysis showed similar results.

24hr SPUTUM VOLUME PRODUCTION

Newall 2005 reported no statistically significant between IMT and sham IMT groups (10.6ml versus 9.6ml respectively)

At present there is no outcome data from randomised control trials to indicate whether physical training in bronchiectasis has an effect on peripheral muscle strength, mass, effort and general fatigue; dyspnoea; weight; physical symptoms; number of and treatment of acute exacerbations; duration, hospitalisation, IV antibiotic courses and time off work; oxygen saturation of the haemoglobin of arterial blood (SaO_2); bone mineral density and diabetes; compliance; nutritional regimes; adverse effects and cost.

DISCUSSION

This systematic review examined the effectiveness of physical training in the management of bronchiectasis. This was in order to determine whether a prescribed regimen of physical training in bronchiectasis produces improvements or prevents deterioration, in physiological and clinical outcomes in bronchiectasis compared to no physical training.

Despite an exhaustive review of available literature, we only identified two relevant primary trials. Both of these trials investigated the efficacy of inspiratory muscle training in bronchiectasis. As there are only two studies the results should be viewed in the context of possible publication bias.

Neither study was reported to be double blinded however this quality issue must be considered in the context of the difficulty of blinding any type of physical training study. Both studies used random allocation, however neither provided details on the specific procedures used. This may be due to the fact that both studies were reported in abstract form only. In both studies the randomisation used was not successful in ensuring the groups were balanced at baseline in all measures. These quality issues effect the internal validity of the studies and justify the low Jadad scores reported.

The primary outcome measure in this review was exercise tolerance. The significant difference reported for this outcome should be viewed with some caution. Firstly, the lower limit of the 95% confidence interval did not exclude the possibility of only a small difference in metres. Secondly the small samples of the two included studies may be prone to sampling error. However, the findings of these analyses justify additional studies of greater size, which would be useful in confirming the effects observed in this review. Secondary outcome measures included pulmonary function tests and quality of life. Analyses of the two studies suggest that there is some evidence of the effect of inspiratory muscle training on endurance exercise capacity, lung function and quality of life but did not show any benefit in terms of maximal exercise capacity.

AUTHORS' CONCLUSIONS

Implications for practice

It has been suggested that the magnitude of improvement from physical training programmes in patients with bronchiectasis should at least be comparable to the improvements demonstrated in other respiratory disease populations. These claims are based primarily on expert opinion of the benefits of training in bronchiectasis, albeit supported by a sound physiological rationale. This review only provides evidence of the benefits of inspiratory muscle training and provides no evidence of the effect of other types of physical training (including pulmonary rehabilitation) in bronchiectasis. The positive effects on endurance measured in this review are drawn from two small studies. Rather than provide a sound basis for the recommendation of this type of therapy, the effects we have observed warrant additional studies in this area.

Implications for research

This review has identified a requirement for further trials assessing the effect of physical training in bronchiectasis. There is a need for well designed, adequately powered, randomised controlled clinical trials to assess the net benefit (positive effects and side effects) of adherence to different forms of prescribed physical training programmes, in patients with bronchiectasis. As it is likely that the benefits and side effects of adherence to different types of physical training differs in patients with mild, moderate and severe disease, the influence of disease severity should be considered in the design of any future trial. The full benefit of any prescribed physical training is unlikely to be demonstrated in programmes that are of insufficient length or intensity. Therefore any future trial should be of sufficient duration, intensity and frequency to assess the net benefit of training on measures of disease impairment, disability and handicap. Further research should also consider whether physical training programmes delivered within the context of a pulmonary rehabilitation program offers any additional advantages to physical training alone.

ACKNOWLEDGEMENTS

We gratefully thank Claire Allen for assistance with the preparation of the synopsis and Kirsty Olsen who copy edited this review.

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Newall 2000a {published data only}

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Newall 2005 {published data only}

Newall C, Henson M, McConnell AK, Stockley RA, Hill SL. The effects of pulmonary rehabilitation (PR) in patients with bronchiectasis (BE). In: European Respiratory Society. Vol. August-Sept. 2000:3.

* Newall C, Stockley RA, Hill SL. Exercise training and inspiratory muscle training in patients with bronchiectasis. *Thorax* 2005;**60**(11):943-8.

References to studies excluded from this review

Choe 1996 {published data only}

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* Indicates the major publication for the study

CHARACTERISTICS OF STUDIES

Characteristics of included studies [ordered by study ID]

Newall 2000a

Study characteristics	
Methods	8 week study; concealment unclear; no dropouts specified; groups not similar at baseline
Participants	19 patients with bronchiectasis (IMT group, n = 10. Mean age 62.4 +/- 16.53); (control group, n = 9. Mean age 62.8 +/- 11.6)
Interventions	8 weeks IMT using a pressure threshold device control no intervention
Outcomes	Included in this study were PImax; VC; RV; TLC; endurance; ISWT; CRDQ
Notes	
Risk of bias	

Physical training for bronchiectasis (Review)

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Newall 2000a (Continued)

Bias	Authors' judgement	Support for judgement
Allocation concealment (selection bias)	Unclear risk	Information not available

Newall 2005

Study characteristics		
Methods	Blinding: single; Randomisation: computer generated random number sequence; Withdrawals: six, 3 from each intervention group; Baseline characteristics: comparable; Point/ variability estimates for between group analysis: Power calculation: none; Statistical analysis: one way ANOVA, sinificant differences being investigated further using unpaired t tests.	
Participants	Country: UK; N=32 (6M); PR-IMT: N=12 (2M); 57.3 +/- 2.4 years; FEV ₁ 1.23 (0.74l); P _I max: 78.0 (17.7 cmH ₂ O); Peak VO ₂ : 19.8 (8.3 ml/min/kg) PR-SHAM: N=11 (4M); 63.1 +/- 3.5 years; FEV ₁ 1.44 (0.77l); P _I max: 66.4 (22.0 cmH ₂ O); Peak VO ₂ : 15.6 (6.2 ml/min/kg) Control: N=9 (0M); 62.9 +/- 3.9 years; FEV ₁ : 1.49 (0.61l); P _I max: 77.2 (24.7 cmH ₂ O); Peak VO ₂ : 19.0 (5.0 ml/min/kg)	
Interventions	PR-IMT: 8 week program of high-intensity exercise training and education, plus IMT using a pressure threshold device. PR-SHAM: 8 week program of high-intensity exercise training and education, plus sham IRT Control: No intervention	
Outcomes	Exercise tolerance (VO ₂ max, endurance exercise distance); P _I max; P _E max; PFT's; QoL; Expectorated secretions.	
Notes		

Risk of bias

Bias	Authors' judgement	Support for judgement
Random sequence generation (selection bias)	Low risk	"...(Participants) were allocated randomly (using a computer generated random number sequence).
Allocation concealment (selection bias)	Unclear risk	Allocation concealment is unclear.
Blinding (performance bias and detection bias) participants	Unclear risk	It is unclear if participants were blinded to their group allocation.
Blinding (performance bias and detection bias) investigators	High risk	"The training intensity (of IMT) was adjusted....performed weekly by the investigator."

Physical training for bronchiectasis (Review)

Newall 2005 (Continued)

Comment: Therefore the investigator was not blinded to group allocation.

Incomplete outcome data (attrition bias) All outcomes	Low risk	Thirty two patients were initially recruited to the study. During the training programme two patients withdrew (one from each intervention group), and in the follow-up period a further two patients withdrew from each of the training programs (two for personal reasons and two because of a disease exacerbation).
Selective reporting (reporting bias)	Low risk	All outcome measures were reported as stated in the methods (PFT's, P _E max, P _I max, peak O ₂ uptake, ISWT, endurance exercise distance, SGRQ, 24 hour sputum volume). All timepoints were reported on (baseline, throughout exercise, end of exercise, 3 month follow up). No subgroups were intended to be analysed.
Other bias	Low risk	All statistical analyses were performed as stated in the methods.

CRDQ: Chronic respiratory disease questionnaire; IMT: Inspiratory muscle training; ISWT: Incremental shuttle walking test; P_Imax: Peak inspiratory pressure (cmH₂O); PR: pulmonary rehabilitation (education, exercise training); RV: Residual Volume (L); TLC: Total Lung Capacity (L); VC: Vital Capacity (L)

Characteristics of excluded studies [ordered by study ID]

Study	Reason for exclusion
Choe 1996	Inappropriate patient population (only 1 patient had bronchiectasis) and no randomisation
Kellett 2005	Assessment of the addition of hypertonic saline to breathing technique. In the absence of an inactive control we excluded the study.

DATA AND ANALYSES

Comparison 1. Pulmonary Rehabilitation and sham inspiratory muscle training versus no intervention (change from baseline)

Outcome or subgroup title	No. of studies	No. of participants	Statistical method	Effect size
1.1 Endurance (metres)	2	43	Mean Difference (IV, Fixed, 95% CI)	213.24 [6.41, 420.06]
1.1.1 Compared to no intervention	1	19	Mean Difference (IV, Fixed, 95% CI)	204.60 [-374.01, 783.21]
1.1.2 Compared to sham (both groups had Pulmonary Rehabilitation)	1	24	Mean Difference (IV, Fixed, 95% CI)	214.50 [-6.96, 435.96]
1.2 Incremental shuttle walking test (metres)	2	43	Mean Difference (IV, Fixed, 95% CI)	30.46 [-35.67, 96.60]

Outcome or subgroup title	No. of studies	No. of participants	Statistical method	Effect size
1.2.1 Compared to no intervention	1	19	Mean Difference (IV, Fixed, 95% CI)	46.80 [-129.87, 223.47]
1.2.2 Compared to sham (both groups had Pulmonary Rehabilitation)	1	24	Mean Difference (IV, Fixed, 95% CI)	27.80 [-43.52, 99.12]
1.3 Health Status (CRDQ score)	2	43	Mean Difference (IV, Fixed, 95% CI)	12.40 [2.38, 22.43]
1.3.1 Compared to no intervention	1	19	Mean Difference (IV, Fixed, 95% CI)	1.90 [-13.52, 17.32]
1.3.2 Compared to sham (both groups had Pulmonary Rehabilitation)	1	24	Mean Difference (IV, Fixed, 95% CI)	20.10 [6.90, 33.30]
1.4 Pi Max (cms of water)	2	43	Mean Difference (IV, Fixed, 95% CI)	15.75 [1.92, 29.57]
1.4.1 Compared to no intervention	1	19	Mean Difference (IV, Fixed, 95% CI)	32.40 [6.09, 58.71]
1.4.2 Compared to sham (both groups had Pulmonary Rehabilitation)	1	24	Mean Difference (IV, Fixed, 95% CI)	9.40 [-6.84, 25.64]

Analysis 1.1. Comparison 1: Pulmonary Rehabilitation and sham inspiratory muscle training versus no intervention (change from baseline), Outcome 1: Endurance (metres)

Analysis 1.2. Comparison 1: Pulmonary Rehabilitation and sham inspiratory muscle training versus no intervention (change from baseline), Outcome 2: Incremental shuttle walking test (metres)

Analysis 1.3. Comparison 1: Pulmonary Rehabilitation and sham inspiratory muscle training versus no intervention (change from baseline), Outcome 3: Health Status (CRDQ score)

Analysis 1.4. Comparison 1: Pulmonary Rehabilitation and sham inspiratory muscle training versus no intervention (change from baseline), Outcome 4: Pi Max (cms of water)

Comparison 2. Inspiratory Muscle Training v Sham or no intervention (post treatment results)

Outcome or subgroup title	No. of studies	No. of participants	Statistical method	Effect size
2.1 Endurance (metres)	2	43	Mean Difference (IV, Fixed, 95% CI)	502.48 [254.67, 750.30]
2.1.1 Compared to no intervention	1	19	Mean Difference (IV, Fixed, 95% CI)	43.90 [-534.71, 622.51]
2.1.2 Compared to sham (both groups had Pulmonary Rehabilitation)	1	24	Mean Difference (IV, Fixed, 95% CI)	605.50 [331.26, 879.74]
2.2 Incremental shuttle walking test (metres)	2	43	Mean Difference (IV, Fixed, 95% CI)	148.96 [60.96, 236.95]
2.2.1 Compared to no intervention	1	19	Mean Difference (IV, Fixed, 95% CI)	-14.20 [-190.87, 162.47]
2.2.2 Compared to sham (both groups had Pulmonary Rehabilitation)	1	24	Mean Difference (IV, Fixed, 95% CI)	202.79 [101.31, 304.27]
2.3 Health Status (CRDQ score)	2	43	Mean Difference (IV, Fixed, 95% CI)	22.89 [12.87, 32.92]
2.3.1 Compared to no intervention	1	19	Mean Difference (IV, Fixed, 95% CI)	17.70 [2.28, 33.12]
2.3.2 Compared to sham (both groups had Pulmonary Rehabilitation)	1	24	Mean Difference (IV, Fixed, 95% CI)	26.70 [13.50, 39.90]

Outcome or subgroup title	No. of studies	No. of participants	Statistical method	Effect size
2.4 Pi Max (cms of water)	2	43	Mean Difference (IV, Fixed, 95% CI)	25.77 [12.36, 39.18]
2.4.1 Compared to no intervention	1	19	Mean Difference (IV, Fixed, 95% CI)	24.40 [-1.91, 50.71]
2.4.2 Compared to sham (both groups had Pulmonary Rehabilitation)	1	24	Mean Difference (IV, Fixed, 95% CI)	26.25 [10.67, 41.83]
2.5 24hour sputum volume	1		Mean Difference (IV, Fixed, 95% CI)	Totals not selected
2.5.1 Compared to no intervention	0		Mean Difference (IV, Fixed, 95% CI)	Totals not selected
2.5.2 Compared to sham (both groups had Pulmonary Rehabilitation)	1		Mean Difference (IV, Fixed, 95% CI)	Totals not selected

Analysis 2.1. Comparison 2: Inspiratory Muscle Training v Sham or no intervention (post treatment results), Outcome 1: Endurance (metres)

Analysis 2.2. Comparison 2: Inspiratory Muscle Training v Sham or no intervention (post treatment results), Outcome 2: Incremental shuttle walking test (metres)

Analysis 2.3. Comparison 2: Inspiratory Muscle Training v Sham or no intervention (post treatment results), Outcome 3: Health Status (CRDQ score)

Analysis 2.4. Comparison 2: Inspiratory Muscle Training v Sham or no intervention (post treatment results), Outcome 4: Pi Max (cms of water)

Analysis 2.5. Comparison 2: Inspiratory Muscle Training v Sham or no intervention (post treatment results), Outcome 5: 24hour sputum volume

WHAT'S NEW

Date	Event	Description
6 April 2021	Review declared as stable	This review is no longer being updated. It has been replaced with a new review with the following citation. Lee AL, Gordon CS, Osadnik CR. Exercise training for bronchiectasis. Cochrane Database of Systematic Reviews 2021, Issue 3. Art. No.: CD013110. DOI: 10.1002/14651858.CD013110.pub2.

HISTORY

Protocol first published: Issue 1, 2001

Review first published: Issue 2, 2002

Date	Event	Description
18 August 2008	Amended	Converted to new review format.

Date	Event	Description
1 February 2002	New citation required and conclusions have changed	Substantive amendment

CONTRIBUTIONS OF AUTHORS

The review was conceived by the Cochrane Airways Group and designed by Dr Judy Bradley and Dr Fidelma Moran. Searches for relevant studies were conducted by Dr Judy Bradley and Dr Fidelma Moran and by the Cochrane Airways Group. Dr Judy Bradley and Dr Fidelma Moran screened, appraised and abstracted data for review. Data entry was and analysis was performed by Dr Judy Bradley and Dr Fidelma Moran with advice from the editor, Dr Mike Greenstone and the Cochrane Airways Group

DECLARATIONS OF INTEREST

None known.

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Internal sources

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INDEX TERMS

Medical Subject Headings (MeSH)

Bronchiectasis [*therapy]; Exercise Therapy [*methods]; Physical Endurance; *Respiratory Muscles

MeSH check words

Humans