

Breathing exercises for asthma (Review)

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[Intervention Review]

Breathing exercises for asthma

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ABSTRACT

Background

There is much anecdotal evidence in Eastern and Western literature describing considerable benefits for patients with asthma when treated with breathing interventions. The term 'breathing exercise, training and retraining' has numerous interpretations depending on the nature of the therapy, therapist and cultural background.

Objectives

To assess the evidence for the efficacy of breathing retraining in the treatment of patients with asthma.

Search strategy

Trials were searched for in the Cochrane Airways Group trials register, Cochrane Complementary Medicine Field trials register, EMBASE: Physical Medicine & Rehabilitation Field, and Databases of the physiotherapy library of current research, World Congress of Physical Therapy Proceedings (1995) and AMED (Allied & Complementary Medicine Database 1985-2003/4). Hand searching of the Association of Chartered Physiotherapists in Respiratory Care Journals was undertaken.

Chartered physiotherapists in the field of respiratory medicine were contacted and appeals made in the 'Physiotherapy' Journal and the Physiotherapy Respiratory Care magazine. Searches were undertaken of bibliographies from the included studies and other appropriate papers. Authors of included studies were contacted for information concerning other relevant trials.

Selection criteria

Randomised or quasi-randomised controlled trials of breathing retraining in patients of all ages with a diagnosis of asthma. Breathing retraining should be a major component of the treatment intervention.

Data collection and analysis

Two reviewers (EH & FR) independently assessed trial quality and extracted data. Authors of included trials were contacted for additional data. Where possible adverse effects were noted.

Main results

Abstracts were identified and 42 full text papers were obtained for assessment and possible inclusion. Thirty five studies were excluded. A total of five studies were included in the original review. Two further studies have been added to this update. Most studies were of

small size. Two studies demonstrated significant reductions in rescue bronchodilator use and three studies showed reductions in acute exacerbations, although these were measured in different ways. Two single studies showed significant improvements in quality of life measures. Overall, benefits of breathing exercises were found in isolated outcome measures in single studies. Five studies compared breathing retraining with no active control and two with asthma education control groups.

Authors' conclusions

Comparisons and conclusions were difficult to evaluate as treatment interventions and outcome measurements from the seven trials varied considerably. At present therefore no reliable conclusions can be drawn concerning the use of breathing exercises for asthma in clinical practice. However trends for improvement, notably in quality of life measurements, are encouraging and further studies including full descriptions of treatment methods and outcome measurements are required.

PLAIN LANGUAGE SUMMARY

Breathing exercises for asthma

The term 'breathing exercise or re-training' has numerous interpretations depending on the nature of the therapy, therapist and cultural background. The objective of this review was to assess the evidence for the effectiveness of breathing retraining for patients with asthma. Due to the small number of studies meeting the criteria for inclusion into this review, the small number of patients in the studies and the use of diverse interventions in the included studies, no reliable conclusions can be drawn as to the beneficial effects of breathing retraining in asthma. However with the introduction of two further studies trends for improvement in an increased number of outcomes were found. There is therefore a need for large scale trials involving breathing retraining in order to observe its effectiveness in the treatment and management of asthma.

BACKGROUND

Breathing exercises have been taught for hundreds of years in both Eastern (Vedanthan 1998) and Western societies for numerous conditions including asthma. Anecdotal evidence from the traditional practice of yoga and other similar physical therapies frequently indicates an alleviation and sometimes elimination of asthma symptoms (Chandra 1994). Since the introduction of pharmacological interventions for the control of asthma symptoms, interest in non-pharmacological methods had declined. However there is renewed public interest in physical therapy and other therapies as evidenced by the proliferation of self-help books and an increase in the demand for complementary therapies (Linde 1998 ; Linde 1998a; Bradley 1991; Clifton-Smith 1999; Bradley 2003).

Manipulation of the breathing pattern has taken many forms and in much of the literature breathing retraining and re-education is not described in detail. However the fashion for encouraging full and often extreme expiration may result in hyperventilation and hypocapnia and thus an exacerbation of asthmatic and other symptoms. These controversial techniques brought the practice of some breathing treatments into disrepute. Over 30 years ago work undertaken at Papworth Hospital, Cambridge, UK, changed the techniques used by many physical therapists for the treatment of asthma and hyperventilation (Cluff 1984; Innocenti 1993; Holloway 1994; Lum 1994). Nowadays in addition to breathing training, relaxation sessions and advice may be included in the Papworth Method of treatment for asthma. This method aims to encourage appropriate breathing patterns by reducing hyperventilation and hyperinflation, therefore increasing carbon dioxide levels and thus reducing the effects of hypocapnia and some symptoms attributed to asthma. The rationale behind the use of the Russian Buteyko Technique (Bowler 1998) is similarly that hypocapnia is a major contributor to the symptoms of asthma and therefore exercises to reduce minute volume will reduce symptoms and the use of medication.

From health economists and patients viewpoint a proven low-risk, low-cost intervention applicable for asthmatic patients would constitute a major advance for consideration. With the recent introduction to the UK, New Zealand and Australia of the Buteyko method of treating asthma and also the increased desire of patients seeking self-help measures and complementary therapies a systematic review of the literature was required to evaluate the evidence concerning the effectiveness of breathing re-training.

This updated review includes two further trials. In the Thomas 2003 trial the Papworth Method component of breathing exercises only was taught by a physiotherapist. In the second, the Russian Buteyko Breathing Technique was taught to patients using a video and manual (Opat 2000).

OBJECTIVES

To evaluate the evidence for the efficacy of breathing retraining in the management of asthma.

METHODS

Criteria for considering studies for this review

Types of studies

Randomised or quasi randomised controlled trials of breathing retraining or therapy in patients with a diagnosis of asthma. Breathing retraining should be a major component of the treatment intervention.

Types of participants

Studies of adult patients with physician diagnosed asthma and/or diagnosis by internationally established criteria: American Thoracic Society (ATS), European Respiratory Society (ERS) or British Thoracic Society (BTS). Patients may be either community or hospital based with their treatment supervised by a general practitioner or respiratory specialist.

Types of interventions

Patients suffering with asthma who have received at least one course of treatment comprising breathing retraining compared with a control group receiving asthma education or alternatively with no active control group (e.g. waiting list control)

Types of outcome measures

Primary outcomes

Improvement in quality of life indices

Secondary outcomes

Secondary Outcomes:

1. Severity of symptoms
2. Number of acute exacerbations
3. In-patient hospitalisation episodes
4. Physiological measures - lung function (e.g. PEFR, FEV1, FVC, MV etc)
5. Reduction in medication usage (e.g. inhaled or oral steroids or rescue bronchodilator)
6. Reduction in GP and hospital out-patient appointments
7. Evidence of symptomatic improvement
8. Patient's subjective evaluation of the intervention

Search methods for identification of studies

Electronic searches

The Cochrane Airways Group database was used to identify controlled clinical trials using the following search terms: (breath*) and (exercise* or retrain* or train* or re-educat* or educat* or physiotherap* or "physical therap*" or "respiratory therapy" or buteyko

Trials were also searched for in the following databases: The Cochrane Airways Group Trials Register, Cochrane Complementary Medicine Field trials register, EMBASE (1988-1999), Physical Medicine & Rehabilitation Field, Physiotherapy library database of current research, World Congress of Physical Therapy Proceedings (1995) and the Allied & Complementary Medicine database (AMED) (1985-2003/4). Hand searching of the Association of Chartered Physiotherapists in Respiratory Care Journals (1987-1999) was also carried out.

Searching other resources

Physiotherapists and specialists in the field of respiratory medicine were contacted and requests for trials were also made through advertisements in the Physiotherapy Journal and the Physiotherapy Respiratory Care magazine.

Searches were undertaken of bibliographies from the included studies and other appropriate papers. Authors of included studies were contacted for information concerning other relevant trials.

Data collection and analysis

Selection of studies

Two reviewers (EH, FR) independently assessed the studies for the possibility of inclusion in the review. Final decisions and disagreements were resolved by discussion between the two reviewers

Data extraction and management

Two reviewers (EH, FR) independently extracted data. We collected information from the studies including:- methods - randomisation procedures, withdrawals and dropouts participants - setting, number, age range, diagnostic criteria, inclusion and exclusion criteria

interventions - methods and types of intervention including number and duration of sessions and also methods used for the control group comparisons

outcomes - quality of life and asthma symptom scores, pulmonary function measurements, medication use, number of acute attacks etc.

Assessment of risk of bias in included studies

We assessed the concealment of allocation, grading this domain of bias as being of low, high or unclear risk of bias.

Dealing with missing data

Authors of the seven included trials were written to in order to clarify or confirm the randomisation methods used, provide missing data, verify the data extracted and help identify any further published or unpublished studies. Any data or replies received from our correspondence are noted and acknowledged.

Data synthesis

Continuous outcomes were expressed as weighted mean difference [WMD, 95% confidence interval (CI)] or as standardised mean difference [SMD, 95% CI] if different methods of measurements

were used by studies (e.g. symptom scores). Dichotomous outcomes were analysed as Relative Risks (RR, 95% CI).

RESULTS

Description of studies

See: [Characteristics of included studies](#); [Characteristics of excluded studies](#).

Results of the search

Full-texts of 42 potentially relevant studies were obtained after screening 182 abstracts and titles revealed by the searches. The Buteyko ([Bowler 1998](#)) paper was obtained from the Internet. The [Emtner 1998](#) and [Pryor 1979](#) theses were obtained through personal contact. Principal reasons for exclusion were: devices used for exercising or training; a diagnosis of chronic obstructive pulmonary disease (COPD) and multiple interventions where breathing exercises were not the principal component. In a number of trials allocation was not randomised or there was no control group. Other reasons for exclusion are detailed in the table Characteristics of Excluded Studies.

Included studies

Seven trials were included that were conducted in six different countries; Australia, Bangalore, Canada, Germany, UK and the USA. Six papers were written in English and one in German. A further UK trial is awaiting assessment [Cooper 2003](#).

Sealed envelopes were used in the [Bowler 1998](#) study to randomise 39 patients; [Girodo 1992](#) stated that the 92 volunteers were 'randomly assigned' to 4 groups; in both studies media solicitations were initially undertaken to recruit patients. [Nagarathna 1985](#) indicated that 53 matched pairs of patients were selected from an outpatient clinic for yoga therapy, he states that the one individual in each pair receiving the intervention was randomised. Seventeen volunteer university students attending an asthma clinic were randomly divided in Vedanthan's study. [Fluge 1994](#) stated that 36 volunteers were randomly assigned to 3 equal groups. We wrote to the authors for further details regarding their methods of randomisation.

In this update two more recent studies were included. [Opat 2000](#) recruited 36 patients from 108 respondents to media advertisements. Patients were excluded if they were receiving oral corticosteroids or higher levels of inhaled steroids. They were randomly allocated, using a computer generated list, to one of two groups. Subjects were blinded in that patients in both groups were told they were receiving "drug-free asthma therapy" - where one group received BBT training and the control group received asthma education. [Thomas 2003](#) recruited patients with high Nijmegen scores currently being treated for asthma from a General Practice. Thirty three patients were then randomised by a statistician using random number tables to either the intervention or control group.

The 5 initially included studies involved multiple interventions however breathing retraining was the major component and this was compared with control groups. In the [Bowler 1998](#) study patients were stratified according to the amount of salbutamol usage. The Buteyko breathing technique was taught to the intervention group; the control group received asthma education, relaxation and abdominal breathing exercises 'not involving hypoventilation'. In the [Girodo 1992](#) study patients underwent deep diaphragmatic breathing exercises and were compared against a group that were on the waiting list (controls). In the [Nagarathna 1985](#); [Fluge 1994](#) and [Vedanthan 1998](#) studies, patients undertook yoga training that involved breathing exercises as the major component; the control groups did not undergo yoga training but continued on their usual medication.

The two recent studies included in the update concentrated on breathing training only. The Buteyko Breathing Technique was taught by means of a video and a manual in the [Opat 2000](#) trial. Participants in the control group were each given a video of nature landscapes to watch daily. Duration of the study was four weeks with two daily viewings recommended. Data on compliance was noted. [Thomas 2003](#) compared three short breathing retraining sessions (total contact time 75 minutes), taught by a physiotherapist, with a control group receiving asthma education from a nurse. In the study by [Thomas 2003](#) results were reported as median values because the data were skewed. When analysed as means and standard deviations the mean difference was found to be very similar to the difference in medians.

In the [Bowler 1998](#) and [Thomas 2003](#) studies, breathing retraining was compared with asthma education; this is reflected in the revised, updated Table of Comparisons and analyses. Participants in the [Opat 2000](#) control group watched a Nature video, [Fluge 1994](#) stated his control group received 'no additional therapy'; [Girodo 1992](#) 'waiting list controls'; [Nagarathna 1985](#) 'patients reported for check ups every six months'; [Vedanthan 1998](#) stated 'all subjects including the control group reported regularly to the Health Centre and were given peak flow meters'.

Risk of bias in included studies

Four studies obtained a low risk of bias ([Bowler 1998](#); [Opat 2000](#); [Thomas 2003](#); [Vedanthan 1998](#)). However in the [Bowler 1998](#) trial, subjects were first stratified by beta-agonist use and then randomised by means of envelopes distributed by a third party. In Thomas study only patients with Nijmegen scores more than 23 (i.e. increased severity of symptoms) were considered for inclusion. Double-blinding is not possible or practical in these studies. If neither the investigator nor the patient involved know the identity of the intervention then the study is double blind. Blinding reduces bias in a trial. The patients in these trials must know whether or not they are undertaking breathing training or asthma education, as compliance is critical to the study. However it is possible to blind the assessor who is analysing the results of the trial.

Not only will the patients in the control groups of the studies receiving asthma education also benefit from the Hawthorne effect, but also those receiving no active treatment. The Hawthorne effect is when subjects are aware that they are part of a study and may alter their behaviour as a result. Those control group patients reported as receiving no intervention may still receive some benefit because they are aware they are included in the study and may benefit from the attention they receive. This is inevitable in most physical therapy studies.

Withdrawals and drop-outs were noted in six studies ([Bowler 1998](#); [Girodo 1992](#); [Nagarathna 1985](#); [Opat 2000](#); [Thomas 2003](#), [Vedanthan 1998](#)). [Thomas 2003](#) was the only study stating intention to treat analysis with respect to a 'clinically relevant change' in asthma related quality of life. Compliance describing number of times the videos were viewed was described in the [Opat 2000](#) paper.

Effects of interventions

COMPARISON A: BREATHING TRAINING VERSUS CONTROL (n = 5 studies)

1. Quality of Life (Marks n = 1)

Asthma symptom scores (weekly) (n = 1).

[Opat](#) reported Quality of Life (Marks, Dunn & Woolcock 1992)) data as a significant improvement ($p=0.043$) but this was not available in a usable format for the meta analysis. Asthma symptom scores were reported by one study ([Vedanthan 1998](#)) but were not significant between the groups.

2. Measures of Physiological Function

Forced Expiratory Volume in 1 second (FEV1) (n = 2)

Forced Vital Capacity (FVC) (n = 2)

Peak Expiratory Flow Rate (PEFR) (daily n = 1)

PEFR (morning and evening measurements n = 1)

Three studies reported physiological measurements on the effect of breathing training (74 patients) compared with control groups (70 patients). A non-significant decrease in FEV1(L) was seen in the treatment group relative to the control group (WMD= -0.19 L, 95% CI: -0.70 to 0.31, $p=0.5$). This finding is based on only two studies ([Fluge 1994](#); [Vedanthan 1998](#)). Unfortunately none of the other studies reported this outcome in a usable format. The effect of breathing re-training on FVC was reported in two studies ([Fluge 1994](#); [Vedanthan 1998](#)). There was no significant effect. Two studies ([Nagarathna 1985](#); [Vedanthan 1998](#)) reported PEFR (L/min). One ([Nagarathna 1985](#)) reported mean daily values which improved significantly when 52 patients treated by breathing retraining were compared with the control group of 53 patients (WMD = 72 Litres, 95%CI: 30.15 to 113.85, $p = 0.0007$). One study ([Vedanthan 1998](#)) reported morning and evening values; neither improved significantly.

3. Medication use

Rescue bronchodilator use (actuations per week n = 1)

Rescue bronchodilator use (μg per day $n = 1$)
Inhaled corticosteroid use (% reduction $n = 1$)
Inhaled corticosteroid use (μg per day $n = 1$)
Inhaled corticosteroid use (number of inhalations $n = 1$)

Two studies showed significant decreases in rescue bronchodilator use measured in different ways. One (Nagarathna 1985) reported a decrease (almost 6 actuations per week) in the use of beta2 agonists in 53 patients during breathing retraining as compared with 53 control patients (WMD=5.82, puffs 95% CI: 2.94 to 8.70). The second study (Opat 2000) reported a significant decrease in rescue bronchodilator use (319 μg per day) when comparing 13 patients with breathing retraining to 15 control group patients (WMD=319.00 95% CI: 52.78 to 585.22). Inhaled corticosteroid use measured by both μg per day and number of inhalations were reported by one study Opat 2000; the results were not significant.

4. Acute Exacerbations

Exacerbations (mean per week ($n = 1$))
Exacerbations (total count per group, $n = 2$)

Two studies reported these results but in different ways. In one (Nagarathna 1985), there was a significant decrease of 1.27 episodes per week (WMD=1.27, 95% CI: 0.28 to 2.26, $p=0.01$). In the other (Fluge 1994) exacerbations were reported as counts per group; there was no difference between treatment arms.

COMPARISON B: BREATHING TRAINING VERSUS ASTHMA EDUCATION ($n = 2$ studies)

1. Quality of Life (QOL)

Number of patients with clinically significant improvement in QOL (Numbers Needed to Treat (NNT) ($n = 1$))
Quality of Life - Asthma Quality of Life Questionnaire (AQLQ) (change at 1 month ($n = 1$))
AQLQ (change at 6 months $n = 1$)
Quality of Life (Marks $n = 1$)
Nijmegen Questionnaire Score ($n = 1$)

The Thomas 2003 study reported numbers needed to treat (NNT). Using a clinically relevant change in AQLQ score (increase of >0.5) the number needed to treat at one month was 2 (95% CI 2 to 8). At six months the NNT was no longer statistically significant.

Two studies reported quality of life outcomes (Bowler 1998; Thomas 2003). Different questionnaires were utilised; the Marks, Dunn and Woolcock questionnaire, where the higher score is the better in a 10 point scale (Bowler 1998), and the Asthma Quality of Life Questionnaire, (AQLQ) (Thomas 2003) with four domains. The Bowler 1998 study compared BBT patients with a control group consisting of patients receiving asthma education; there was a significant improvement of 0.80 points (WMD=0.80, 95% CI: 0.38 to 1.22) in the Marks quality of life scores. As noted previously in the Thomas 2003 study as the data were skewed changes in the median values were given by the author. The median difference for the overall score for AQLQ at one month was 0.51 ($p=0.018$) and at six months the median difference was 0.76

($p=0.065$). Means were obtained from the author and have been entered into RevMan as when analysed as means and standard deviations the mean difference is very similar to the difference in medians.

Thomas also reported statistically significant median values for the Nijmegen questionnaire scores (out of a 64 point scale the lower the better) ($p=0.154$ at one month and $p = 0.010$ at six months) and noted that there was a correlation in quality of life scores with the Nijmegen questionnaire scores at 1 and 6 months. However patients had been stratified originally and only those with a score of more than 23 were selected for randomisation in the study.

The Nijmegen questionnaire is a symptom measurement tool which assists in indicating dysfunctional breathing patterns and hyperventilation.

2. Measures of Physiological Function

FEV1 (L) ($n = 1$)
PEFR (morning $n = 1$)
Minute Volume (MV) ($n = 1$)

In the study by Bowler 1998, the percent predicted FEV1 (L) showed no difference between the two groups at the end of a 3 month period of BBT (Mean (SD); 72 (22% predicted) and the control group: (72 (15% predicted), $p=0.4$). Bowler 1998 reported morning PEFR (L/min) values. No difference was found between the BBT and education groups at three months.

Bowler 1998 also reported Minute Volume (as L/min) at 3 months being significantly less in the BBT group than the control group (WMD=3.70 L/min, 95% CI: 1.40 to 6.00). ($p=0.004$).

3. Medication Use

Rescue bronchodilator use (canisters per 6 months $n = 1$)
Inhaled corticosteroid use (canisters per 6 months $n = 1$)
Inhaled corticosteroid use (% reduction in daily use $n = 1$)

Thomas reported no significant changes between the number of canisters of inhaled steroid and bronchodilator medication used 6 months before and after the intervention and between both groups of patients. Bowler 1998 reported a significant reduction in inhaled steroid use (% reduction in daily use) (WMD=49.0 % reduction, 95% CI: 42.9 to 55.1) assessed three months after the after the one week intervention. Owing to the small number of included studies and the few outcomes that could be pooled across studies, statistical heterogeneity was not demonstrated in most of the outcomes. None of the studies reported: any change in GP and hospital out-patient appointments and admissions or patient's subjective evaluation of the intervention.

WITHDRAWALS/DROPOUTS/ADVERSE EFFECTS

Fluge 1994 - Withdrawals and dropouts were not reported in the translation of the paper we received. Three patients in the control group were reported as having additional oral steroids for acute exacerbations

Girodo 1992 - Owing to the 'demands of weekly commitments and difficult training' patients were encouraged in a 2 week pre-

intervention period to identify themselves and discontinue the study at this stage. Originally 46 patients in the DDB group and 23 in the control group were randomly assigned. Ultimately 32 DDB patients and 23 controls took part in the study. No withdrawals or adverse effects during the trial period were reported.

[Nagarathna 1985](#) - Patients were not reported to have dropped out during the yoga intervention period, however a number not practising for 16 days out of each month over a period of 30 months in the follow up period were considered to have dropped out. No adverse effects were recorded. No inhalers were used but numbers of bronchodilator tablets and injections were scored.

[Opat 2000](#) - Four subjects dropped out of the trial. One subject in the control group was admitted to hospital with an exacerbation of asthma symptoms.

[Vedanthan 1998](#) - No withdrawals or dropouts occurred.

[Bowler 1998](#) - Three patients from the BBT and control group were admitted to hospital for exacerbations of asthma. During the 8 months subsequent to the intervention 6 BBT and 7 controls received short courses of prednisone. After the intervention one patient from each group was lost to follow-up.

[Thomas 2003](#) - Five patients, from the control and breathing retraining groups, were reported to have withdrawn for various reasons during the intervention and 6 month follow up period. One patient developed an exacerbation of a non-respiratory illness and withdrew from the study and another in the control group died from a cardiac condition in the assessment period.

DISCUSSION

With the recent addition of two further studies seven studies are now found to meet the inclusion criteria for this review. Searches were undertaken for randomised controlled trials describing studies where patients with asthma were treated with breathing retraining as the major component of treatment. There are many descriptive and non randomised trials and it was disappointing to find so few randomised controlled trials in view of the widespread interest from the general public and increasingly health professionals in non pharmacological therapies.

As described above it was decided after discussion to introduce two categories in the Table of Comparisons owing to the inclusion of Thomas' recent study where a brief breathing retraining intervention (one component of the Papworth Method) was compared with asthma education. Asthma education is known to improve the well-being of asthma patients and the earlier [Bowler 1998](#) study has now been included in this second category. In the other five studies the breathing retraining group was compared with a non-active control group.

The improvement in FEV1 reported by two studies was not significantly different between the control group and breathing retraining groups. PEFr was reported by three studies but an im-

provement was only observed in one ([Nagarathna 1985](#)). It is difficult to derive any firm conclusions for the effect of breathing retraining on PEFr in asthma. However as asthma attacks occurs intermittently and the airways and not lung tissue are affected, some physiological measurements are not always indicative of the severity of asthma. Quality of life measurements are increasingly being recognised as important outcome measures for a number of chronic conditions. Minute volume (MV) was reported by one study ([Bowler 1998](#)) to decrease by 3.7 L. As the intention of the Buteyko and Papworth method of breathing retraining is to reduce the accompanying elements of hyperventilation in asthma patients this is of interest.

A significant decrease in the use of 'rescue beta-2 agonist' by almost 6 actuations per week was reported by one study ([Nagarathna 1985](#)). The study by [Bowler 1998](#) also reported a decrease in use of beta-2 agonist, however the results were not included in this outcome because the author reported actual total dosage used and the study actively recruited patients who were higher users of beta-2 agonists (> 1400 mcg). Inhaled corticosteroids use was also reported to fall by 49% in this study. At baseline, steroid use was higher in the actively treated arm than in the control group (1500 mcg/day & 1000 mcg/day, respectively). This may have led to a regression to the mean effect causing an apparently better effect in the treated patients. Bowler's intervention was concentrated into one weeks treatment but additional encouragement was given by telephone and subsequently outcomes were assessed three months later.

Asthma symptoms scores reported by one study ([Vedanthan 1998](#)) did not improve significantly, but there was a trend towards improvement. Asthma exacerbations fell in one study ([Nagarathna 1985](#)), but not in another ([Fluge 1994](#)). [Nagarathna 1985](#) measured exacerbations in mean episodes per week; severity of attack was rated from 1 to 3 where 3 was the most severe requiring an injection or admission to hospital. [Fluge 1994](#) and [Opat 2000](#) measured exacerbations as total counts per group. Fluge stated that three patients in the control group suffered from acute exacerbations requiring oral steroids, however definitions and severity of exacerbations were not described. Measures of Quality of Life were reported to improve in two studies ([Bowler 1998](#); [Thomas 2003](#)) both of which compared breathing retraining with asthma education control groups; unfortunately the two studies used two different instruments, the Marks questionnaire and the Juniper Asthma Quality of Life Questionnaire (AQLQ); therefore it was not possible to combine them. Also breathing retraining methods used in the two studies were different, namely the BBT and the breathing training element of the Papworth Method. Thomas' was the only study reporting a 'numbers needed to treat' calculation, using the AQLQ, of 2 at one month and 4 at 12 months.

In addition to the varying techniques of teaching breathing retrain-

ing the length and frequency of the treatment interventions also varied considerably with the BBT taught daily for 60-90 minutes in the [Bowler 1998](#) study to 45 minute sessions of yoga breathing training three times a week for 16 weeks in the [Vedanthan 1998](#) study. In another yoga trial [Nagarathna 1985](#) the training programme ran daily for 2.5 hours for two weeks. There is little uniformity between the interventions even when the techniques are similar, again making comparisons difficult.

Both Bowler and Thomas stratified their participants, the former by higher levels of medication and Thomas' inclusion criteria were those scoring over 23 in Nijmegen questionnaire scores. Outcome measures in these studies will relate only to similar populations with similar characteristics. We can only generalise results to a patient population bearing similar characteristics. Bowler's results relate to those patients with initial high beta agonist usage and Thomas' to patients exhibiting more severe symptoms associated with dysfunctional breathing.

The applicability of the results of this review are limited with a number of factors contributing to this problem; the small number of studies, small number of participants and a diversity of methods of breathing retraining and outcome measures. Data clarification and further information were sought from all authors in order to improve and increase the amount of data entered into the review. We have now received responses from four authors ([Bowler 1998](#), Professor Abramson for [Opat 2000](#), [Thomas 2003](#) and [Vedanthan 1998](#)) to whom we are grateful. Because of receiving further information four studies have now been methodologically rated A as methods of randomisation have been described.

Overall, these studies were too small to provide a reliable estimate of the efficacy of breathing exercises for asthma. Despite the impossibility of running double blind studies with breathing retraining as the intervention, further randomised controlled trials should be undertaken to evaluate the different methods of breathing retraining. The methods should be fully described for evaluation by patients, the public and professionals. Further studies and larger studies are required including outcome measurements such as health status questionnaires, measurements of symptom free days and the frequency and definitions of exacerbations to-

gether with routine physiological measurements and also measures evaluating airway inflammation.

AUTHORS' CONCLUSIONS

Implications for practice

No reliable conclusions, as yet, can be drawn concerning the use of breathing exercises for asthma in clinical practice although a number of trends of improvement in a number of outcomes are seen in this review. Diverse methods of training with breathing exercises are utilised and it is important that these be fully described and evaluated clinically as well as academically.

Implications for research

Due to the small number of RCT's meeting the criteria for inclusion into this review and due to the small number of patients, and the multiple interventions employed in these studies, there is a requirement for large scale good quality methodological trials involving breathing retraining in the treatment and management of asthma. Comprehensive outcome measurements including validated quality of life questionnaires and the newer measurements of airway inflammation are required to determine which, and if, forms of breathing training benefit patients. Further studies are needed in order to address the issues raised here and to clarify and confirm the findings from this review.

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* Indicates the major publication for the study

CHARACTERISTICS OF STUDIES

Characteristics of included studies [ordered by study ID]

Bowler 1998

Methods	DESIGN: Randomised Controlled Trial. 4 week run-in period. Stratified according to beta agonist use. Selection of 39 subjects from 170 volunteers. Further cohort of 20 'normal' hospital staff recruited for comparisons of pulmonary function. METHOD OF RANDOMISATION: randomly allocated to 2 groups using sealed envelopes. METHOD OF ALLOCATION CONCEALMENT: sealed envelopes prepared by clerical staff. Participants and staff blinded to the allocation of the two groups. OUTCOME ASSESSOR BLINDING: Not described. WITHDRAWAL/ DROPOUTS: 3 in post run-in period. Post-intervention 1 in both groups. 3 from each of the 2 groups admitted to hospital with exacerbations during the study. 6 Buteyko breathing training (BBT) and 7 controls received courses of prednisone during the 8 months after interventions.
Participants	Country: Australia. Setting: Community. Trial took place from January to April 1995. Provider: BBT taught by representative of Buteyko Australia. Control group by Control Group Instructor. Subjects: n = 39. 19 (43%) female. Age range: 12-70 Normal subjects: n = 20. Age range: 25-68.

Bowler 1998 (Continued)

	BBT - active group: n = 19. 9 (47%) female. Age range: 12-68. (mean not stated) Control group: n = 20. 8 (40%) female. Age range: 12-69. Asthma diagnosis: subjects recruited from an Asthma Foundation publicity campaign and accepted if 'variable difficulty', wheeze or chest tightness with response to beta2-agonist and taking substantial doses of asthma medication. Inclusion Criteria: Asthma patients with substantial medication use. Exclusion criteria: Unstable asthma, or subjects considered not to have asthma. Significant unstable medical conditions. Undertaken previous BBT training. Change in medication within the 4 week run-in period.	
Interventions	Both groups underwent 60-90 minute training sessions daily for 7 days and were given diaries to record events. Active treatment: 19 in the BBT group were given breathing exercises to reduce depth and frequency of breathing and also breath holding exercises. Follow up telephone calls and extra breathing classes were given if considered necessary, number not specified. Control: Asthma education, relaxation, abdominal breathing exercises not involving hypoventilation. One telephone call to this group. Calls were made every 2 weeks to both groups to encourage reduction of selective medication. Co-intervention: none specified.	
Outcomes	Pulmonary function: The normal group had significantly higher mean end tidal carbon dioxide (ETCO2) levels than either the BBT or control group in their run-in period and also at the 3 month follow-up check. QOL: The (Marks) self-administered questionnaire indicated trends of improvement. Medication: The BBT group relative reduction in beta2-agonist was thought to be related to a proportional reduction in minute volume. There was a trend to lower inhaled steroid doses in the BBT group.	
Notes	The author responded to our request regarding method of randomisation, and further data etc.	
<i>Risk of bias</i>		
Item	Authors' judgement	Description
Allocation concealment?	Yes	A - Adequate

Fluge 1994

Methods	DESIGN: Randomised controlled trial. 15 days duration. METHOD OF RANDOMISATION: randomly assigned into three equal groups (12x3). METHOD OF ALLOCATION CONCEALMENT: not possible. OUTCOME ASSESSOR BLINDING: not described. WITHDRAWAL/ DROPOUTS: Attrition during trial reported. (This paper was translated from German)	
Participants	Country: Germany. Setting: Community. Provider: trial investigators Control group by Control Group Instructor. There were 3 arms in this trial, 2 of interest. Subjects: n = 36 (12 males). Age range: 21-55 years Normal subjects: n = 12. Active group: n = 12 Exclusion criteria: cardiopulmonary complications due to asthma.	
Interventions	Duration: active treatment: 3 weeks training of three hour 15 times total. Breathing groups; physical and respiratory exercises. Control/placebo: no therapy. Re-evaluated after 15 sessions. Co-intervention: no information given.	
Outcomes	Pulmonary function and number of acute attacks.	
Notes	Study had three arms; breathing vs yoga vs control with 12 patients in each arm. We have written to the author for further clarification.	
Risk of bias		
Item	Authors' judgement	Description
Allocation concealment?	Unclear	B - Unclear

Girodo 1992

Methods	DESIGN: Randomised Controlled Trial with a run-in period. METHOD OF RANDOMISATION: 'randomly assigned' to 4 groups; method not described. METHOD OF ALLOCATION CONCEALMENT: not possible. OUTCOME ASSESSOR BLINDING: not described. WITHDRAWAL/ DROPOUTS: Attrition occurred in the run-in period in all groups except controls. Attrition during trial and at follow-up not reported.
Participants	Country: Canada Setting: Community Time: December to May Subjects: From media solicitations for asthmatics, 274 respondents. Eligible: 92 Randomised: 92 to 4 groups. Providers: 2 deep diaphragmatic breathing (DDB) groups, one taught by a singing instructor the other by a 25 year old asthma patient. Physical education group led by student with PE experience. Control group: waiting list subjects who self-monitored. Data at the end of the 2 week run in period:- DDB groups: n = 32: 20 (62%) female. Age mean (sd): 28.61 (11.21). PE group. Subjects: n = 12: 8 (66%) female. Mean age (sd): 34.92 (10.53) Waiting list control group. Subjects: n = 23: 13 (56% female). Age mean (sd): 32.9 (6.55). Inclusion criteria: "detailed examination of the history of their condition - doctor's approval and informed consent". Exclusion criteria: History of allergies, severe asthma, chest disease, diabetes, inability to make 26 week commitment.
Interventions	Duration: active treatment: 16 weeks training of one hour 3 times a week. Breathing groups; physical and respiratory exercises to enlarge the thoracic cage and increase the capacity for maximum lung efficiency during expiration. PE group: physical exercises with no emphasis on deep diaphragmatic breathing. Control/placebo: waiting list controls had pre-test assessment of 'chronicled' medication use and asthma symptoms. Re-evaluated after 8 and 16 weeks. Co-intervention: no information given.
Outcomes	Data from the 2 breathing groups was combined. Four outcomes were measured: daily medication use, attack duration and intensity, asthma symptom checklist and physical activity inventory; data only given for end of pre-test period. Bar charts given for medication use and attack intensity. Asthma symptom checklist: Kinsman: 1973 Admit/relapse: not reported for the end of the trial. Types of medication not described.
Notes	We have written to the author for information on randomisation methods and further data.
<i>Risk of bias</i>	

Item	Authors' judgement	Description
Allocation concealment?	Unclear	B - Unclear

Nagarathna 1985

Methods	DESIGN: Random selection not described. Comparison with matched subjects as controls. METHOD OF RANDOMISATION: method of selection not described. MEANS OF ALLOCATION CONCEALMENT: Not described. OUTCOME ASSESSOR BLINDING: Not described. WITHDRAWAL/ DROPOUTS: patients who stopped practising or did not practise for more than 16 days each month were eliminated from the study. No other reason for attrition was noted. 25 (47%) dropped out; 7 after 6 months, 7 after 12 months, 2 after 18 months 4 after 24 months, 5 after 30 months.
Participants	Country: Bangladesh. Setting: Yoga Therapy and Research Centre. Subjects: n =106. Provider: Yoga trainer. Yoga group: n=53, 15 (28%) female. Age mean: 26.36. Age range: 9-47. Control group: n = 53, 15 (28%) female. Age mean: 26.41 Age range: 9-47 Asthma diagnosis: satisfying the clinical criteria of Crotton, Douglas and Shivpuri. Inclusion criteria: established bronchial asthma. Exclusion criteria: not recorded.
Interventions	Active treatment: training programme for 2 weeks for 2.5 hours daily from 18.00-20.30 hours. Included were:- breathing exercises associated with simple movements; yoga loosening exercises; various physical postures combined with slow breathing and exercise; relaxation and slow deep breathing; meditation and devotional session including chanting; weekly traditional voluntary nose and stomach wash techniques; yoga philosophy lectures and discussions. Patients were instructed to continue the practises daily during the follow-up period of 30 months Control group: patients reported for check ups every 6 months. Co-intervention: No inhalers used. Continued with usual, self-regulated broncho-dilators and injections. The doctor decided if a change in the 'brand' of drug was required. Patients kept diaries recording drug usage, number and severity of attacks of airway obstruction.
Outcomes	Pulmonary function: PEF Number and severity of attacks. Drug treatment score.

Notes	Written to author for clarification.	
<i>Risk of bias</i>		
Item	Authors' judgement	Description
Allocation concealment?	Unclear	B - Unclear

Opat 2000

Methods	DESIGN: Randomised Controlled Clinical Trial of the Buteyko Breathing Technique (BBT) taught by video. Single-blind, placebo controlled. 108 subjects with asthma were recruited through media advertisements. METHOD OF RANDOMISATION: random allocation of subjects to a control or treatment group by a computer generated list. METHOD OF ALLOCATION CONCEALMENT: both group subjects received a video and asthma diary. BLINDING: all subjects were told that they were taking part in a drug free asthma therapy trial. OUTCOME ASSESSOR BLINDING: not mentioned. WITHDRAWALS/DROPOUTS: 4 subjects dropped out and 4 did not submit symptom diaries for varying reasons. ADVERSE EVENTS: one control group subject had a severe asthma exacerbation 10 days after commencement of the trial.
Participants	Country: Australia. Setting: Organised by the Department of Epidemiology and Preventive Medicine, Melbourne. Provider: the intervention video and manual taught the BBT. The video distributed to the control group was called 'Nature's Landscapes' and utilised images and sounds from nature with classical music. Subjects: 36 subjects satisfying the inclusion criteria were willing to participate in the study. n=36, 18 (50%) female. Age range: 18-50 years Intervention group age: mean 31.6 (sd.9.5), placebo group mean age: 32.7 (sd11.4) Asthma diagnosis: self-reported diagnosis of asthma by a medical practitioner Inclusion criteria: adults aged between 18 and 50 years with mild to moderate asthma willing to devote time twice a day to watching a video Exclusion criteria: previous BBT training. Taking oral steroids or more than 1600ug of inhaled steroids per day. Less than 3 doses of inhaled bronchodilator medication per week. Those who had experienced a severe asthma exacerbation in the previous 6 weeks.
Interventions	Active treatment: subjects given a manual and 67minute 'Buteyko Breathing Method' instruction video to practise twice a day for 4 weeks. No other intervention included. Control subjects were given a nature landscape video with no breathing instruction, a portion to be watched for 20minutes twice a day.No follow-up post trial reported.

Opat 2000 (Continued)

Outcomes	Compliance: maximum number of video viewings was 56. The intervention group reported an average of 36.7 viewings and the control group 41.9.Q.O.L. Asthma Quality of Life Questionnaire (Marks et al).Diaries kept by patients detailed medication intake: total inhaled bronchodilator (ug) use per day and inhaled steroid medication (ug) use per day. Also peak expiratory flow and asthma symptom list were recorded.Statistically significant improvement in breathlessness and mood disturbance sub-scale groups between the BBT and placebo group.Asthma diary filled in by all participants,recording day & night time symptoms, medication intake and peak flow.Day and night symptoms were reduced in the BBT group but did not reach statistical significance. Regular peakflow; statistically non-significant improvement between the BBT and control group.The mean difference in inhaled steroid intake between groups was a non-statistically significant decrease of 84ug per day in the BBT group.	
Notes	New inclusion for 2003 update. In response to our request further information has been provided by Professor Abramson on behalf of Dr Opat.	
<i>Risk of bias</i>		
Item	Authors' judgement	Description
Allocation concealment?	Yes	A - Adequate

Thomas 2003

Methods	DESIGN: Randomised Controlled Clinical Trial. Subjects from a General Practice, whose medical notes indicated they had asthma, were invited to fill in the Nijmegen questionnaire. METHOD OF RANDOMISATION: Those with a Nijmegen score above 23 were randomised using the alphabet and random number tables. METHOD OF ALLOCATION CONCEALMENT: a statistician supervised the random allocation. BLINDING: The assessor was blinded when marking the assessments. Patients could not be blinded to their treatment group as to whether they were attending for breathing training or asthma education. WITHDRAWALS/DROPOUTS: Intervention group - one had an exacerbation of a non-respiratory illness. Control group: one had already received a similar breathing training course. One died from a myocardial infarct between the one and six month assessments. Two subjects failed to return the six month questionnaires.	
Participants	Country: England, UK Setting: semi-rural General Practice. Subjects: n = 33 Age range: 17-65 mean 48.8. 7 (21%) male subjects. Breathing trial: n = 17 Control group: n = 16 Asthma diagnosis: searches were made of medical notes of patients with a diagnosis of asthma made by a General Practitioner and at least one prescription for an inhaled or oral bronchodilator or prophylactic anti asthma medication in the previous year.	

Thomas 2003 (Continued)

Interventions	Active treatment: breathing re-training with a Chartered Physiotherapist. Initial group treatment for 45 minutes followed by 2 individual training sessions lasting 15 minutes each which were 1 and 2 weeks apart. Explanation and training in relaxed diaphragmatic breathing given. Patients were assessed at 1 and 6 months post-intervention. Control group: 60 minute group session with asthma nurse teaching asthma education. Subjects invited to attend for further individual asthma review if they wished.	
Outcomes	Nijmegen Questionnaire (van Dixhoorn 1985)Asthma Quality of Life Questionnaire (AQLQ, Juniper 1992). Domains: symptoms, activities, emotions and environment.	
Notes	New inclusion for 2003 update. The author has responded with further information regarding non-parametric data, method of randomisation etc.	
<i>Risk of bias</i>		
Item	Authors' judgement	Description
Allocation concealment?	Yes	A - Adequate

Vedanthan 1998

Methods	DESIGN: Randomised Controlled Trial METHOD OF RANDOMISATION: Numbers picked out of a hat. OUTCOME ASSESSOR BLINDING: records coded; investigating physicians unaware of active and control groups data. WITHDRAWAL/ DROPOUTS: none reported	
Participants	Country: Colorado, USA. Setting: University, Allergy and Asthma Clinic. Health Centre. Provider: Yoga teacher. Randomised subjects: 17 students Age range: 19-52, mean: 26.5. Yoga trial subjects: n = 9, 3 (33%) female. Mean age: 28.12 Controls: n = 8, 6 (75%) female. Mean age: 25.11. Asthma diagnosis: based on guidelines established by the National Asthma Education Panel. Recruitment: student volunteers from a university Asthma & Allergy clinic Inclusion criteria: Mild to moderate asthma. Exclusion criteria: not stated No smokers in either group. Baseline: Mean FEV1, FVC, PEF given. Adverse effects: none reported.	

Vedanthan 1998 (Continued)

Interventions	Active treatment: training programme of yoga techniques including - various breath slowing exercises together with physical exercises, these were without breath holding; also physical postures, meditation, exercises and lectures on yoga philosophy. Subjects given audio cassettes and written information for home practise. Duration:45 minutes, 3 times a week for 16 weeks. Control group: no information given. Both groups were given peak flow meters to record daily am and pm readings. Subjects from both groups regularly attended the Health Center.	
Outcomes	Pulmonary function tests. Symptom questionnaire which included severity and frequency of attack scores. Medication use. No differences between groups in the use of theophylline preparations, inhaled steroids and antihistamines. 3 patients in the control group reduced their use of adrenergic inhalers	
Notes	The author has responded to our enquiries with further details.	
<i>Risk of bias</i>		
Item	Authors' judgement	Description
Allocation concealment?	Yes	A - Adequate

Characteristics of excluded studies [ordered by study ID]

Aleksandrov 1990	Not a randomised controlled trial (RCT).
Anonymous 1968	Investigation comparing the active group treated with hypnosis and the control group with breathing plus relaxation training.
Asher 1990	Each treatment preceded by nebulized salbutamol. Multiple intervention treatments.
Berlowitz 1995	Not an RCT.
Bobokhodzaev 1984	Not an RCT.
Cambach 1997	Mixed population of COPD and asthma in programme. Multiple interventions.
Cambach 1999	Not RCT

(Continued)

Coll 1994	Journal letter only. Not RCT.
Emtner 1998	Not RCT. Three studies included in dissertation. Physical training principal component in all studies.
Erschine 1979	Not breathing training. Comparison of muscular relaxation with muscular and mental relaxation training in patients with asthma. No control group.
Falkenbach 1993	Not RCT. Patients acted as their own control in a before-after trial. A control group was not established because of the small numbers involved for satisfactory statistical analyses.
Gallefoss 1999	Breathing training not a major component of the physiotherapy intervention.
Gosselink 1993	Not an RCT.
Holmes 1990	Not an RCT.
Joseph 1999	Not an RCT.
Khanam 1996	Not an RCT.
Kotses 1978	Not breathing training. Examining muscle tension relationships with bronchial airways resistance.
Kurabayashi 1998	Not an RCT, no control group, COPD not asthma.
Lacasse 1997	Not an RCT.
Loew 1996	Not RCT. Comparison of the effect of treatment with terbutaline and relaxation. Breathing plus movement therapy in two groups of asthmatic patients.
Manocha 2002	Breathing retraining not included as part of intervention.
Mass 1991	Device used for breathing training
McFadden 1986	Not a study of breathing exercises. Study was set up to observe thermal effects on the airways in exercise-induced asthma.
Mussell 1986	Device used for reducing bronchospasm
Paleev 1988	Not an RCT.
Pryor 1979	Thesis. Treatments randomised not subjects. Evaluation of postural drainage time for evacuation of secretions with and without the addition of forced expiratory technique (FET), in addition to other physiotherapeutic modalities.
Redchits 1986	Not RCT.

(Continued)

Schulze 2000	Not RCT. Children.
Singh 1987	Excluded. A device was used for altering the breathing pattern. Description of device amended in 2003 update in response to researcher's comment that the device does not increase muscle strength but imposes components of pranayamic breathing.
Singh 1990	Device used.
Smyth 1999	Not RCT. Relaxation training not breathing as principle component.
Tandon 1978	Study involved patients with COPD, not asthma.
van der Schans 1997	Not breathing exercises. Study used propranolol to induce bronchoconstriction and then reverse its effect using pursed lip breathing
Weiner 1992	Device used.
Wilson 1975	Transcendental meditation not breathing training.

DATA AND ANALYSES

Comparison 1. Breathing retraining versus control

Outcome or subgroup title	No. of studies	No. of participants	Statistical method	Effect size
1 Asthma Symptom Scores (weekly, higher score better)	1		Mean Difference (IV, Fixed, 95% CI)	Subtotals only
2 FEV1 (L)	2	38	Mean Difference (IV, Fixed, 95% CI)	-0.19 [-0.70, 0.31]
3 FVC (L)	2	38	Mean Difference (IV, Fixed, 95% CI)	0.16 [-0.41, 0.73]
4 PEFR (L/min)	2		Mean Difference (IV, Fixed, 95% CI)	Subtotals only
4.1 PEFR (daily)	1	106	Mean Difference (IV, Fixed, 95% CI)	72.01 [30.15, 113.85]
4.2 PEFR (morning)	1	17	Mean Difference (IV, Fixed, 95% CI)	-11.01 [-72.29, 50.29]
4.3 PEFR (evening)	1	17	Mean Difference (IV, Fixed, 95% CI)	-5.01 [-60.26, 50.26]
5 Rescue bronchodilator use (actuations per week)	1		Mean Difference (IV, Fixed, 95% CI)	Subtotals only
6 Rescue bronchodilator use (ug per day)	1		Mean Difference (IV, Fixed, 95% CI)	Subtotals only
7 Inhaled corticosteroid use (% reduction in daily use)	1		Mean Difference (IV, Fixed, 95% CI)	Totals not selected
8 Inhaled corticosteroids use (ug per day)	1		Mean Difference (IV, Fixed, 95% CI)	Subtotals only
9 Inhaled steroid usage (number of inhalations per day)	1		Mean Difference (IV, Fixed, 95% CI)	Totals not selected
10 Exacerbations (mean episodes per week)	1		Mean Difference (IV, Fixed, 95% CI)	Subtotals only
11 Exacerbations (total count per group)	2	52	Risk Ratio (M-H, Fixed, 95% CI)	0.21 [0.03, 1.66]

Comparison 2. Breathing retraining versus asthma education

Outcome or subgroup title	No. of studies	No. of participants	Statistical method	Effect size
1 Number of patients with clinically significant improvement in quality of life	1		Risk Ratio (M-H, Fixed, 95% CI)	Totals not selected
1.1 After one month	1		Risk Ratio (M-H, Fixed, 95% CI)	Not estimable
1.2 After six months	1		Risk Ratio (M-H, Fixed, 95% CI)	Not estimable
2 Asthma Quality of Life (Overall AQLQ, higher score denotes better health, lower worse)	1		Mean Difference (IV, Fixed, 95% CI)	Subtotals only

2.1 Change score at one month.	1	31	Mean Difference (IV, Fixed, 95% CI)	0.69 [0.14, 1.22]
2.2 Change score at six months.	1	28	Mean Difference (IV, Fixed, 95% CI)	0.69 [0.04, 1.32]
3 Quality of Life (10 point scale, higher better)	1		Mean Difference (IV, Fixed, 95% CI)	Subtotals only
4 PEFR (L/min)	1		Mean Difference (IV, Fixed, 95% CI)	Subtotals only
4.1 PEFR (daily)	1	37	Mean Difference (IV, Fixed, 95% CI)	-9.01 [-79.48, 61.48]
4.2 PEFR (morning)	1	2	Mean Difference (IV, Fixed, 95% CI)	Not estimable
4.3 PEFR (evening)	1	2	Mean Difference (IV, Fixed, 95% CI)	Not estimable
5 MV (L/min)	1		Mean Difference (IV, Fixed, 95% CI)	Subtotals only
6 Rescue bronchodilator use (canisters per 6 months)	1		Mean Difference (IV, Fixed, 95% CI)	Subtotals only
7 Inhaled corticosteroids use (% reduction in daily use)	1		Mean Difference (IV, Fixed, 95% CI)	Subtotals only
8 Inhaled corticosteroid use (canisters per 6 months)	1		Mean Difference (IV, Fixed, 95% CI)	Subtotals only
9 Nijmegen Score (64 point scale, lower better)	1		Mean Difference (IV, Fixed, 95% CI)	Subtotals only

WHAT'S NEW

Last assessed as up-to-date: 15 September 2003.

21 July 2008	Amended	Converted to new review format.
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HISTORY

Protocol first published: Issue 4, 1998

Review first published: Issue 3, 2000

16 September 2003	New citation required and conclusions have changed	Substantive amendment
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CONTRIBUTIONS OF AUTHORS

Elizabeth Holloway and Felix Ram (previous author) carried out all the work required for this review.

DECLARATIONS OF INTEREST

None known.

SOURCES OF SUPPORT

Internal sources

- NHS Executive, South East, UK.

External sources

- Felix Ram received funding from The Netherlands Asthma Foundation, Netherlands.

NOTES

04.02.2003 Two further studies included - Opat (2000) & Thomas (2001).

28.03.2003 Opat - Quality of Life & PEF sd estimated.

11.07.2003 Thomas' et al.(2000) stated median values in their paper as the data were skewed and not normally distributed. In response to our request Thomas has provided us with mean values also. When analysed as means and sd's the mean difference is very similar to the difference in median values. We have therefore entered the data in the meta-analysis.

09.2003 Cooper et al study(2003), awaiting assessment.

INDEX TERMS

Medical Subject Headings (MeSH)

Asthma [*rehabilitation]; *Breathing Exercises; Randomized Controlled Trials as Topic; Respiratory Function Tests

MeSH check words

Humans