

## Appendix A: Search Strategy

Database: **AltHealthWatch**

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- S16 S1 and S15
- S15 S2 or S3 or S4 or S5 or S6 or S7 or S8 or S9 or S10 or S11 or S12 or S13 or S14
- S14 TI biofeedback or AB biofeedback
- S13 TI diaphragmatic breath\* or AB diaphragmatic breath\*
- S12 AB ( diaphragm\* ) and AB ( exercise\* or training or retraining or pattern\* or technique\* )
- S11 AB ( breath\* or respirat\* ) and AB ( exercise\* or training or retraining or pattern\* or technique\* )
- S10 TI ( breath\* or respirat\* ) and TI ( exercise\* or training or retraining or pattern\* or technique\* )
- S9 TI ( breath\* or respirat\* ) and TI ( paced or pursed )
- S8 AB ( breath\* or respirat\* ) and AB ( paced or pursed )
- S7 AB ( breath\* or respirat\* ) and AB ( physiotherap\* or physical therap\* )
- S6 TI ( breath\* or respirat\* ) and TI ( physiotherap\* or physical therap\* )
- S5 TI Pranayama or AB Pranayama
- S4 TI Buteyko or AB Buteyko
- S3 TI yogic OR AB yogic
- S2 TI yoga OR AB yoga
- S1 TI asthma\* or AB asthma\*

Database: **AMED\*** (Allied and Complementary Medicine) <1985 to January 2011>

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- 1 asthma/
- 2 asthma\$.ti,ab.
- 3 1 or 2
- 4 breathing exercises/
- 5 yoga/
- 6 Yoga.ti,ab.
- 7 yogic.ti,ab.
- 8 Buteyko.ti,ab.
- 9 Pranayama.ti,ab.
- 10 Papworth.ti,ab.
- 11 "inspiratory muscle training".ti,ab.
- 12 "expiratory muscle training".ti,ab.
- 13 ((breath\$ or respirat\$) adj5 (physiotherap\$ or physical therap\$)).ti,ab.
- 14 ((breath\$ or respirat\$) adj5 (paced or pursed)).ti,ab.
- 15 ((breath\$ or respirat\$) adj5 (exercise\$ or training or retraining or pattern\$ or technique\$)).ti,ab.
- 16 (diaphragm\* and (exercise\$ or training or retraining or pattern\$ or technique\$)).ti,ab.
- 17 diaphragmatic breath\$.ti,ab.
- 18 biofeedback/

- 19 biofeedback.ti,ab.
- 20 or/4-19
- 21 3 and 20
- 22 limit 21 to yr="1990 -Current"
- 23 limit 22 to english

Database: **CINAHL**

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- S27 S3 and S25 Limiters - Published Date from: 19900101-20111231
- S26 S3 and S25
- S25 S4 or S5 or S6 or S7 or S8 or S9 or S10 or S11 or S12 or S13 or S14 or S15 or S16 or S17 or S18 or S19 or S20 or S21 or S22 or S23 or S24
- S24 TI biofeedback or AB biofeedback
- S23 (MH "Biofeedback") OR (MH "Biofeedback (Iowa NIC)")
- S22 TI diaphragmatic breath\* or AB diaphragmatic breath\*
- S21 TI diaphragm\* and TI ( exercise\* or training or retraining or pattern\* or technique\* )
- S20 AB diaphragm\* and AB ( exercise\* or training or retraining or pattern\* or technique\* )
- S19 AB ( breath\* or respirat\* ) and AB ( exercise\* or training or retraining or pattern\* or technique\* )
- S18 TI ( breath\* or respirat\* ) and TI ( exercise\* or training or retraining or pattern\* or technique\* )
- S17 TI ( breath\* or respirat\* ) and TI ( paced or pursed )
- S16 AB ( breath\* or respirat\* ) and AB ( paced or pursed )
- S15 AB ( breath\* or respirat\* ) and AB ( physiotherap\* or physical therap\* )
- S14 TI ( breath\* or respirat\* ) and TI ( physiotherap\* or physical therap\* )
- S13 TI "expiratory muscle training" or AB "expiratory muscle training"
- S12 TI "inspiratory muscle training" or AB "inspiratory muscle training"
- S11 TI Papworth or AB Papworth
- S10 TI Pranayama or AB Pranayama
- S9 TI Buteyko or AB Buteyko
- S8 TI yogic or AB yogic
- S7 TI yoga or AB yoga
- S6 (MH "Yoga") OR (MH "Yoga Pose")
- S5 (MH "Breathing Exercises (Saba CCC)")
- S4 (MH "Breathing Exercises") OR (MH "Buteyko Method")
- S3 s1 or s2
- S2 TI asthma\* or AB asthma\*
- S1 (MH "Asthma") OR (MH "Asthma, Exercise-Induced") OR (MH "Status Asthmaticus")

Database: **Cochrane Central Register of Controlled Trials**

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- #1 asthma\*:ti,ab,kw
- #2 "breathing exercises":ti,ab,kw
- #3 yoga:ti,ab,kw

- #4 yogic:ti,ab,kw
- #5 Buteyko:ti,ab,kw
- #6 Pranayama:ti,ab,kw
- #7 Papworth:ti,ab,kw
- #8 "inspiratory muscle training":ti,ab,kw
- #9 "expiratory muscle training":ti,ab,kw
- #10 breath\*:ti or respirat\*:ti
- #11 physiotherap\*:ti or physical therap\*:ti
- #12 (#10 AND #11)
- #13 breath\*:ab or respirat\*:ab
- #14 physiotherap\*:ab or physical therap\*:ab
- #15 (#13 AND #14)
- #16 paced:ti,ab or pursed:ti,ab
- #17 (( #11 OR #14 ) AND #16)
- #18 exercise\*:ti or training:ti or retraining:ti or pattern\*:ti or technique\*:ti
- #19 (#10 AND #18)
- #20 exercise\*:ab or training:ab or retraining:ab or pattern\*:ab or technique\*:ab
- #21 (#13 AND #20)
- #22 diaphragm\*:ti,ab
- #23 (#22 AND ( #18 OR #20 ))
- #24 diaphragmatic next breath\*
- #25 biofeedback:ti,ab,kw
- #26 (#2 OR #3 OR #4 OR #5 OR #6 OR #7 OR #8 OR #9 OR #12 OR #15 OR #17 OR #19 OR #21 OR #23 OR #24 OR #25)
- #27 (#1 AND #26), from 1990 to 2011

Database: **CSA** <Fri Aug 12>

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KW=asthma AND KW=(Buteyko OR Pranayama OR Papworth OR yoga OR yogic OR biofeedback OR "inspiratory muscle training" OR "expiratory muscle training" OR "breathing physical therapy" OR "breathing physiotherapy" OR paced OR pursed OR "breathing exercise\*" OR "breathing training" OR "breathing retraining" OR "diaphragmatic breathing" OR "breathing technique\*")

Database: **EMBASE** <1988 to 2011 July 28>

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- 1 asthma/ or allergic asthma/ or asthmatic state/ or exercise induced asthma/ or extrinsic asthma/ or intrinsic asthma/ or mild intermittent asthma/ or mild persistent asthma/ or moderate persistent asthma/ or nocturnal asthma/ or occupational asthma/ or severe persistent asthma/ (112140)
- 2 asthma\$.ti,ab.
- 3 1 or 2
- 4 breathing exercise/
- 5 YOGA/
- 6 yoga.ti,ab.

- 7 yogic.ti,ab.
- 8 Buteyko.ti,ab.
- 9 Pranayama.ti,ab.
- 10 Papworth.ti,ab.
- 11 "inspiratory muscle training".ti,ab.
- 12 "expiratory muscle training".ti,ab.
- 13 ((breath\$ or respirat\$) adj5 (physiotherap\$ or physical therap\$)).ti,ab.
- 14 ((breath\$ or respirat\$) adj5 (paced or pursed)).ti,ab.
- 15 ((breath\$ or respirat\$) adj5 (exercise\$ or training or retraining or pattern\$ or technique\$)).ti,ab.
- 16 (diaphragm\* and (exercise\$ or training or retraining or pattern\$ or technique\$)).ti,ab.
- 17 diaphragmatic breath\$.ti,ab.
- 18 feedback system/
- 19 biofeedback.ti,ab.
- 20 or/4-19
- 21 3 and 20
- 22 limit 21 to yr="1990 -Current"
- 23 limit 22 to english language (1105)

Database: **Mantis\*** <1880 to November 2010>

- 
- 1 asthma\$.mp. [mp=title, abstract, descriptors]
  - 2 yoga.mp. [mp=title, abstract, descriptors]
  - 3 yogic.mp. [mp=title, abstract, descriptors]
  - 4 Buteyko.mp. [mp=title, abstract, descriptors]
  - 5 Pranayama.mp. [mp=title, abstract, descriptors]
  - 6 Papworth.mp. [mp=title, abstract, descriptors]
  - 7 "inspiratory muscle training".mp. [mp=title, abstract, descriptors]
  - 8 "expiratory muscle training".mp. [mp=title, abstract, descriptors]
  - 9 ((breath\$ or respirat\$) adj5 (physiotherap\$ or physical therap\$)).mp. [mp=title, abstract, descriptors]
  - 10 ((breath\$ or respirat\$) adj5 (paced or pursed)).mp. [mp=title, abstract, descriptors]
  - 11 ((breath\$ or respirat\$) adj5 (exercise\$ or training or retraining or pattern\$ or technique\$)).mp. [mp=title, abstract, descriptors]
  - 12 (diaphragm\* and (exercise\$ or training or retraining or pattern\$ or technique\$)).mp. [mp=title, abstract, descriptors]
  - 13 diaphragmatic breath\$.mp. [mp=title, abstract, descriptors]
  - 14 biofeedback.mp. [mp=title, abstract, descriptors]
  - 15 or/2-14
  - 16 1 and 15
  - 17 limit 16 to yr="1990 -Current"

Database: Ovid **MEDLINE**(R) <1948 to July Week 3 2011>

- 
- 1 asthma/ or asthma, exercise-induced/ or status asthmaticus/
  - 2 asthma\$.ti,ab.

- 3 1 or 2
- 4 Breathing Exercises/
- 5 Yoga/
- 6 yoga.ti,ab.
- 7 yogic.ti,ab.
- 8 Buteyko.ti,ab.
- 9 Pranayama.ti,ab.
- 10 Papworth.ti,ab.
- 11 "inspiratory muscle training".ti,ab.
- 12 "expiratory muscle training".ti,ab.
- 13 ((breath\$ or respirat\$) adj5 (physiotherap\$ or physical therap\$)).ti,ab.
- 14 ((breath\$ or respirat\$) adj5 (paced or pursed)).ti,ab.
- 15 ((breath\$ or respirat\$) adj5 (exercise\$ or training or retraining or pattern\$ or technique\$)).ti,ab.
- 16 (diaphragm\* and (exercise\$ or training or retraining or pattern\$ or technique\$)).ti,ab.
- 17 diaphragmatic breath\$.ti,ab.
- 18 biofeedback, psychology/
- 19 biofeedback.ti,ab.
- 20 4 or 5 or 6 or 7 or 8 or 9 or 10 or 11 or 12 or 13 or 14 or 15 or 16 or 17 or 18 or 19
- 21 3 and 20
- 22 limit 21 to yr="1990 -Current"
- 23 remove duplicates from 22
- 24 limit 23 to english language

Database: **PEDRO**

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asthma  
AND  
buteyko OR  
yoga OR  
yogic OR  
papworth OR  
pranayama OR  
biofeedback OR  
expiratory muscle training OR  
inspiratory muscle training OR  
breathing physical therapy OR  
breathing physiotherapy OR  
paced OR  
pursed OR  
breathing exercise OR  
breathing training OR  
breathing retraining OR  
diaphragm breathing OR  
breathing technique OR

breathing pattern

Database: **PsychINFO** <1987 to July Week 4 2011>

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- 1 asthma/
- 2 asthma\$.ti,ab.
- 3 1 or 2
- 4 yoga/
- 5 yoga.ti,ab.
- 6 yogic.ti,ab.
- 7 Buteyko.ti,ab.
- 8 Pranayama.ti,ab.
- 9 Papworth.ti,ab.
- 10 "inspiratory muscle training".ti,ab.
- 11 "expiratory muscle training".ti,ab.
- 12 ((breath\$ or respirat\$) adj5 (physiotherap\$ or physical therap\$)).ti,ab.
- 13 ((breath\$ or respirat\$) adj5 (paced or pursed)).ti,ab.
- 14 ((breath\$ or respirat\$) adj5 (exercise\$ or training or retraining or pattern\$ or technique\$)).ti,ab.
- 15 (diaphragm\* and (exercise\$ or training or retraining or pattern\$ or technique\$)).ti,ab.
- 16 diaphragmatic breath\$.ti,ab.
- 17 biofeedback/ or biofeedback training/
- 18 biofeedback.ti,ab.
- 19 or/4-18
- 20 3 and 19
- 21 limit 20 to yr="1990 -Current"
- 22 limit 21 to english language

\*Institutional subscription to literature search databases expired during time of the review, unable to perform updated literature searches

## Appendix B: Non-English Studies

Our literature search identified 245 unique articles published in a non-English language. The following are articles that appear to be relevant studies (only based on their title and/or abstract), if translational services were available.

Reference	Abstract	Language
Abrosimov VN, Garmash VI, Sokolova GT. Possibilities of using the biofeedback method in the combined modality therapy of patients with bronchial asthma. Ter Arkh 1991;63(3):87-90. PMID: 2063344.	The efficacy of biological feedback was studied in multimodality treatment of patients suffering from bronchial asthma. Use was made of a device modified by the authors themselves. In that device, the system of the patient's respiration control was synchronized with the block of diaphragmatic pacing. The method was shown to be highly effective. The clinical status of the patients improved. The changes in the capnographic parameters attest to a decrease of hyperventilation in patients suffering from bronchial asthma.	Russian
Anokhin MI, Sergeev VN, Domanskii VL. Correction of the breathing in the treatment of bronchial asthma by means of biological feedback. Med Tekh 1996 Jan;(1):26-9. PMID: 8868392.	The development of nondrug therapies for BA is highly pressing. The application of respiration-correcting methods and means that implement a principle of BFB is one of the promising lines. To polish procedures for practical work and to evaluate their efficiency, a respiration corrector has been devised, which visualizes a patient's external respiration rhythm and synchronizes it with the reference rhythm whose parameters are set by a physician or by a patient himself. The efficiency of BFB technique was evaluated in the treatment of BA in children. Studies using the device were done 2 to 3 times a day with 15 to 20min in each session. The treatment regime averaged a fortnight. Its application relieved the occurred episode without drugs in most children with mild and moderate BA, prevented attacks and made them fewer, prolonged remission, and reduced the amount of bronchodilating agents to be used. BFB correction made under the polyclinic setting is indicated for patients with mild and moderate atopic BA in the episode, post-episode, and inter-episode periods and contraindicated for patients with severe BA when they have an episode. Treating BA via BFB correction diminishes psychosomatic disorders: anxiety, bronchodilator dependence, fear of a recurrent episode, whining, irritability, and insomnia.	Russian
Clini EM, Confalonieri M. Physiotherapy of respiratory patients: An evidence-based intervention. Rassegna di Patologia dell'Apparato Respiratorio 2009;24(5):270-4. PMID: None.	No abstract.	Italian
Fedoseev GB, Sinitsina TM, Nazarova VA, et al. Treatment of patients with bronchial asthma by voluntary changes in the pattern of respiration. Klin Med (Mosk) 1991 Jan;69(1):82-3. PMID: 2023406.	No abstract.	Russian

Reference	Abstract	Language
<p>Fluge T, Richter J, Fabel H, et al. Long-term effects of breathing exercises and yoga in patients with bronchial asthma. <i>Pneumologie</i> 1994;48(7):484-90. PMID: 7937658.</p>	<p>To compare the effects of BE or Y on the course of bronchial asthma we studied 36 subjects with a mild disease. The patients were randomly divided into three groups. two of them participated in a 3 weeks training program of BE or Y while the third group rested without any additional treatment (C). At the end of the training period the patients were asked to practice BE or Y on their own. Drug therapy and lung function parameters before and after a beta<sub>2</sub>-agonist metered dose inhaler ALB were recorded prior to the training program and in 4 weeks intervals for 4 months thereafter. The response to the beta<sub>2</sub>-agonist was documented continuously in 28 patients. The mental state of the patients was elucidated by questionnaires. Prior to the study a significant effect of inhaled ALB on the FEV<sub>1</sub> was shown without any significant between group differences. Both, BE and Y, caused a significant amelioration of the mental state but only the BE induced a significant improvement of lung function parameters compared to the individual baseline values. The FEV<sub>1</sub> increased significantly by 356.3 ± 146.2 ml (p &lt; 0.05) and the VC by 225.0 ± 65.5 ml (p &lt; 0.01). These long-term changes were not significantly different from the actual response to ALB. BE decreased the RV significantly by 306.3 ± 111.6 ml (p &lt; 0.05), an effect significantly higher compared to the beta<sub>2</sub>-agonist (p &lt; 0.01). BE in combination with ALB caused an additive effect.</p>	<p>German</p>
<p>Groller B. Efficacy of combined relaxation exercises for children with bronchial asthma. <i>Rehabilitation (Bonn)</i> 1991 May;30(2):85-9. PMID: 1871422.</p>	<p>In the framework of a pilot study, 15 children having bronchial asthma (4 female, 11 male; age 5-11:6) participated, over a period of 8 weeks, in two weekly sessions of combined relaxation, respiratory and sports exercises. The present article in particular focuses on the relaxation exercises, made up of Progressive Muscle Relaxation and Autogenic Training elements as well as of phantasy travels, mantras, and periodic music. Ongoing observation of the children during training, the findings of subsequent semi-structured interviews with them, topical instances of coping with impending asthma attacks by using the techniques learned, as well as the results of a catamnestic inquiry some 3 years later--all indicate a positive impact of the relaxation exercises. Statistical analysis of the data at hand revealed significant improvements in a number of pulmonary function parameters (airway resistance, FEV<sub>1</sub>, FVC, PEFr). Interpretation of these findings must however take into account the entirety of the training provided.</p>	<p>German</p>
<p>Hirokawa Y, Kondou T, Ohta Y, et al. Trial of 10Hz respiratory resistance meter and its application to the biofeedback therapy of bronchial asthma. <i>Kokyu to Junkan</i> 1992 Mar;40(3):249-53. PMID: 1579746.</p>	<p>No abstract.</p>	<p>Japanese</p>
<p>Janiszewski M, Kronenberger M, Drozd B. Studies on the use of music therapy as a form of breathing exercise in bronchial asthma. <i>Pol Merkur Lekarski</i> 1996 Jul;1(1):32-3. PMID: 9156888.</p>	<p>96 patients suffering was examined. 46 patients over 1 year was offending kinesytherapy during a special active music therapy techniques was used. It was the form of breathing exercises. 50 patients during the period of 1 year was under program of traditional breathing kinesytherapy. The authors observed a greater effectiveness of music therapy which decrease bronchial resistances, increases physical self-feeling and reduces anxiety level.</p>	<p>Polish</p>

Reference	Abstract	Language
Meyer A, Wendt G, Taube K, et al. Physical training of adult asthmatics can increase fitness and reduce hospitalisation days. <i>Pneumologie</i> 1997;51(8):845-9. PMID: 9380660.	Physical training is a well established method in the rehabilitation of patients with chronic obstructive pulmonary disease. In adult asthmatics its efficacy has been shown by intensive training programs lasting for 2 to 12 weeks. No data exist on the effect of long-term physical training once a week. 31 patients (f = 24, m = 7; mean age 55 ± 2 years; mean FEV <sub>1</sub> 82 ± 4%pred.) participated in a physical training program for at least 2 years. (8 patients had mild, 12 moderate and 11 severe asthma according to the International Consensus Report of 1993). Training time was 1 hour per week. The physical training program consisted of breathing techniques like pursed-lip breathing and diaphragmatic exercise, progressive muscle relaxation, circuits and endurance training. According to the health insurance records nine patients had been hospitalized for their disease two years prior to the study for a total number of 218 in-hospital days. During the 2 years of the study two patients had been hospitalized for a total number of 29 days (p < 0.001). A comparison group of 10 patients who did not participate in the rehabilitation program had been hospitalized for their disease 2 years prior to and during the study period for a total number of 236 and 201 in-hospital days (p > 0.2). In a subgroup of nine patients bicycle exercise testing was performed once a month and work load at a submaximal heart-rate (200-age) was recorded. During the 2 years mean work rate improved from 48 watts to 83 watts for 15 minutes (p < 0.01). We conclude from our findings that long-term physical training of adult patients with asthma in an outpatient setting once a week is effective in reducing hospitalization days as well as in increasing cardiorespiratory fitness.	German
Rocha EM. The effect of respiratory rehabilitation on the functional ventilation changes in the asthmatic child. <i>Allerg Immunol</i> 1993;25(1):26-8. PMID: 8471136.	The aim of this study was to evaluate the improvement of lung function abnormalities during asymptomatic periods in children with perennial atopic asthma after physical respiratory rehabilitation and swimming	French
Shaw I, Shaw BS, Brown GA. Role of diaphragmatic breathing and aerobic exercise in improving pulmonary function and maximal oxygen consumption in asthmatics. <i>Sci Sports</i> 2010;25(3):139-45. PMID: None.	Current knowledge: Asthma has created a substantial economic- and health-burden in Western society. The current treatments for asthma rely on pharmacological agents, which are expensive and inaccessible to many people, and alternative treatments are derived from COPD studies. When exercise therapy is prescribed, aerobic training has been the primary mode of training. Aims: To compare the effects of 8 weeks, three times weekly supervised AE, DB and combined AEDB on FVC and forced expiratory volume in one second FEV <sub>1</sub> and VO <sub>2max</sub> in moderate-persistent asthmatics. The AE group exercised at 60 percent of their individual age-predicted maximum heart rate while the DB group performed DB combined with inspiratory resistive breathing in the semi-recumbent position at varying inspiration, expiration ratios. The AEDB group utilised a combination of AEDB and the control group did not take part in any structured physical activity. Prospects: AEDB increased FEV <sub>1</sub> and VO <sub>2max</sub> as effectively as AE and more so for FVC, despite AEDB subjects doing only half as much aerobic training as the aerobic-only training group. This finding supports the inclusion of AEDB for moderate-persistent asthmatics to improve asthmatic symptomatology due to this mode's low risk and cost while allowing a patient to gain the unique benefits of both modes of exercise.	French

Abbreviations: AE: aerobic exercise; AEDB: combined aerobic exercise and diaphragmatic breathing; ALB: albuterol; BA: bronchial asthma; BFB: biological feedback; C: control; COPD: chronic obstructive pulmonary disease; DB: diaphragmatic breathing; FEV<sub>1</sub>: forced expiratory volume in 1 second; FVC: forced vital capacity; min: minute; ml: milliliter; PEF: pulmonary expiratory flow rate; RV: residual volume; VC: vital capacity; VO<sub>2max</sub>: maximal aerobic power; Y: yoga

## Appendix C: Evidence Tables

**Evidence Table 1a. Study characteristics: hyperventilation reduction breathing techniques versus control**

Study	Country	Group	N randomized	Age (mean)	% Female	SABA use	ICS use	FEV <sub>1</sub> % pred.	Inclusion criteria	Exclusion criteria
Cooper 2003 <sup>35</sup>	UK	IG1 (BBT)	30	44	44.9	2 puffs/d†	657 mcg/d	80	Aged 18 to 70y, non-smoking volunteers with stable asthma, taking an inhaled SABA at least 2 times/w and regular ICS w/ no change in dose in previous 4w, pre-bronchodilator FEV <sub>1</sub> of at least 50 percent predicted and 10 percent increase following 400mcg inhaled salbutamol, a PD <sub>20</sub> of methacholine causing a 20 percent fall in FEV <sub>1</sub> of 10.24 µmol or less, mean daily sx score of 1 or more during run-in.	No other important illnesses, taking tx other than sodium cromoglycate.
		CG	30							
Grammatopoulou 2011 <sup>37</sup>	Greece	IG (HRBT)	20	46.8	42.5	NR	NR	83.7	Aged 18 to 60y, adults diagnosed with asthma.	Aged < 60y, smokers, used oral corticosteroids in the previous 3m, suffered from heart failure, previously participated in a asthma education program.
		CG	20							
Holloway 2007 <sup>38,55</sup>	UK	IG (Papworth)	39	49.7	57.6	NR	NR	89.6	Aged 16 to 70y, literate in English, commitment to participate for up to eight attendances, no serious comorbidity.	NR
		CG	46							

Study	Country	Group	N randomized	Age (mean)	% Female	SABA use	ICS use	FEV <sub>1</sub> % pred.	Inclusion criteria	Exclusion criteria
McGowan 2003 <sup>39</sup>	Scotland	IG (BBT)	200	NR	50	18 puffs/w	NR	76.7	Age 14 to 69y; documented mild asthma with a total symptom score > 7 in the last 1w of run-in; asthma management requiring at least 12 bronchodilator dose units in the last 1w of run-in.	Previous BBT, Balanced Volitional Breathing or Eucapnic Breath training; unsafe asthma (requiring ≤ 500mcg/d ICS and use of beta <sub>2</sub> -agonist > 5 times/d; or > 500mcg/d ICS and use of beta <sub>2</sub> -agonist > 8 times percent predicted); significant other illness (including chronic pulmonary airways obstruction); exacerbation of asthma (e.g., hospitalization, major change in preventative therapy within last 4w); HR > 90 on two occasions prior to randomization.
		CG1 (nurse education)	200							
		CG2 (brief asthma education)	200							
Opat 2000 <sup>40,60</sup>	Australia	IG (BBT)	18	32.2	58.3	404 mcg/d	430 mcg/d	NR	Aged 18 to 50y, diagnosed with asthma by a medical practitioner (self-reported physician diagnosis), ready access to a VCR throughout trial period.	Previously learned BBT; regularly taking oral corticosteroids or more than 1600mcg of inhaled steroid per day; taking < three doses of inhaled bronchodilator medication per week; experienced a severe asthma exacerbation within 6w of trial start date.
		CG	18							
Thomas 2009 <sup>42,62-64</sup>	UK	IG (HRBT)	94	46.0*	61.2	1.4 doses/d	400 mcg/d*	89.5	Aged 17 to 65y treated for asthma in 10 primary care general practices in the UK, physician-diagnosed asthma, moderate impairment of asthma-	NR

Study	Country	Group	N randomized	Age (mean)	% Female	SABA use	ICS use	FEV <sub>1</sub> % pred.	Inclusion criteria	Exclusion criteria
		CG	89						related health status (AQLQ score < 5.5, "uncontrolled"), had < 10 pack-years, ≥ one anti-asthma medication Rx in the previous 1y, no COPD, and asthma not dangerously unstable and in need of urgent medical review (assessed by asthma nurse).	
Cooper 2009† <sup>34,58,72</sup>	UK	IG (mouth-taping)	51	53	64	10 puffs /w†	567 mcg/d	86.2	Aged 18 to 72y with symptomatic asthma defined as taking at least four puffs/w of an inhaled short-acting bronchodilator, daily sx plus nocturnal or early morning sx or PEF of 10 percent or more on at least three nights/w during the run-in period.	FEV <sub>1</sub> below 50 percent predicted value, previous BBT training, unable to breathe through nose, diagnosed with sleep apnea, or history of smoking more than 10 pack years.
		CG								

\*Median

†Median puffs/d, typical dose per puff = 100 mcg

‡Crossover study design, mouth-taping and control phases

Abbreviations: AQLQ: Asthma Quality of Life Questionnaire; BBT: Buteyko breathing techniques; CG: control group; d: day(s); COPD: chronic obstructive pulmonary disease; d: day; FEV<sub>1</sub>: forced expiratory volume in 1 second; HR: heart rate; HRBT: hyperventilation reduction breathing technique; ICS: inhaled corticosteroids; IG: intervention group; mcg: microgram(s); NR: not reported; PD<sub>20</sub>: provocative dose causing an decrease in FEV<sub>1</sub> of 20 percent; PEF: pulmonary expiratory flow; pred: predicted; Rx: prescription; SABA: short-acting beta<sub>2</sub>-agonists; sx: symptoms; tx: treatment; UK: United Kingdom; μmol: micromole(s); VCR: videocassette recorder; w: week(s); y: year(s)

**Evidence Table 1b. Description of intervention groups: hyperventilation reduction breathing techniques versus control**

Study	Intervention group	Description	Intervention session	Homework	Additional components
Cooper 2003 <sup>35</sup>	IG1 (BBT)	Eucapnic BBT taught by a certified Buteyko practitioner. Pts taught to reduce fx and depth of breathing, use the technique bid to relieve asthma sx (used 420 times over 6m) and use bronchodilator if BBT failed, nocturnal mouth-taping with Micropore hypoallergenic tape. F/U call provided 2w after training and open communication with trainer available. Avoid certain foods (e.g., highly processed food and additives), avoid stress, avoid oversleeping.	Five 2-hour sessions, over weekends or successive evenings.  (10 hours total)	Home exercises with an audiotape or CD with technique reminders.	Also included dietary restrictions, stress management and instruction to avoid oversleeping.
	CG	Sham device with no valve and a leak ensured no resistance to breathing, use bid (420 times in 6m).	One session  (Hours NR)	NR	NR
Grammatopoulou 2011 <sup>37</sup>	IG (HRBT)	Phase 1: one 60min group session (5 pts/group) structured according to the health belief model. Pts educated in (1) normal breathing pattern and breathing pattern during exacerbations, (2) recognizing asthma sx, (3) comprehension of their ability to modify their breathing pattern targeting self-management of sx, (4) expressed their perceived asthma severity and the benefits and barriers of adapting a modified breathing pattern for 6m. 12 individual 60min sessions (3 times/w) comprised of asthma education and practice of: diaphragmatic breathing, nasal breathing, short hold of breath (2 to 3s), and adaptation of speech pattern (speaking, singing) in any position during physical activity and in asthma exacerbation. Taught by a physiotherapist. Phase 2: Development of specific action plan regarding duration (> 20 min) and frequency (2 to 3 times/d) of home training for 5m.	One 60-min group session, twelve 60-min individual sessions over 26w.  (13 hours total)	Home training.	NR

Study	Intervention group	Description	Intervention session	Homework	Additional components
	CG	Usual care, no additional treatment	NR	NR	NR
Holloway 2007 <sup>38,55</sup>	IG (Papworth)	Papworth method training in addition to usual asthma care including medication and routine asthma education; integrate techniques in daily life activities. Breathing training to reduce dysfunctional breathing (e.g., hyperventilation, hyperinflation, education w/ emphasis on breathing and stress response, relaxation training). Pts taught by a respiratory physiotherapist.	Five 60-min sessions over 6m.  (5 hours total)	Home exercises with an audiotape or CD with technique reminders.	Also included stress management.
	CG	Received usual asthma care including medication and routine asthma education; usual care did not include advice about breathing exercises. Taught by practice nurse.	NR	NR	NR
McGowan 2003 <sup>39,77</sup>	IG (BBT)	Buteyko Institute Method Program; introductory asthma education by the researcher in one 120-min session over 1w; followed by seven sessions over the next 3w comprising of information on normal physiology and pathophysiology of airways, use of medication and compliance, inhale technique, exercise "triggers", opportunistic infection and steroids.	Eight sessions over 4w.  (Hours NR)	Home practice required.	NR
	CG1 (nurse education)	Introductory asthma education by the researcher in one 120min session over 1w; followed by seven sessions with a Practice Nurse over the next 3w.	Eight sessions over 4w.  (Hours NR)	NR	NR
	CG2 (brief asthma education)	Introductory education course only.	One 120-min session over 1w.  (2 hours total)	NR	NR
Opat 2000 <sup>40,60</sup>	IG (BBT)	67min video including an explanation of the BBT theory and a 20min self-guided BBT session involving short periods of shallow breathing, interspersed breath holding; pts asked to watch a "portion of the video" daily. No mouth taping, no dietary change.	One 67-min video; 56 20-min sessions with video over 4w.  (19.8 hours total)	Video viewed at home.	NR

Study	Intervention group	Description	Intervention session	Homework	Additional components
	CG	60min video entitled "Nature Landscapes" watched for 20min bid for 4w.	56 20-min sessions over 4w.  (18.6 hours total)	NR	NR
Thomas 2009 <sup>42,62-64</sup>	IG (HRBT)	During group sessions, pts explained normal breathing and possible effects of dysfunctional breathing (e.g., mouth breathing, etc.). During individual sessions, pts taught regular diaphragmatic and nasal breathing techniques (similar to Papworth method) to improve hyperventilation reduction breathing. Pts taught by a physiotherapist.	One 60-min group session; two 30- to 45-min individual sessions w/ 2 to 4w between sessions.  (2 to 2.5 hours total)	Encouraged to practice for at least 10min/d.	NR
	CG	Asthma education on the information on the nature of asthma followed by individual sessions presenting broad asthma and atopy concepts and explaining tx rationale w/out providing personalized asthma advice. Pts taught by a nurse.	One 60-min group session; two 30- to 45-min individual sessions w/ 2 to 4w between sessions.  (2 to 2.5 hours total)	NR	NR
Cooper 2009 <sup>34,58,72</sup>	IG (mouth-taping)	Pts taped their mouth at night with 2.5cm wide microporous tape (Micropore™) to facilitate nose breathing; options to practice during daytime to increase tolerance. Plus a meeting w/ study coordinator to describe mouth-taping.	One training session, mouth-taped for 28 nights for entire night for 4w.  (Hours NA)	NR	NR
	CG	Usual breathing.	28 nights for entire night for 4w.  (Hours NA)	NR	NR

Abbreviations: BBT: Buteyko breathing technique; bid: twice daily; CD: compact disc; cm: centimeters; d: day(s); F/U: followup; fx: frequency; HRBT: hyperventilation reduction breathing technique; min: minute(s); NA: not applicable; NR: not reported; pts: participants; s: second(s); sx: symptoms; w/: with.

**Evidence Table 1c. Change in asthma symptoms: hyperventilation reduction breathing techniques versus control**

Study	Symptom outcome (unit)	Follow-up	Group	N randomized	Follow-up N	Baseline mean (SD)	Mean change (SD) from baseline	p-value for difference between groups at followup	Standardized Effect Size Hedges' d (95% CI) (all coded lower= better)	Additional asthma symptom outcomes
Cooper 2003 <sup>35</sup>	Mini-Juniper AQLQ, symptoms subscale  (higher= better)	13w	IG1 (BBT)	30	26	5.0 (1.0)	0.42 (-0.17, 1.6)†	0.6 (for difference between all three groups)	Insufficient data to calculate	<b>Three groups differed across median daily symptom scores at 26w, p=0.003.*</b> NSD between groups in the number of exacerbations at 26w.
			CG	29	25	4.9 (0.9)	0.33 (-0.31, 0.58)†			
		26w	IG1	30	23	5.0 (1.0)	1.08 (0.08, 1.92)†	0.2 (for difference across all three groups)	Insufficient data to calculate	
			CG	29	22	4.9 (0.9)	0.33 (-0.19, 1.17)†			
Grammato-poulou 2011 <sup>37</sup>	Asthma control test score  (higher= better)	4w	IG (HRBT)	20	20	18.1 (2.59)	<b>4.1 (1.56)*</b>	<b>0.007*</b>	<b>-1.77 (-2.51, -1.03)*</b>	Significant difference between groups at 4 and 12w for those with controlled asthma, NSD at 26w.
			CG	20	20	19.0 (3.52)	<b>0.7 (2.16)*</b>			
		12w	IG	20	20	18.1 (2.59)	4.8 (1.56)	<b>0.001*</b>	<b>-2.04 (-2.82, -1.26)*</b>	
			CG	20	20	19.0 (3.52)	0.9 (2.14)			
		26w	IG	20	20	18.1 (2.59)	3.9 (2.02)	0.100	<b>-1.23 (-1.91, -0.55)*</b>	
			CG	20	20	19.0 (3.52)	1.3 (2.12)			
Holloway 2007 <sup>38,55</sup>	SGRQ symptoms subscale  (lower= better)	26w	IG (Papworth)	39	33	42.9 (21.3)	-21.1 (12.8)	<b>0.001*</b>	<b>-1.47 (-1.98, -0.97)*</b>	
			CG	46	45	35.1 (12.9)	-2.3 (12.5)			
		52w	IG	39	32	42.9 (21.3)	-18.0 (12.8)	<b>0.007*</b>	<b>-1.46 (-1.99, -0.94)*</b>	
			CG	46	40	35.1 (12.9)	-1.6 (9.5)			
McGowan 2003 <sup>39,77</sup>	Asthma symptoms score  (lower= better)	26w	IG (BBT)	200	180	2.2 (0.4)	-1.46 (0.91)	NR	<b>CG1: -2.58 (-2.86, -2.29)*</b>	
			CG1 (nurse education)	200	165	2.2 (0.4)	0.3 (0.26)			
			CG2 (brief asthma education)	200	146	2.2 (0.4)	0.2 (0.25)			<b>CG2: -2.38 (-2.66, -2.09)*</b>
Opat 2000 <sup>40,60</sup>	Daytime symptoms score  (lower= better)	4w	IG (BBT)	18	13	0.82 (0.58)	NR (NR) (-0.31 more in IG than CG)	0.10	Insufficient data to calculate	-0.21 greater change in IG than CG in nighttime symptom scores at 4w, p=0.24.
			CG	18	15	0.79 (0.56)	NR (NR)			
Thomas 2009 <sup>42,62-</sup>	ACQ, total score	4w	IG (HRBT)	94	73	1.4 (0.8)	-0.2 (0.5)	0.70	0.08 (-0.24, 0.40)	
			CG	89	79	1.5 (0.9)	-0.3 (0.7)			

Study	Symptom outcome (unit)	Follow-up	Group	N randomized	Follow-up N	Baseline mean (SD)	Mean change (SD) from baseline	p-value for difference between groups at followup	Standardized Effect Size Hedges' d (95% CI) (all coded lower= better)	Additional asthma symptom outcomes
64	(lower= better)	26w	IG	94	63	1.4 (0.8)	-0.3 (0.5)	0.12	-0.26 (-0.60, 0.09)	
			CG	89	66	1.5 (0.9)	-0.13 (0.6)			
Cooper 2009 ‡ <sup>34,58,72</sup>	ACQ, total score (lower= better)	4w	IG (mouth-taping)	51	51	NR (NR)	2.41 (1.7)	0.92	Insufficient data to calculate	No differences between groups on nighttime waking, symptom diary scores, number experiencing exacerbations. Difference between treatment periods -0.03 (95% CI, -0.68 to 0.61) in ACQ.
			CG			NR (NR)	2.37 (1.3)			

\*Statistically significant change from baseline or between groups (p<0.05)

†Median or median change from baseline (IQR)

‡Crossover study design, mouth-taping and control phases

Abbreviations: ACQ: Asthma Control Questionnaire; AQLQ: Asthma Quality of Life Questionnaire; BBT: Buteyko breathing technique; CG: control group; CI: confidence interval; HRBT: hyperventilation reduction breathing technique; IG: intervention group; IQR: inter-quartile range; NR: not reported; NSD: no significant difference; SD: standard deviation; SGRQ: St. George's Respiratory Questionnaire; w: week(s)

**Evidence Table 1d. Change in asthma medication use: hyperventilation reduction breathing techniques versus control**

Study	Reliever medication outcome (unit)	Follow-up	Group	N randomized	Follow-up N	Baseline mean (SD)	Mean change (SD) from baseline	p-value for difference between groups at followup	Standardized Effect Size Hedges' d (95% CI)	Controller and additional medication outcomes
Cooper 2003 <sup>35</sup>	Beta <sub>2</sub> -agonist use, median (puffs/d)	26w	IG1 (BBT)	30	23	2 (0, 4)†	-2 (-4, 0)†	<b>0.005 (for difference across all three groups)*</b>	Insufficient data to calculate	NSD between all three groups in median number of days taking increased ICS dose or median number of prednisolone courses per subject at 26w, or median ICS reduction during extended followup phase.
			CG	30	22	2 (0, 3.8)†	0 (-2, 0)†			
Grammatopoulou 2011 <sup>37</sup>	None	26w	IG (HRBT)	20	20	NA	NA	NA	NA	
			CG	20	20	NA	NA			
Holloway 2007 <sup>38</sup>	None	52w	IG (Papworth)	39	32	NA	NA	NA	NA	
			CG	46	40	NA	NA			
McGowan 2003 <sup>39,77</sup>	Bronchodilator use (puffs/w)	26w	IG (BBT)	200	180	18 (3)	-17.9 (2.66)	NR	<b>CG1: -7.67 (-8.19, -7.06)*</b> <b>CG2: -8.17 (-8.84, -7.51)*</b>	IG group decreased use of preventer medication, oral reliever and oral prevent preparations by > 90 percent at 26w; no significant change in CG1 or CG2.
			CG1 (nurse education)	200	165	18 (3)	0 (1.90)	NR		
			CG2 (brief asthma education)	200	145	18 (3)	3 (2.41)	NR		
Opat 2000 <sup>40,60</sup>	Bronchodilator use (mcg/d)	4w	IG (BBT)	18	13	350 (342)	<b>-220 (206)*</b>	NR	<b>-0.78 (-1.55, 0.00)*</b>	NSD between groups in inhaled steroid use at 4w.
			CG	18	15	459 (478)	-10 (303)			
Thomas 2009 <sup>42,62-64</sup>	Bronchodilator use (mcg)	4w	IG (HRBT)	94	73	NR (NR)	<b>"Reduced", data NR*</b>	0.72	Insufficient data to calculate	Mean bronchodilator use difference between groups, -0.06 (95% CI, -0.36 to 0.25) at 4w. NSD between groups in ICS use.
			CG	89	79	NR (NR)	<b>"Reduced", data NR*</b>			
Cooper 2009‡ <sup>34,58,72</sup>	Short-acting bronchodilator use, median (puffs/w)	4w	IG (mouth-taping)	51	51	10 (4.3,28)†	-0.5 (NR)†	0.12	Insufficient data to calculate	
			CG			10 (NR)†	-3.5 (NR)†			

\*Statistical significant change from baseline or between groups ( $p < 0.05$ )

†Median or median change from baseline (IQR)

‡Crossover study design, mouth-taping and control phases

Abbreviations: BBT: Buteyko breathing technique; CG: control group; CI: confidence interval; d: day(s); HRBT: hyperventilation reduction breathing technique; ICS: inhaled corticosteroids; IG: intervention group; IQR: inter-quartile range; mcg: microgram(s); NA: not applicable; NR: not reported; NSD: no significant difference; SD: standard deviation; w: week(s)

**Evidence Table 1e. Change in quality of life: hyperventilation reduction breathing techniques versus control**

Study	Quality of life outcomes	Follow-up	Group	N randomized	Follow-up N	Base-line mean (SD)	Mean change (SD) from baseline	p-value for difference between groups at followup	Standardized Effect Size Hedges' d (95% CI) (coded higher= better)	Functioning or additional quality of life outcomes
Cooper 2003 <sup>35</sup>	AQLQ-Juniper, total score  (higher= better)	13w	IG1 (BBT)	30	26	5.1 (1.0)	0.45 (0.11, 1.47)†	0.4 (for difference across all three groups)	Insufficient data to calculate	<b>Groups differed in SF-36 role limitations due to physical problems at 13w.* Groups differed in SF-36 role limitations due to physical problems and social functioning at 26w.*</b> NSD between groups on other components of the SF-36 at 12 and 26w.
			CG	30	25	5.0 (0.8)	0.33 (-0.20, 0.75)†			
		26w	IG	30	23	5.1 (1.0)	1.03 (0.19, 1.69)†	0.2 (for difference across all three groups)	Insufficient data to calculate	
			CG	30	22	5.0 (0.8)	0.61 (-0.11, 0.95)†			
Grammatopoulou 2011 <sup>37</sup>	None	4w, 12w, 26w	IG (HRBT)	20	20	NA	NA	NA	NA	Groups differed in SF-36 physical components at 4 and 12w, not 26w. NSD between groups in the SF-36 mental component at any time point.
			CG	20	20	NA	NA			
Holloway 2007 <sup>38,55</sup>	None	26w	IG (Pappworth)	39	32	NA	NA	NA	NA	<b>Groups differed in HADS anxiety and depression scores at 26 and 52w.*</b>
			CG	46	40	NA	NA			
McGowan 2003 <sup>39,77</sup>	None	26w	IG (BBT)	200	180	NA	NA	NA	NA	
			CG1 (nurse education)	200	165	NA	NA			

Study	Quality of life outcomes	Follow-up	Group	N randomized	Follow-up N	Base-line mean (SD)	Mean change (SD) from baseline	p-value for difference between groups at followup	Standardized Effect Size Hedges' d (95% CI) (coded higher= better)	Functioning or additional quality of life outcomes
			CG2 (brief asthma education)	200	145	NA	NA			
Opat 2000 <sup>40,60</sup>	AQLQ-Marks, total score  (lower= better)	4w	IG (BBT)	18	16	2.72 (1.58)	NR (NR)	<b>0.043*</b>	Insufficient data to calculate	<b>Mean AQLQ difference between groups -1.29 (95% CI, -2.53 to -0.05).*</b>
			CG	18	16	2.70 (1.61)	NR (NR)			
Thomas 2009 <sup>42,62-64</sup>	AQLQ-Juniper, total score  (higher= better)	4w	IG (HRBT)	94	73	4.2 (1.0)	0.92 (1.11)	0.78	0.04 (-0.28, 0.36)	<b>Groups differed in HADS anxiety and depression scores at 26w.*</b>
			CG	89	79	4.3 (0.9)	0.88 (1.00)			
		26w	IG	94	63	4.2 (1.0)	1.12 (0.81)	0.01	<b>0.43 (0.08, 0.78)*</b>	
			CG	89	66	4.3 (0.9)	0.74 (0.95)			
		52w	IG	94	55	4.2 (1.0)	<b>1.52 (0.89)*</b>	0.002	<b>0.46 (0.10, 0.82)*</b>	
			CG	89	68	4.3 (0.9)	<b>1.04 (1.16)*</b>			
Cooper 2009§ <sup>34,58,72</sup>	Mini-AQLQ, total score  (higher= better)	4w	IG (mouth-taping)	51	51	NR (NR)	5.33 (1.19)‡	0.40	Insufficient data to calculate	
			CG			NR (NR)	5.43 (0.94)‡			

\*Statistically significant change from baseline or between groups (p<0.05)

†Median or median change from baseline (IQR)

‡Mean (SD) at each time point

§Crossover study design, mouth-taping and control phases

Abbreviations: AQLQ: Asthma Quality of Life Questionnaire; BBT: Buteyko breathing technique; CG: control group; CI: confidence interval; HADS: Hospital Anxiety and Depression Scale; HRBT: hyperventilation reduction breathing technique; IG: intervention group; IQR: inter-quartile range; NA: not applicable; NR: not reported; NSD: no significant difference; SD: standard deviation; SF: social functioning (e.g., SF-36 Health Survey); w: week(s)

**Evidence Table 1f. Change in pulmonary function: hyperventilation reduction breathing techniques versus control**

Study	FEV <sub>1</sub> outcome (unit)	Follow-up	Group	N randomized	Follow-up N	Baseline mean (SD)	Mean change (SD) from baseline	p-value for difference between groups at followup	Standardized Effect Size Hedges' d (95% CI)	Additional pulmonary function outcomes
Cooper 2003 <sup>35</sup>	FEV <sub>1</sub> (L)	26w	IG1 (BBT)	30	23	2.58 (0.76)	0.06 (0.26)	0.4 (for difference across all three groups)	0.28 (-0.31, 0.86)	NSD between groups at 13 and 26w in provocative dose causing a fall of 20 percent in FEV <sub>1</sub> .
			CG	30	22	2.71 (0.89)	0.001 (0.14)			
Grammatopoulou 2011 <sup>37</sup>	FEV <sub>1</sub> , predicted (%)	4w	IG (HRBT)	20	20	83.5 (7.74)	<b>1.85 (4.97)*</b>	0.779	0.21 (-0.41, 0.83)	Significant differences between groups at 4, 12, and 26w in end-tidal CO <sub>2</sub> and respiratory rate.
			CG	20	20	83.9 (10.14)	0.6 (6.67)			
		12w	IG	20	20	83.5 (7.74)	3.15 (5.07)	0.510	0.40 (-0.23, 1.03)	
			CG	20	20	83.9 (10.14)	0.75 (6.59)			
		26w	IG	20	20	83.5 (7.74)	2.75 (5.06)	0.576	0.35 (-0.28, 0.98)	
			CG	20	20	83.9 (10.14)	0.65 (6.60)			
Holloway 2007 <sup>38,55</sup>	FEV <sub>1</sub> (L)	26w	IG (Papworth)	39	32	2.7 (0.9)	0.2 (0.55)	0.974	0.35 (-0.11, 0.82)	NSD between groups at 26 or 52w in end-tidal CO <sub>2</sub> , FVC, PEF, vital capacity.
			CG	46	41	2.8 (0.9)	0 (0.57)			
		52w	IG	39	30	2.7 (0.9)	0.1 (0.54)	0.583	0.36 (-0.12, 0.85)	
			CG	46	37	2.8 (0.9)	-0.1 (0.55)			
McGowan 2003 <sup>39,77</sup>	FEV <sub>1</sub> , predicted (%)	26w	IG (BBT)	200	180	80 (10.47)	1 (6.50)	NR	<b>CG1: 0.30 (0.09, 0.51)*</b>  CG2: 0.15 (-0.07, 0.37)	
			CG1 (nurse education)	200	165	75 (11.31)	-1 (6.80)	NR		
			CG2 (brief asthma education)	200	145	75 (11.31)	0 (6.79)	NR		
Opat 2000 <sup>40,60</sup>	None	4w	IG (BBT)	18	13	NA	NA	NA	NA	NSD between groups at 4w in PEF.
			CG	18	15	NA	NA			
Thomas	FEV <sub>1</sub> (L)	4w	IG (HRBT)	94	73	2.85 (0.83)	<b>0.1 (0.52)*</b>	0.07	-0.10	NSD

Study	FEV <sub>1</sub> outcome (unit)	Follow-up	Group	N randomized	Follow-up N	Baseline mean (SD)	Mean change (SD) from baseline	p-value for difference between groups at followup	Standardized Effect Size Hedges' d (95% CI)	Additional pulmonary function outcomes
2009 <sup>42,62-64</sup>			CG	89	79	2.82 (0.76)	<b>0.15 (0.48)*</b>		(-0.42, 0.22)	between groups at 4w in F <sub>ENO</sub> , sputum eosinophils, end-tidal CO <sub>2</sub> , and minute volume.
Cooper 2009† <sup>34,58,72</sup>	FEV <sub>1</sub> (L)	4w	IG (mouth-taping)	51	51	2.41 (0.80)	0.03 (0.51)	0.14	-0.37 (-0.77, 0.02)	NSD between groups at 4w in PEF (morning, evening, or amplitude percent mean).
			CG			2.41 (0.80)	0.27 (0.74)			

\*Statistically significant change from baseline or between groups (p<0.05)

†Crossover study design, mouth-taping and control phases

Abbreviations: BBT: Buteyko breathing technique; CG: control group; CI: confidence interval; CO<sub>2</sub>: carbon dioxide; F<sub>ENO</sub>: fraction of exhaled nitric oxide; FEV<sub>1</sub>: forced expiratory volume in 1 second; FVC: forced vital capacity; HRBT: hyperventilation reduction breathing technique; IG: intervention group; L: liter(s); NA: not applicable; NSD: no significant difference; PEF: peak expiratory flow; SD: standard deviation; w: week(s)

**Evidence Table 2a. Study characteristics: yoga breathing technique versus control**

Study	Country	Group	N randomized	Age (mean)	% Female	SABA use	ICS use	FEV <sub>1</sub> % pred.	Inclusion criteria	Exclusion criteria
Khare 1991 <sup>43</sup>	India	IG (yoga breathing)	17	38.9	0	NR	NR*	NR	Aged 25 to 50y, male asthmatics not suffering from other disease (e.g., coronary heart disease, valvular disease, chronic bronchitis and emphysema). Pts on vegetarian diet only.	Cigarette smokers
		CG	17							
Kligler 2011 <sup>44</sup>	United States	IG (yoga)	77	44.6	81.2	NR	79%‡	NR	Aged 18 to 80y, Class II through IV asthma sufferers (mild, moderate and severe persistent asthma); ability to read/write at 5th grade level; willingness to comply with study instructions; English speakers.	Pregnant or lactating; concurrent serious or life-threatening illness as determined by clinical judgment; psychiatric disorder as determined by clinical judgment; inability to understand and following direction associated with the clinical study as determined by clinical judgment; fish allergy; history of adverse reaction to vitamin C or fish oil as determined by clinical history.
		CG	77							
Sabina 2005 <sup>45</sup>	United States	IG (yoga breathing)	29	51	74.2	1 puffs /d	NR	NR	Aged ≥ 18y, dx of mild to moderate asthma for ≥ 6m (ATS spirometry criteria: FEV <sub>1</sub> /FVC below lower limit of normal, response to bronchodilator [≥ 12 percent increase and ≥ 200mL absolute increase in FEV <sub>1</sub> 15min after two puffs of short-acting beta <sub>2</sub> -agonist]), taking ≥ one of the following: inhaled corticosteroids, inhaled beta <sub>2</sub> -agonists, methylxanthines, anticholinergics, leukotriene inhibitors, receptor antagonists, or mast cell-stabilizing agents > 6m, stable medication dosing for ≥ 1m.	Smoked currently (within past 12m), smoking history > 5 pack years, lung disease, only EIA, practices yoga in past 3y, pregnancy, chronic medical condition that required tx w/ oral corticosteroids within 1m, medical condition that contraindicated exercise, or another unstable medical condition.
		CG	33							

Study	Country	Group	N randomized	Age (mean)	% Female	SABA use	ICS use	FEV <sub>1</sub> % pred.	Inclusion criteria	Exclusion criteria
Saxena 2009 <sup>46</sup>	India	IG (yoga breathing)	25	29.25	50	NR	NR	72	Bronchial asthma pts with diagnostic confirmation: sx of asthma, FEV <sub>1</sub> < 85 percent, reversibility (increase in FEV <sub>1</sub> ) > 12 percent after 20min of two salbutamol puffs. Study cases has FEV <sub>1</sub> > 70 percent, interest in yoga and a 6m minimum experience in performing yogic practices.	Pts with sx suggestive of disease other than bronchial asthma like ischemic heart disease, bronchinitis, and anemia; history of smoking.
		CG	25							
Vempati 2009 <sup>47,57,66-70</sup>	India	IG (yoga breathing)	30	33.45	42.1	2.1 puffs/d (plus 11 non-users)	339 mcg/d (plus 25 non-users)	66	Aged ≥ 18y; had an established diagnosis of mild-to-moderate asthma for at least 6m (meeting the ATS spirometry criteria for mild-to-moderate asthma, which requires either FEV <sub>1</sub> /FVC < the lower limit of normal w/a significant response to a bronchodilator [a ≥ 12 increase and a ≥ 200mL absolute increase in FEV <sub>1</sub> 15min after the administration of two puffs of a SABA] or PEFV variability > 20%); taking at least one of the following: inhaled beta <sub>2</sub> -agonists, methylxanthines, anticholinergics, ICS; and stable medication dosing for the past 1m.	Smoked currently (or in the past year) or had a smoking history of > 5 pack years; had a concomitant lung disease; were taking leukotriene inhibitors or receptor antagonists, or mast cell-stabilizing agents for at least 6m; practiced yoga or any other similar discipline during 6m prior to the study; pregnant; had a chronic medical condition that required treatment with oral or systemic corticosteroids in the past 1m; had a medical condition that contraindicated exercise; or had an unstable medical condition.
		CG	30							

\*19/34 (56%) “disturbed sleep and dyspnea on daily routine work which was relieved by oral drugs”; 8/34 (24%) “asthma required injection frequently to control dyspnea or admission in the hospital”

†Median puffs/d, typical dose per puff = 100 mcg

‡Percent using corticosteroid or other asthma medication

Abbreviations: ATS: American Thoracic Society; CG: control group; d: day(s); dx: diagnosis; EIA: exercise-induced asthma; FEV<sub>1</sub>: forced expiratory flow in 1 second; FVC: forced vital capacity; ICS: inhaled corticosteroids; IG: intervention group; m: month(s); min: minute(s); mL: milliliter(s); NR: not reported; PD<sub>20</sub>: provocative dose causing a decrease in FEV<sub>1</sub> of 20 percent; PEFV: pulmonary expiratory flow rate; pts: participants; pred: predicted; SABA: short-acting beta<sub>2</sub>-agonists; sx: symptoms; tx: treatment; μmol: micromole(s); US: United States; y: year(s)

**Evidence Table 2b. Description of intervention groups: yoga breathing techniques versus control**

Study	Intervention group	Description	Intervention session	Homework	Additional components
Khare 1991 <sup>43</sup>	IG (yoga breathing)	Pts underwent yoga asana training (once) taught by a yogasana instructor. Practices included Surya Namaskar (2min), Sarvang asana (3min), Halasana (3min), Matsyasana (3min), Bhujang asana (2min), Shalabasana (2min), Dhanurasana Vajrasana (5min), Meditation (15min), Pranayama (15min), Shavasana (20min). Practices performed daily from to 7 AM. Any error in learning were rectified; weekly followup of most pts possible. All pts hospitalized initially to facilitate training.	180 70-min sessions over 6m.  (210 hours total of yoga practice)	Perform daily at home.	NR
	CG	Pts received only bronchodilators, antibiotics and expectorants as indicated. Pts did not perform yoga.	NR	NR	NR

Study	Intervention group	Description	Intervention session	Homework	Additional components
Kligler 2011 <sup>44</sup>	IG (yoga)	<p>Pts attended two yoga and prayanama breathing classes with a certified yoga instructor. Yoga included (1) brief centering focused on breath and body awareness, (2) diaphragmatic abdominal breathing while lying on back, (3) mountain brook pose followed by gentle yoga stretch pulling the knees towards the chest while lying supine to release tension in the lower back, (4) legs up the wall (modified inversion) followed by modified fish pose (counterpose for inversion), (5) guided deep relaxation with imagery (20min). During second yoga session, deerga swasaam breathing replaced diaphragmatic breathing. Pts also attended two sessions on healthy eating with a nutritionist, focused on eliminating inflammation-promoting foods and common causes of food sensitivity (e.g., eggs, dairy, soy, wheat, corn, citrus, nuts, shellfish, pork, chocolate) (2-4w) followed by a testing phase in which each excluded food group is singly introduced and eat regularly for 3-5d with close monitoring for asthma sx. Food groups that provoke asthma are removed from the diet during the study period. Pts also took fish oil (2800mg/d containing EPA 860mg/DHA 580mg), vitamin C supplements (100 mg/d) and on a standardized hops extract with natural antiinflammatory products and pts provided w/ 6m supply. Pts also attended one guided journaling session (facilitated by a social worker) to write about the most traumatic or stressful experience to date (30min). Pts also attended one information session to ask questions regarding their asthma or specific treatments delivered during the study.</p>	<p>Six 60 to 90-min sessions over 6w.  (9 hours maximum of direct instruction)</p>	<p>Perform at home, frequency NR.</p>	<p>Also include dietary modification and restrictions, supplement use and stress management</p>
	CG	Usual care	NR	NR	NR

Study	Intervention group	Description	Intervention session	Homework	Additional components
Sabina 2005 <sup>45</sup>	IG (yoga breathing)	The principles of Iyengar yoga including 15 asana (postures), pranayama (breathing), and dhyana (meditation) were taught to pts in 90min classes two times/w. The experience Iyengar yoga instructor individually tailored advice to improve each pt's technique. Classes concluded with relaxation and meditation. Pts provided handouts and cassettes to practice at home. At end of 4w, pts asked to continue home practice for 20min/d, 3 times/w for additional 3m.	Eight 90-min sessions with instructor over 4w, then 36 20-min sessions at home sessions over 12w.  (12 hours direct instruction)	Encouraged to practice at home during 4w instruction period, 2m homework-only phase.	NR
	CG	Sham intervention of basic muscle stretching exercises during a 1hr class, two times/w. Classes taught by a certified exercise physiologist or graduate student in exercise physiology. Instruction based on ACSM published guidelines. Pts provided handouts and cassettes to practice at home. At end of 4w, pts asked to continue home practice for 20min/d, 3 times/w for additional 3m.	Eight 90-min sessions with instructor over 4w, then 36 20-min sessions at home sessions over 12w.  (12 hours direct instruction)	Encouraged to practice at home during 4w instruction period, 2m homework-only phase.	NR
Saxena 2009 <sup>46</sup>	IG (yoga breathing)	Pts practiced yoga breathing exercises/pranayama for 20min bid for 12w. Breathing exercises included: 1) deep breathing (sit in sukhasana, breathing through nostrils), 2) sasankasana breathing, 3) Anumaloma viloma (alternate nostrils), 4) Bhramari changint (breathing through nostrils, hum like a bee), and 5) Omkara (modified, exhalation exercise). First three exercises normalize breathing, last two are expiratory muscles.	168 20-min sessions over 12w (unclear how many supervised versus at home).  (56 hours of practice)	168 20-min sessions over 12w (unclear how many supervised versus at home).	NR
	CG	Pts practiced meditation (closed eyes, sitting posture) for 20min bid for 12w. Pts advised to confirm the side of nostril from wherein the air is coming maximum, then to concentrate on the same nostril, to appreciate the sound of the air along the inward/outward movement of outerwall of nostril.	168 20-min sessions over 12w (unclear how many supervised versus at home).  (56 hours of practice)	168 20-min sessions over 12w (unclear how many supervised versus at home).	NR

Study	Intervention group	Description	Intervention session	Homework	Additional components
Vempati 2009 <sup>47,57,66-70</sup>	IG (yoga breathing)	Conventional care in addition to yoga (raja-based) as taught by a qualified yoga instructor. Yoga-based lifestyle modification and stress management program for 4hrs/d for 2w. Sessions conducted btwn 8 AM and noon. Program consisted of lectures (on yoga, stress management, nutrition, health education), practice session on asanas (postures), pranayama (breathing techniques), kriyas (cleansing techniques), meditation and shavasna (relaxation). Session included 1hr of asanas/pranayama, breakfast and group support (30min), lecture/discussion (2hrs); meditation (30min). Pts received at least one individualized counseling session by physicians with special interest in yoga. Yoga practice sessions about 1.5hrs during 2w training period, followed by 6w home practice (1hr asana/pranayama, 10min relaxation, 20min meditation). Pts provided audiocassettes and printed materials to reference; telephonic support as provided. Predominantly vegetarian diet (unrefined cereals and pulses, moderate amounts of judiciously chosen fats, mild, milk products, spices; vegetables/fruits 500g/d predominantly leafy greens/raw). Predominantly vegetarian diet (unrefined cereals and pulses, moderate amounts of judiciously chosen fats, mild, milk products, spices; vegetables/fruits 500g/d predominantly leafy greens/raw).	14 240-min program sessions over 2w; 30 90-min home practice sessions (5 times/w to be compliant) over 6w.  (56 hours direct instruction)	Practice at home for additional 6w at least five times/w to be compliant.	Also included dietary advice, instruction on cleansing techniques, meditation, and relaxation.
	CG	Conventional care, a session on health education relevant to their illness. At end of 8w study period, pts offered the intervention based on yoga (wait-list).	One session.	NR	NR

Abbreviations: ACSM: American College of Sports Medicine; addtl: additional; bid: twice daily; btwn: between; d: day; g: grams; hr(s): hour(s); IG: intervention group; m: month(s); mg: milligram; min: minute(s); NR: not reported; pts: participants; sx: symptoms; w: weeks; w/: with.

**Evidence Table 2c. Change in asthma symptoms: yoga breathing techniques versus control**

Study	Symptom outcome (unit)	Follow-up	Group	N randomized	Follow-up N	Baseline mean (SD)	Mean change (SD) from baseline	p-value for difference between groups at followup	Standardized Effect Size Hedges' d (95% CI) (all coded lower=better)	Additional asthma symptom outcomes
Khare 1991 <sup>43</sup>	Severity score, mild (number of participants)	26w	IG (yoga breathing)	17	17	3 (17.6%)†	9 (52.9%)†	NR	NA	<b>More improved symptoms in IG (47%) than CG (12%); more symptom deterioration in CG (41%) than IG (18%), p-value NR but likely statistically significant.*</b>
			CG	17	17	4 (23.5%)†	5 (29.4%)†			
	Severity score, moderate (number of participants)	26w	IG	17	17	9 (52.9%)†	6 (35.3%)†	NR	NA	
			CG	17	17	10 (58.8%)†	8 (47.1%)†			
	Severity score, severe (number of participants)	26w	IG	17	17	5 (29.4%)†	2 (11.7%)†	NR	NA	
			CG	17	17	3 (17.6%)†	4 (23.5%)†			
Kliger 2011 <sup>44</sup>	AQLQ-Juniper symptoms subscale (higher=better)	6w	IG (yoga)	77	NR	4.28 (1.41)	<b>0.94 (0.85)*</b>	NR	<b>-0.51 (-0.86, -0.16)*</b>	
			CG	77	NR	4.38 (1.24)	0.52 (0.79)			
		12w	IG	77	66	4.28 (1.41)	<b>1.16 (0.85)*</b>	NR	<b>-0.75 (-1.11, -0.39)*</b>	
			CG	77	60	4.38 (1.24)	0.54 (0.79)			
		26w	IG	77	67	4.28 (1.41)	<b>1.23 (0.85)*</b>	<b>0.02*</b>	<b>-0.53 (-0.88, -0.18)*</b>	
			CG	77	62	4.38 (1.24)	0.80 (0.75)			
Sabina 2005 <sup>45</sup>	Asthma symptom score, morning	4w	IG (yoga breathing)	29	23	1.90 (1.08)	<b>NR (NR)*</b>	NSD	Insufficient data to calculate	
			CG	33	22	0.40 (0.63)	<b>NR (NR)*</b>			
		16w	IG	29	23	1.90 (1.08)	<b>NR (NR)*</b>	NSD	Insufficient data to calculate	
			CG	33	22	0.40 (0.63)	<b>NR (NR)*</b>			
Saxena 2009 <sup>46</sup>	Overall symptoms, severity score (% with symptoms)	12w	IG (yoga breathing)	25	NR	74%	10%	<b>&lt;0.01*</b>	Insufficient data to calculate	
			CG	25	NR	78%	72%			

Study	Symptom outcome (unit)	Follow-up	Group	N randomized	Follow-up N	Baseline mean (SD)	Mean change (SD) from baseline	p-value for difference between groups at followup	Standardized Effect Size Hedges' d (95% CI) (all coded lower=better)	Additional asthma symptom outcomes
										severity scores at 12w, p<0.01.*
Vempati 2009 <sup>47,57,66-70</sup>	AQLQ-Juniper, symptoms subscale  (higher=better)	2w	IG (yoga breathing)	30	28	3.77 (1.3)	<b>1.3 (0.87)*</b>	NR	<b>-1.00 (-1.55, -0.45)*</b>	
			CG	30	29	3.62 (1.42)	0.34 (1.02)			
		4w	IG	30	28	3.77 (1.3)	<b>1.61 (0.8)*</b>	NR	<b>-0.92 (-1.47, -0.37)*</b>	
			CG	30	29	3.62 (1.42)	<b>0.8 (0.93)*</b>			
		8w	IG	30	28	3.77 (1.3)	<b>1.65 (0.81)*</b>	0.033	<b>-0.61 (-1.14, -0.08)*</b>	
			CG	30	29	3.62 (1.42)	<b>1.08 (1.02)*</b>			

\*Statistically significant change from baseline or between groups (p<0.05)

†Number of participants (%) reporting severity score

‡Median or median change from baseline (IQR)

Abbreviations: AQLQ: Asthma Quality of Life Questionnaire; CG: control group; CI: confidence interval; IG: intervention group; IQR: inter-quartile range; NA: not applicable; NR: not reported; NSD: no significant difference; SD: standard deviation; w: week(s)

**Evidence Table 2d. Change in asthma medication use: yoga breathing techniques versus control**

Study	Reliever medication outcome (unit)	Follow-up	Group	N randomized	Follow-up N	Baseline mean (SD)	Mean change (SD) from baseline	p-value for difference between groups at followup	Standardized Effect Size Hedges' d (95% CI)	Controller and additional medication outcomes
Khare 1991 <sup>43</sup>	None	26w	IG (yoga breathing)	17	17	NA	NA	NA	Insufficient data to calculate	More in IG than CG reduced drug dose by 50% or more at 26w. More IG (53%) than CG (18%) reduced medication use at 26w p-value NR but likely <0.05.*
			CG	17	17	NA	NA			
Kliger 2011 <sup>44</sup>	None	26w	IG (yoga)	77	67	NA	NA	NA	NA	
			CG	77	62	NA	NA			
Sabina 2005 <sup>45</sup>	Rescue inhaler use (times/d)	4w	IG (yoga breathing)	29	23	1.13 (2.15)	-0.06 (0.77)	NR	0.28 (-0.31, 0.86)	
			CG	33	22	0.79 (1.15)	-0.47 (1.92)			
		16w	IG	29	23	1.13 (2.15)	-0.31 (1.92)	NR	-0.48 (-1.08, 0.11)	
			CG	33	22	0.79 (1.15)	0.45 (1.03)			
Saxena 2009 <sup>46</sup>	None	12w	IG (yoga breathing)	25	NR	NA	NA	NA	NA	
			CG	25	NR	NA	NA			
Vempati 2009 <sup>47,57,66-70</sup>	Rescue medication use (puffs/d)	2w	IG (yoga breathing)	30	28	2.27 (1.5)	-1.14 (0.92)	<0.05*	<b>-1.14 (-1.71, -0.58)*</b>	
			CG	30	29	1.98 (2.09)	0.21 (1.36)			
		4w	IG	30	28	2.27 (1.5)	-1.64 (0.96)	<0.01*	<b>-1.36 (-1.94, -0.78)*</b>	
			CG	30	29	1.98 (2.09)	-0.04 (1.33)			
		6w	IG	30	28	2.27 (1.5)	-1.39 (0.90)	NR	<b>-0.78 (-1.32, -0.24)*</b>	
			CG	30	29	1.98 (2.09)	-0.48 (1.36)			
		8w	IG	30	28	2.27 (1.5)	<b>-1.46 (0.90)*</b>	NR	<b>-0.84 (-1.38, -0.29)*</b>	
			CG	30	29	1.98 (2.09)	<b>-0.48 (1.36)*</b>			

\*Statistically significant change from baseline or between groups (p<0.05)

†Median or median change from baseline (IQR)

Abbreviations: CG: control group; CI: confidence interval; d: day(s); ICS: inhaled corticosteroids; IG: intervention group; IQR: inter-quartile range; NA: not applicable; NR: not reported; NSD: no significant difference; SD: standard deviation; w: week(s)

**Evidence Table 2e. Change in quality of life: yoga breathing techniques versus control**

Study	Quality of life outcomes	Follow-up	Group	N randomized	Follow-up N	Baseline mean (SD)	Mean change (SD) from baseline	p-value for difference between groups at followup	Standardized Effect Size Hedges' d (95% CI) (all coded higher= better)	Functioning or additional quality of life outcomes
Khare 1991 <sup>43</sup>	None	26w	IG (yoga breathing)	17	17	NA	NA	NA	NA	
			CG	17	17	NA	NA			
Kligler 2011 <sup>44</sup>	AQLQ-Juniper, total score  (higher= better)	6w	IG (yoga)	77	NR	4.21 (1.29)	<b>0.98 (0.78)*</b>	NR	<b>0.66 (0.30, 1.02)*</b>	Groups differed on the activities (p<0.001) and emotions (p<0.001) subscale of the AQLQ at 26w.* Groups differed on the SF-12 on all domains except pain, general health, vitality and emotional role limitation.*
			CG	77	NR	4.43 (1.21)	0.47 (0.76)			
		12w	IG	77	66	4.21 (1.29)	<b>1.14 (0.80)*</b>	NR	<b>0.83 (0.47, 1.20)*</b>	
			CG	77	60	4.43 (1.21)	0.49 (0.75)			
		26w	IG	77	67	4.21 (1.29)	<b>1.15 (0.78)*</b>	<0.001	<b>0.70 (0.34, 1.06)*</b>	
			CG	77	62	4.43 (1.21)	0.61 (0.75)			
Sabina 2005 <sup>45</sup>	Mini-AQLQ, total score  (higher= better)	4w	IG (yoga breathing)	29	23	4.82 (1.02)	0.17 (0.67)	NR	-0.22 (-0.80, 0.37)	
			CG	33	22	4.80 (0.8)	0.36 (1.03)			
		16w	IG	29	23	4.82 (1.02)	0.57 (1.77)	NR	0.16 (-0.43, 0.74)	
			CG	33	22	4.80 (0.8)	<b>0.35 (0.75)*</b>			
Saxena 2009 <sup>46</sup>	None	12w	IG (yoga breathing)	25	NR	NA	NA	NA	NA	
			CG	25	NR	NA	NA			
Vempati 2009 <sup>47,57,66-70</sup>	AQLQ-Juniper, total score  (higher= better)	2w	IG (yoga breathing)	30	28	3.72 (1.17)	<b>1.21 (0.79)*</b>	NR	<b>1.11 (0.54, 1.67)*</b>	Groups differed on the activities (p=0.033) and emotions (p=0.006) subscale of the AQLQ at 8w.*
			CG	30	29	3.64 (1.14)	0.26 (0.9)			
		4w	IG	30	28	3.72 (1.17)	<b>1.56 (0.7)*</b>	NR	<b>1.31 (0.74, 1.89)*</b>	
			CG	30	29	3.64 (1.14)	<b>0.53 (0.84)*</b>			
		8w	IG	30	28	3.72 (1.17)	<b>1.74 (0.72)*</b>	<b>0.013*</b>	<b>1.06 (0.51, 1.62)*</b>	
			CG	30	29	3.64 (1.14)	<b>0.86 (0.9)*</b>			

\*Statistically significant change from baseline or between groups (p<0.05)

†Median or median change from baseline (IQR)

Abbreviations: AQLQ: Asthma Quality of Life Questionnaire; CG: control group; CI: confidence interval; IG: intervention group; IQR: inter-quartile range; NR: not reported; NSD: no significant difference; SD: standard deviation; SF: social functioning (e.g., SF-36 Health Survey); w: week(s)

**Evidence Table 2f. Change in pulmonary function: yoga breathing techniques versus control**

Study	FEV <sub>1</sub> outcome (unit)	Follow-up	Group	N randomized	Follow-up N	Baseline mean (SD)	Mean change (SD) from baseline	p-value for difference between groups at followup	Standardized Effect Size Hedges' d (95% CI)	Additional pulmonary function outcomes
Khare 1991 <sup>43</sup>	FEV <sub>1</sub> (L)	26w	IG (yoga breathing)	17	17	2.16 (0.37)	<b>0.4 (0.23)*</b>	NR	<b>1.05 (0.33, 1.77)*</b>	Larger changes observed in IG at 26w in end-tidal volume, inspiratory reserve volume, inspiratory capacity, maximal voluntary ventilation, FVC, PEFR, and FEV <sub>1</sub> /VC ratio.
			CG	17	17	1.73 (0.32)	0.16 (0.21)			
Kligler 2011 <sup>44</sup>	FEV <sub>1</sub> (NR)	26w	IG (yoga)	77	67	NR	NR	0.46	Insufficient data to calculate	NSD between groups in FVC (data NR). PFTs did not show a significant change over time in either group (FVC, FEV <sub>1</sub> , FEF <sub>25-75</sub> , MEF).
			CG	77	62	NR	NR			
Sabina 2005 <sup>45</sup>	FEV <sub>1</sub> (NR)	4w	IG (yoga breathing)	29	23	2.05 (0.65)	NR (NR)	NR	Insufficient data to calculate	Follow-up data NR. NSD between groups at 4 and 16w in FEV <sub>1</sub> . FEV <sub>25-75</sub> , FVC, PEFR (evening and morning), and FEV <sub>1</sub> /FVC ratio.
			CG	33	22	2.69 (0.92)	NR (NR)			
		16w	IG	29	23	2.05 (0.65)	NR (NR)	NR	Insufficient data to calculate	
			CG	33	22	2.69 (0.92)	NR (NR)			
Saxena 2009 <sup>46</sup>	FEV <sub>1</sub> , predicted (%)	12w	IG (yoga breathing)	25	NR	72 (1.7)	12 (1.38)	<b>&lt;0.001*</b>	<b>6.73 (5.25, 8.21)*</b>	<b>Groups differed in PEFR at 12w, p&lt;0.001.*</b>
			CG	25	NR	73 (2.07)	2 (1.54)			
Vempati 2009 <sup>47,57,66-70</sup>	FEV <sub>1</sub> , predicted (%)	2w	IG (yoga breathing)	30	28	70.2 (17.4)	3.7 (11.89)	NR	0.25 (-0.27, 0.77)	<b>At 8w, groups differed in PEFR (p&lt;0.001), predicted FEV<sub>1</sub>/FVC ratio (p=0.011), and FEF<sub>25-75</sub> (p=0.035).*</b> NSD between groups at 8w in serum ECP level, EIB, and predicted FVC.
			CG	30	29	62.5 (19.2)	0.6 (12.61)			
		4w	IG	30	28	70.2 (17.4)	5.9 (12.13)	NR	<b>0.62 (0.09, 1.15)*</b>	
			CG	30	29	62.5 (19.2)	-2 (13.1)			
		8w	IG	30	28	70.2 (17.4)	<b>7.7 (10.94)*</b>	<b>0.009*</b>	<b>0.88 (0.34, 1.43)*</b>	
			CG	30	29	62.5 (19.2)	-2.6 (12.11)			

\*Statistically significant change from baseline or between groups (p<0.05)

Abbreviations: CG: control group; CI: confidence interval; ECP: eosinophilic cationic protein; EIB: exercise-induced bronchoconstriction; ECP: eosinophilic cationic protein; FEF: forced expiratory flow; FEV<sub>1</sub>: forced expiratory volume in 1 second; FEV<sub>25-75</sub>: forced expiratory volume between 25 and 75 percent; FVC: forced vital capacity; IG: intervention group; L: liter(s); MEF: maximum expiratory flow; NR: not reported; NSD: no significant difference; PEF: peak expiratory flow; PEFR: peak expiratory flow rate; PFT: pulmonary function test; SD: standard deviation; VC: vital capacity; w: week(s)

**Evidence Table 3a. Study characteristics: inspiratory muscle training versus control**

Study	Country	Group	N randomized	Age (mean)	% Female	SABA use	ICS use	FEV <sub>1</sub> % pred.	Inclusion criteria	Exclusion criteria
Lima 2008 <sup>48</sup>	Brazil	IG (IMT)	25	9.68	68	NR	NR	NR	Asthmatic children aged 8 to 12y having received no previous tx for asthma and presenting with uncontrolled asthma.	NR
		CG	25							
Shaw 2011 <sup>49</sup>	South Africa	IG (abdom. strengthening)	22	21.9	NR	NR	NR	NR	Caucasian pts with moderate-persistent asthma, inactive, weight stable for 6m prior to commencement of study, non-smokers, exhibited daily and nocturnal asthmatic sx more than 1 night/w, peak flow variability > 30 percent.	Influenza-like or respiratory infections 2w prior to the evaluations.
		CG	22							
Weiner 1992 <sup>50</sup>	Israel	IG (IMT)	15	40.5	40	6 puffs /d	NR	59	Pts w/ moderate to severe asthma, satisfied criteria of the ATS.	NR
		CG	15							
Weiner 2000 <sup>52</sup>	Israel	IG (IMT)	12	34.0	34.8	2.7 puffs /d	NR	91	Pts w/ mild, stable asthma (FEV <sub>1</sub> > 80 percent predicted normal value on at least two visits), satisfied ATS definition of asthma (sx of episodic wheezing, cough and shortness of breath responding to bronchodilators and reversible airflow function study), stable clinical condition. Subjects who were high consumers (> 1 puff/d) of beta <sub>2</sub> -agonists randomized.	Pts recorded PEFr < 80 percent predicted of their best value during run-in period.
		CG	11							
Weiner 2002 <sup>51</sup>	Israel	IG (IMT)	11	36.2	100	3.2 puffs /d	NR	83	Pts w/ mild persistent-to-moderate asthma (FEV <sub>1</sub> > 60 percent predicted normal values), satisfied ATS definition of asthma w/ sx of episodic wheezing, cough and shortness of breath responding to bronchodilators and reversible airflow obstruction documented in at least one previous pulmonary function study.	NR
		CG	11							

Abbreviations: abdom: abdominal; ATS: American Thoracic Society; CI: confidence interval; d: day(s); FEV<sub>1</sub>: forced expiratory volume in 1 second; ICS: inhaled corticosteroids; IG: intervention group; IMT: inspiratory muscle training; NR: not reported; PEFr: pulmonary expiratory flow rate; pred: predicted; pts: participants; SABA: short-acting beta<sub>2</sub>-agonists; sx: symptoms; tx: treatment; y: year(s)

**Evidence Table 3b. Description of intervention groups: inspiratory muscle training versus control**

Study	Intervention group	Description	Intervention session	Homework	Additional components
Lima 2008 <sup>48</sup>	IG (IMT)	Inspiratory muscle training and breathing exercises, two 50min sessions/w for 7w. First 25min, breathing exercises in supine and sitting positions to provide respiratory reeducation/awareness. Breathing training included diaphragmatic breathing, fractionated breathing, pursed-lip breathing; each performed as a series of 10 repetitions. Last 25min, IMT using Threshold IMT (Respironics): 20min IMT used in 10 series of 60s each, separated by rest of 60s to develop muscle strength; final 5min IMT used uninterrupted to develop endurance. IMT pressure threshold load was 40 percent of maximal inspiratory pressure. In addition to monthly medical visits and educational program (one 60min session/m) about asthma, signs and signals of exacerbation, asthma triggers, environmental control, rescue medication, and preventive medication.	Three 60-min asthma education classes; three medical visits over 13w (minutes NR); 14 50-min IMT sessions over 7w.  (14.6 hours, not including medical visits)	Home exercises with an audiotape or CD with technique reminders.	Environmental modification and awareness of asthma triggers.
	CG	Monthly medical visits and educational program (one 60min session/m) about asthma, signs and signals of exacerbation, asthma triggers, environmental control, rescue medication, and preventive medication.	Three 60-min sessions (asthma education classes / medical visits) over 13 weeks.  (3 hours)	NR	NR
Shaw 2011 <sup>49</sup>	IG (abdominal strengthening)	Diaphragmatic breathing combined with inspiratory resistive breathing in the semi-recumbent position. Pts inspired and expired through a 10cm x 1cm tube principally using abdominal motion while reducing upper rib cage motion. One hand of pts stabilized a 2.5kg (weeks 1 to 4) or a 5kg (weeks 5 to 8) onto the abdominal cavity. Pts completed three sets of 5 to 10 repetitions using 1s of inspiration and 2s of expiration (1:2 ratio), three sets of 10 to 15 repetitions of 2:4 inspiration-expiration ratio and three sets of 15 to 20 repetitions at 3:6 inspiration-expiration ratio.	NR, training over 8 weeks.  (Hours NR)	NR	NR

Study	Intervention group	Description	Intervention session	Homework	Additional components
	CG	No structured exercise program.	NR	NR	NR
Weiner 1992 <sup>50</sup>	IG (IMT)	Inspiratory muscle training with resistance equal to 15 percent of $PI_{max}$ taught by a physiotherapist. Resistance incrementally increased to 60 percent of $PI_{max}$ within 1m; adjusted q2m according to $PI_{max}$ achieved. During last 2m, resistance equality to 80 percent of $PI_{max}$ .	120 30-min sessions over 6m.  (60 hours total)	None	NR
	CG	Sham-training with a threshold inspiratory muscle trainer with no resistance; taught by a physiotherapist.	120 30-min sessions over 6m.  (60 hours total)	NR	NR
Weiner 2000 <sup>52</sup>	IG (IMT)	Specific inspiratory muscle training with a threshold inspiratory muscle trainer (Threshold® Inspiratory Muscle Trainer, Health Scan). Baseline resistance level equal to 15 percent of $PI_{max}$ for 1w; increased incrementally 5 to 10 percent each session to reach 60 percent of their $PI_{max}$ at end of 1m; continued and adjusted q1w to the new $PI_{max}$ achieved.	72 30-min sessions over 3m.  (36 hours total)	Trained 6 times/w.	NR
	CG	Sham-training, no resistance.	72 30-min sessions over 3m.  (36 hours total)	NR	NR
Weiner 2002 <sup>51</sup>	IG (IMT)	Inspiratory muscle training with a threshold inspiratory muscle trainer (Threshold® IMT, Respironics); end-point when the mean inspiratory muscle strength of women equaled to that of the male subjects (not randomized).	120 30-min sessions over 20w.  (60 hours total)	NR	NR
	CG	Sham muscle training with same device, no resistance.	120 30-min sessions over 20w.  (60 hours total)	NR	NR

Abbreviations: CI: confidence interval; cm: centimeter; d: day; IG: intervention group; IMT: inspiratory muscle training; kg: kilogram; m: month(s); min: minute(s); NR: not reported;  $PI_{max}$ : maximal inspiratory mouth pressure; q1w: every one week; q2m; every 2 months; s: seconds; SIMT: specific inspiratory muscle training; w: week(s).

**Evidence Table 3c. Change in asthma symptoms: inspiratory muscle training versus control**

Study	Symptom outcome (unit)	Follow-up	Group	N randomized	Follow-up N	Baseline mean (SD)	Mean change (SD) from baseline	p-value for difference between groups at followup	Standardized Effect Size Hedges' d (95% CI)	Additional asthma symptom outcomes
Lima 2008 <sup>48</sup>	Daytime symptoms (number of participants)	13w	IG (IMT)	25	25	NA	0 (0%)†	<0.0001*	NA	Groups differed in number of participants with frequent asthma attack, p<0.0001.*
			CG	25	25	NA	25 (100%)†			
	Nighttime symptoms (number of participants)	13w	IG	25	25	NA	3 (12%)†	<0.0001*	NA	
			CG	25	25	NA	25 (100%)†			
Shaw 2011 <sup>49</sup>	None	8w	IG (abdom. strengthening)	22	22	NA	NA	NA	NA	
			CG	22	22	NA	NA			
Weiner 1992 <sup>50</sup>	Chest tightness, morning (diary score)	26w	IG (IMT)	15	15	NR (NR)	<b>NR (NR)*</b>	NR	Insufficient data to calculate	
			CG	15	15	NR (NR)	NR (NR)			
	Cough (diary score)	26w	IG	15	15	1.4 (NR)	<b>-1.1 (NR)*</b>	NR	Insufficient data to calculate	
			CG	15	15	2.4 (NR)	0.1 (NR)			
	Daytime asthma (diary score)	26w	IG	15	15	1.7 (NR)	<b>-1.1 (NR)*</b>	NR	Insufficient data to calculate	
			CG	15	15	2.0 (NR)	-0.2 (NR)			
	Night-time asthma (diary score)	26w	IG	15	15	2.2 (NR)	<b>-1.5 (NR)*</b>	NR	Insufficient data to calculate	
			CG	15	15	2.4 (NR)	0.1 (NR)			
Weiner 2000 <sup>52</sup>	None	13w	IG (IMT)	12	11	NA	NA	NA	NA	
			CG	11	11	NA	NA			
Weiner 2002 <sup>51</sup>	None	4, 8, 12, 16, 20w	IG (IMT)	11	10	NA	NA	NA	NA	
			CG	11	9	NA	NA			

\*Statistically significant change from baseline or between groups (p<0.05)

†Number of participants (%) experiencing symptoms at followup

Abbreviations: abdom: abdominal; CG: control group; CI: confidence interval; IG: intervention group; IMT: inspiratory muscle training; NA: not applicable; NR: not reported; SD: standard deviation; w: week(s)

**Evidence Table 3d. Change in asthma medication use: inspiratory muscle training versus control**

Study	Reliever medication outcome (unit)	Follow-up	Group	N randomized	Follow-up N	Baseline mean (SD)	Mean change (SD) from baseline	p-value for difference between groups at followup	Standardized Effect Size Hedges' d (95% CI)	Controller and additional medication outcomes
Lima 2008 <sup>48</sup>	Rescue bronchodilator use (number of participants)	13w	IG (IMT)	25	25	NA	4 (16%)†	<0.0001*	Insufficient data to calculate	
			CG	25	25	NA	21 (84%)†			
Shaw 2011 <sup>49</sup>	None	8w	IG (abdom. strengthening)	22	22	NA	NA	NA	NA	
			CG	22	22	NA	NA			
Weiner 1992 <sup>50</sup>	Beta <sub>2</sub> -agonist use (puffs/d)	26w	IG (IMT)	15	15	5.5 (NR)	<b>-4.3 (NR)*</b>	NR	Insufficient data to calculate	<b>More participants able to stop oral steroid use in IG than CG at 26w.*</b>
			CG	15	15	6.5 (NR)	-0.5 (NR)			
Weiner 2000 <sup>52</sup>	Beta <sub>2</sub> -agonist use (puff/d)	13w	IG (IMT)	12	11	2.6 (1.33)	<b>-1 (0.84)*</b>	NR	-0.76 (-1.63, 0.11)	
			CG	11	11	2.8 (2.65)	0.1 (1.78)			
Weiner 2002 <sup>51</sup>	Beta <sub>2</sub> -agonist use (puffs/d)	4w	IG (IMT)	11	10	3.4 (1.99)	-0.4 (NR)	NR	Insufficient data to calculate	
			CG	11	9	3.0 (1.66)	0.2 (NR)			
		8w	IG	11	10	3.4 (1.99)	-0.6 (NR)	NR	Insufficient data to calculate	
			CG	11	9	3.0 (1.66)	-0.1 (NR)			
		12w	IG	11	10	3.4 (1.99)	-0.9 (NR)	NR	Insufficient data to calculate	
			CG	11	9	3.0 (1.66)	0.2 (NR)			
		16w	IG	11	10	3.4 (1.99)	-1 (NR)	NR	Insufficient data to calculate	
			CG	11	9	3.0 (1.66)	0.3 (NR)			
		20w	IG	11	10	3.4 (1.99)	<b>-1.3 (1.2)*</b>	NR	Insufficient data to calculate	
			CG	11	9	3.0 (1.66)	0 (NR)			

\*Statistically significant change from baseline or between groups (p<0.05)

†Number of participants (%) using bronchodilator at followup

Abbreviations: abdom: abdominal; CG: control group; CI: confidence interval; d: day(s); IG: intervention group; IMT: inspiratory muscle training; NA: not applicable; NR: not reported; SD: standard deviation; w: week(s)

**Evidence Table 3e. Change in quality of life: inspiratory muscle training versus control**

Study	Quality of life outcomes	Followup	Group	N randomized	Follow-up N	Baseline mean (SD)	Mean change (SD) from baseline	p-value for difference between groups at followup	Standardized Effect Size Hedges' d (95% CI)	Functioning or additional quality of life outcomes
Lima 2008 <sup>48</sup>	None	13w	IG (IMT)	25	25	NR	NR	<0.0001*	NA	0 percent with impaired ability to perform activities of daily living in IG vs 100 percent in CG at followup, all impaired at baseline.
			CG	25	25	NR	NR			
Shaw 2011 <sup>49</sup>	None	8w	IG (abdom. strengthening)	22	22	NR	NR	NA	NA	
			CG	22	22	NR	NR			
Weiner 1992 <sup>50</sup>	None	26w	IG (IMT)	15	15	NR	NR	NR	Insufficient data to calculate	Absences from work/school in past 3m reduced by 1.7 days in IG, increased by 0.2 in CG.
			CG	15	15	NR	NR			
Weiner 2000 <sup>52</sup>	None	4w	IG (IMT)	13	11	NA	NA	NA	NA	
			CG	11	11	NA	NA			
Weiner 2002 <sup>51</sup>	None	4,8,12,16,20w	IG (IMT)	11	10	NA	NA	NA	NA	
			CG	11	9	NA	NA			

\*Statistically significant change from baseline or between groups (p<0.05)

Abbreviations: CG: control group; CI: confidence interval; d: day(s); IG: intervention group; m: month(s); IMT: inspiratory muscle training; NA: not applicable; NR: not reported; SD: standard deviation; w: week(s)

**Evidence Table 3f. Change in pulmonary function: inspiratory muscle training versus control**

Study	FEV <sub>1</sub> outcome (unit)	Follow-up	Group	N randomized	Follow-up N	Baseline mean (SD)	Mean change (SD) from baseline	p-value for difference between groups at followup	Standardized Effect Size Hedges' d (95% CI)	Additional pulmonary function outcomes
Lima 2008 <sup>48</sup>	None	7w, 13w	IG (IMT)	25	25	NA	NA	NA	NA	Significant difference between groups at 7 and 13w in PEF, p-value NR.*
			CG	25	25	NA	NA			
Shaw 2011 <sup>49</sup>	FEV <sub>1</sub> (L)	8w	IG (abdom. strengthening)	22	22	2.85 (0.57)	<b>0.37 (0.38)*</b>	NR	<b>0.80 (0.18, 1.42)*</b>	Significant change from baseline in FVC, PEF, inspiratory vital capacity in IG only (p<0.05).* NSD from baseline in maximal voluntary ventilation in either group.
			CG	22	22	2.62 (0.53)	0.08 (0.33)			
Weiner 1992 <sup>50</sup>	FEV <sub>1</sub> , predicted (%)	26w	IG (IMT)	15	15	57.3 (12.47)	<b>7.9 (7.48)*</b>	NR	<b>1.31 (0.51, 2.11)*</b>	Significant change from baseline in FVC (p<0.005) in IG only.*
			CG	15	15	62.5 (10.07)	-1.7 (6.37)			
Weiner 2000 <sup>52</sup>	None	13w	IG (IMT)	12	11	NA	NA	NA	NA	
			CG	11	11	NA	NA			
Weiner 2002 <sup>51</sup>	FEV <sub>1</sub> , predicted (%)	20w	IG (IMT)	11	10	NR (NR)	NR (NR)	NSD	Insufficient data to calculate	
			CG	11	9	NR (NR)	NR (NR)			

\*Statistically significant change from baseline or between groups (p<0.05)

Abbreviations: abdom: abdominal; CG: control group; CI: confidence interval; FEV<sub>1</sub>: forced expiratory volume in 1 second; FVC: forced vital capacity; IG: intervention group; IMT: inspiratory muscle training; NA: not applicable; NR: not reported; NSD: no significant difference; PEF: peak expiratory flow; SD: standard deviation; w: week(s)

**Evidence Table 4a. Study characteristics: nonhyperventilation reduction breathing techniques versus control**

Study	Country	Group	N randomized	Age (mean)	% Female	SABA use	ICS use	FEV <sub>1</sub> % pred.	Inclusion criteria	Exclusion criteria
Cooper 2003 <sup>35</sup>	UK	IG2 (yoga breathing device)	30	44	44.9	2 puffs /d†	657 mcg /d	80	Aged 18 to 70, non-smoking volunteers with stable asthma, taking an inhaled SABA at least 2 times/w and regular ICS w/ no change in dose in previous 4w, pre-bronchodilator FEV <sub>1</sub> of at least 50 percent predicted and 10 percent increase following 400mcg inhaled salbutamol, a PD <sub>20</sub> of methacholine causing a 20 percent fall in FEV <sub>1</sub> of 10.24 µmol or less, mean daily sx score of one or more during run-in.	No other important illnesses, taking tx other than sodium cromoglycate.
		CG	30							
Lehrer 2004 <sup>53,59</sup>	US	IG (abdominal breathing w/ biofeedback)	23	37.3	68.1	NR	NR	NR*	Aged 18 to 65y, history of asthma sx, positive bronchodilator test results (postbronchodilator FEV <sub>1</sub> increase of ≥ 12%) within past 1y, positive methacholine inhalation challenge test result, or documented recent history (i.e., within past 1y) of clinical improvement and FEV <sub>1</sub> increase ≥ 12 percent following instigation of inhaled steroid therapy among individuals with a protracted history of asthma.	Disorder that would impede performing the biofeedback procedures (e.g., abnormal cardiac rhythm), a negative methacholine challenge test result, an abnormal diffusing capacity (testing among all subjects aged > 55y or w/ > 20 pack years of smoking), current practice of any relaxation, biofeedback or breathing technique.
		CG1 (biofeedback)	22							
		CG2 (placebo)	24							
		CG3 (waitlist)	25							
Thomas 2003 <sup>54,61,65</sup>	UK	IG (diaphragm breathing)	17	48.8	78.8	1.5 canisters /3m	600 mcg /d	NR	Aged 17 to 65y with dx of asthma who had received at least one Rx for an inhaled or oral bronchodilator or prophylactic anti-asthma	NR

Study	Country	Group	N randomized	Age (mean)	% Female	SABA use	ICS use	FEV <sub>1</sub> % pred.	Inclusion criteria	Exclusion criteria
		CG	16						medication in previous 1y, $\geq$ 23 on Nijmegen questionnaire (suggestive of dysfunctional breathing).	

\*Most patients rated as having moderate-persistent asthma according to the NAEPP guideline

Abbreviations: CG: control group; d: day(s); dx: diagnosis; FEV<sub>1</sub>: forced expiratory volume in 1 second; ICS: inhaled corticosteroids; IG: intervention group; m: month(s), mcg: microgram(s); NAEPP: National Asthma Education and Prevention Program; NR: not reported; pred: predicted; PD<sub>20</sub>: provocative dose causing a decrease in FEV<sub>1</sub> of 20 percent; Rx: prescription; SABA: short-acting beta<sub>2</sub>-agonists; sx: symptom(s); tx: treatment(s); UK: United Kingdom; US: United States; y: year(s)

**Evidence Table 4b. Description of intervention groups: nonhyperventilation reduction breathing techniques versus control**

Study	Intervention group	Description	Intervention session	Homework	Additional components
Cooper 2003 <sup>35</sup>	IG2 (yoga breathing device)	PCLE (yoga breathing device) imposed a 1:2 ratio on the duration of inspiration compared with expiration. Device set at largest aperture, pts asked to breathe at rate which they felt no resistance and could feel no chest movement. Over time decrease aperture size to gradually reduce respiratory rate. Use beta <sub>2</sub> -agonist only for sx relief. PCLE used bid (420 times over 6m).	One session, 6m practice.  (Hours NR)	Use PCLE bid.	NR
	CG	Sham device with no valve and a leak ensured no resistance to breathing, use bid (420 times in 6m).	One session.	Use device bid.	NR
Lehrer 2004 <sup>53,59</sup>	IG (abdominal breathing w/ biofeedback)	Pursed-lips abdominal breathing w/ prolonged exhalation biofeedback targeting respiratory resistance, respiratory reactance, and HRV. Pts asked to practice at home for 20min bid using a home trainer unit (KC-3, Biosvyaz).	10 sessions over 10w.  (Hours NR)	Asked to practice at home for 20min bid.	NR
	CG1 (biofeedback)	HRV biofeedback only. Pts asked to practice at home for 20min bid using a home trainer unit (KC-3®, Biosvyaz).	10 sessions over 10w.  (Hours NR)	Asked to practice at home for 20min bid.	NR
	CG2 (placebo)	Placebo biofeedback procedure involving bogus subliminal suggestions designed to help asthma (with no further details provided and no actual suggestions given) and biofeedback training to alternately increase and decrease frontal EEG alpha-rhythms. Maintain a state of relaxed alertness during home practice using mental strategies developed during the sessions, given tape recording w/ classical music and supposed subliminal suggestions to improve asthma.	10 sessions over 10w.  (Hours NR)	Asked to practice at home for 20min bid.	Practice (but no instruction) maintaining state of relaxed alertness, classical music tapes.
	CG3 (waitlist)	Waitlist control	Waited for 30w.	NA	NR

<b>Study</b>	<b>Intervention group</b>	<b>Description</b>	<b>Intervention session</b>	<b>Homework</b>	<b>Additional components</b>
Thomas 2003 <sup>54,61,65</sup>	IG (diaphragm breathing)	Diaphragm breathing retraining; pts practiced slow diaphragmatic breathing for short (e.g., 10min) periods qd using an established physiotherapy method as taught by a physiotherapist. Learned about effects of overbreathing (by abnormal breathing such as non-diaphragmatic breathing).	One 45-min group session, two 15-min individual sessions, over 2w.  (1.25 hours total)	NR	NR
	CG	Asthma education provided by an asthma nurse; pts also invited to attend individual asthma review w/ nurse or doctor in which six (38%) participated.	One 60-min session.	NR	NR

Abbreviations: CG: control group; EEG: electroencephalography; HRV: heart rate variability; IG: intervention group; m: month(s); min: minute(s); NR: not reported; PCLE: Pink City Lung exerciser; pts: patients; qd: everyday; w/: with.

**Evidence Table 4c. Change in asthma symptoms: nonhyperventilation reduction breathing techniques versus control**

Study	Symptom outcome (unit)	Follow-up	Group	N randomized	Follow-up N	Baseline mean (SD)	Mean change (SD) from baseline	p-value for difference between groups at followup	Standardized Effect Size Hedges' d (95% CI)	Additional asthma symptom outcomes
Cooper 2003 <sup>35</sup>	Mini-AQLQ, symptoms subscale  (higher= better)	13w	IG2 (yoga breathing device)	30	25	5.0 (0.8)	0.50 (-0.38, 1.21)‡	0.6 (for difference between all three groups)	Insufficient data to calculate	<b>Three groups differed across median daily symptom scores at 26w, p=0.003.*</b> NSD between groups in the number of exacerbations at 26w.
			CG	30	24	4.9 (0.9)	0.33 (-0.31, 0.58)‡			
		26w	IG2	30	24	5.0 (0.8)	0.58 (0, 1.21)‡			
			CG	30	22	4.9 (0.9)	0.33 (-0.19, 1.17)‡	0.2 (for difference across all three groups)	Insufficient data to calculate	
Lehrer 2004 <sup>53,59</sup>	Asthma symptoms (diary score)  (lower= better)	12w	IG (abdominal breathing with biofeedback)	23	17	0.81 (NR)	<b>-0.48 (NR)*</b>	<b>&lt;0.0001*</b>	Insufficient data to calculate	More exacerbations occurred in CG2 and CG3 than IG and CG1.
			CG1 (biofeedback)	22	17	0.95 (NR)	<b>-0.47 (NR)*</b>			
			CG2 (placebo)	24	19	0.71 (NR)	<b>-0.33 (NR)*</b>			
			CG3 (waitlist)	25	23	1.15 (NR)	-0.2 (NR)			
Thomas 2003 <sup>54,61,65</sup>	AQLQ-Juniper, symptoms, median  (higher= better)	4w	IG (diaphragm breathing)	17	16	4.68 (1.06)	0.42 (0.11, 1.17)†	<b>0.042*</b>	NA	
			CG	16	15	4.60 (1.35)	0.09 (-0.58, 0.50)†			
		26w	IG	17	16	4.68 (1.06)	0.33 (-0.13, 1.13)†	0.059	NA	
			CG	16	12	4.60 (1.35)	-0.17 (-0.73, 0.4)†			

\*Statistically significant change from baseline or between groups (p<0.05)

†Median or median change from baseline (IQR)

Abbreviations: AQLQ: Asthma Quality of Life Questionnaire; CG: control group; CI: confidence interval; IG: intervention group; NA: not applicable; NR: not reported; NSD: no significant difference; SD: standard deviation; w: week(s)

**Evidence Table 4d. Change in asthma medication use: nonhyperventilation reduction breathing techniques versus control**

Study	Reliever medication outcome (unit)	Follow-up	Group	N randomized	Follow-up N	Baseline mean (SD)‡	Mean change (SD) from baseline	p-value for difference between groups at followup	Standardized Effect Size Hedges' d (95% CI)	Controller and additional medication outcomes
Cooper 2003 <sup>35</sup>	Beta <sub>2</sub> -agonist use, median (puffs/d)	26w	IG2 (yoga breathing device)	30	24	2 (0, 4)†	0 (-2, 0)†	NR	Insufficient data to calculate	NSD between all three groups in median number of days taking increased ICS dose or median number of prednisolone courses per subject at 26w.
			CG	30	22	2 (0, 3.8)†	0 (-2, 0)†			
Lehrer 2004 <sup>53,59</sup>	None	12w	IG (abdominal breathing with biofeedback)	23	17	NA	NA	NA	NA	Fewer IG and CG1 participants increased use of controlled medication from baseline than CG2 and CG3 (after run-in to achieve lowest ICS use that stabilizes symptoms).
			CG1 (biofeedback)	22	17	NA	NA			
			CG2 (placebo)	24	19	NA	NA			
			CG3 (waitlist)	25	23	NA	NA			
Thomas 2003 <sup>54,61,65</sup>	Bronchodilator use, canisters issued (number of canisters)	26w	IG (diaphragm breathing)	17	16	1 (0, 4)†	0 (NR)†	NR	NA	NSD in number of ICS canisters issued within each group at 26w.
			CG	16	12	0 (0, 10)†	1 (NR)†			

\*Statistically significant change from baseline or between groups (p<0.05)

†Median number of canister issued (range)

‡Bronchodilator use measured 6 months before intervention

Abbreviations: CG: control group; CI: confidence interval; ICS: inhaled corticosteroids; IG: intervention group; NA: not applicable; NR: not reported; SD: standard deviation; w: week(s)

**Evidence Table 4e. Change in quality of life: nonhyperventilation breathing techniques versus control**

Study	Quality of life outcomes	Follow-up	Group	N randomized	Follow-up N	Baseline mean (SD)	Mean change (SD) from baseline	p-value for difference between groups at followup	Standardized Effect Size Hedges' d (95% CI)	Functioning or additional quality of life outcomes
Cooper 2003 <sup>35</sup>	AQLQ-Juniper, total score  (higher=better)	13w	IG2 (yoga breathing device)	30	25	4.9 (0.8)	0.45 (-0.13, 1.11)†	0.4 (for difference across all three groups)	Insufficient data to calculate	<b>Groups differed in SF-36 role limitations due to physical problems at 13w.* Groups differed in SF-36 role limitations due to physical problems and social functioning at 26w.*</b> NSD between groups on other components of the SF-36 at 13 and 26w.
			CG	30	24	5.0 (0.8)	0.33 (-0.22, 0.75)†			
		26w	IG2	30	24	4.9 (0.8)	0.57 (0.07, 1.10)†	0.2 (for difference across all three groups)	Insufficient data to calculate	
			CG	30	22	5.0 (0.8)	0.61 (-0.11, 0.95)†			
Lehrer 2004 <sup>53,59</sup>	None	12w	IG (abdominal breathing with biofeedback)	23	17	NA	NA	NA	NA	
			CG1 (biofeedback)	22	17	NA	NA			
			CG2 (placebo)	24	19	NA	NA			
			CG3 (waitlist)	25	23	NA	NA			
Thomas 2003 <sup>54,61,65</sup>	AQLQ-Juniper, total score, median  (higher=better)	4w	IG (diaphragm breathing)	17	16	4.60 (1.01)	0.60 (0.05, 1.12)†	<b>0.018*</b>	Insufficient data to calculate	
			CG	16	15	4.57 (1.27)	0.09 (-0.25, 0.26)†			
		26w	IG	17	16	4.60 (1.01)	0.79 (-0.09, 1.40)†	0.065	Insufficient data to calculate	
			CG	16	12	4.57 (1.27)	0.03 (-0.33, 0.47)†			

\*Statistically significant change from baseline or between groups (p<0.05)

†Median or median change from baseline (IQR)

Abbreviations: AQLQ: Asthma Quality of Life Questionnaire; CG: control group; CI: confidence interval; IG: intervention group; IQR: inter-quartile range; NA: not applicable; SD: standard deviation; SF: social functioning (e.g., SF-36 Health Survey); w: week(s)

**Evidence Table 4f. Change in pulmonary function: nonhyperventilation reduction breathing techniques versus control**

Study	FEV <sub>1</sub> outcome (unit)	Follow-up	Group	N randomized	Follow-up N	Baseline mean (SD)	Mean change (SD) from baseline	p-value for difference between groups at followup	Standardized Effect Size Hedges' d (95% CI)	Additional pulmonary function outcomes
Cooper 2003 <sup>35</sup>	FEV <sub>1</sub> (L)	26w	IG2 (yoga breathing device)	30	24	2.64 (0.94)	-0.002 (0.14)	0.4 (for difference across all three groups)	-0.02 (-0.60, 0.56)	NSD between groups at 13 and 26w in provocative dose causing a fall of 20 percent in FEV <sub>1</sub> .
			CG	30	22	2.71 (0.89)	0.001 (0.14)			
Lehrer 2004 <sup>53,59</sup>	"Spirometry", specific measures NR	12w	IG (abdominal breathing with biofeedback)	23	17	NR	NR	NSD	NR	NSD from baseline within each group at 12w.
			CG1 (biofeedback)	22	17	NR	NR			
			CG2 (placebo)	24	19	NR	NR			
			CG3 (waitlist)	25	23	NR	NR			
Thomas 2003 <sup>54,61,65</sup>	None	26w	IG (diaphragm breathing)	17	16	NA	NA	NA	NA	
			CG	16	12	NA	NA			

Abbreviations: CG: control group; CI: confidence interval; FEV<sub>1</sub>: forced expiratory volume in 1 second; ICS: inhaled corticosteroids; IG: intervention group; NA: not applicable; NR: not reported; NSD: no significant difference; SD: standard deviation; w: week(s)

**Evidence Table 5a. Study characteristics: hyperventilation reduction breathing techniques versus nonhyperventilation reduction breathing techniques**

Study	Country	Group	N randomized	Age (mean)	% Female	SABA use	ICS use	FEV <sub>1</sub> % pred.	Inclusion criteria	Exclusion criteria
Bowler 1998 <sup>33,56,71</sup>	Australia	IG1 (BBT)	19	45.5	43.6	892 mcg /d	1250 mcg /d	74	Aged 12 to 70y, reported a history of asthma (variable difficulty in breathing, wheeze or chest tightness w/ response to beta <sub>2</sub> -agonist), taking substantial doses of asthma medication, using at least 1400mcg of SABA or equivalent doses of nebulised or LABA in the last week of run-in period.	Change in inhaled steroid dose or use of oral steroids within the 4w run-in period, other significant unstable medical conditions, undertaken BBT previously.
		IG2 (abdominal breathing)	20							
Cooper 2003 <sup>35</sup>	UK	IG1 (BBT)	30	44	44.9	2 puffs /d*	657 mcg /d	80	Aged 18 to 70y, non-smoking volunteers with stable asthma, taking an inhaled SABA at least 2 times/w and regular ICS w/ no change in dose in previous 4w, pre-bronchodilator FEV <sub>1</sub> of at least 50 percent predicted and 10 percent increase following 400mcg inhaled salbutamol, a PD <sub>20</sub> of methacholine causing a 20 percent fall in FEV <sub>1</sub> of 10.24 µmol or less, mean daily sx score of one or more during run-in.	No other important illnesses, taking tx other than sodium cromoglycate.
		IG2 (yoga breathing device)	30							
Cowie 2008 <sup>36</sup>	Canada	IG1 (BBT)	65	47.5	76.7	NR	840 mcg /d	81	Aged 18 to 50y, asthma (confirmed by physician's dx and current use of asthma medications or by a current or previous demonstration of reversibility of their FEV <sub>1</sub> w/ beta <sub>2</sub> -agonist of at least 12 percent and no less than 200mL.	Not suffered from an exacerbation of their disease requiring oral corticosteroids and/or a visit to an ED within 2m of their study entry, dx of another respiratory disease including COPD.
		IG2 (physiotherapy)	64							

Study	Country	Group	N randomized	Age (mean)	% Female	SABA use	ICS use	FEV <sub>1</sub> % pred.	Inclusion criteria	Exclusion criteria
Slader 2006 <sup>41</sup>	Australia	IG1 (BBT)	28	NR	56.1	3 puffs /d	NR	80	Aged 15 to 80y, as-needed reliever use $\geq$ 4 times/w use of ICS ( $\geq$ 200mcg/d for $\geq$ 3m w/ no dose change during previous 4w), current non-smoker, FEV <sub>1</sub> $\geq$ 50 percent, < 90 percent predicted or FEV <sub>1</sub> /FVC < 70 percent, reversibility $\geq$ 200mL to bronchodilator w/in previous 6m, daily access to TV/VCR.	Current smoker, > 10 pack year smoking history, recently unstable asthma (defined as requiring urgent care or night waking more than 1 time/w), asthma exacerbation or respiratory infection in previous 4w, oral corticosteroids in previous 4w, current or planned pregnancy, substantial limitation of shoulders or thoracic spine, complete nasal obstruction, prior tuition in BBT, use of long-acting beta <sub>2</sub> -agonists.
		IG2 (diaphragm breathing)	29							

\*Median puffs/d, typical dose per puff = 100 mcg

Abbreviations: BBT: Buteyko breathing technique; COPD: chronic obstructive pulmonary disease; d: day(s); dx: diagnosis; ED: emergency department; FEV<sub>1</sub>: forced expiratory volume in 1 second; FVC: forced vital capacity; ICS: inhaled corticosteroids; IG: intervention group; LABA: long-acting beta<sub>2</sub>-agonists; m: month(s); mcg: microgram(s); mL: milliliter(s); PD<sub>20</sub>: provocative dose causing a decrease in FEV<sub>1</sub> of 20 percent; pred: predicted; SABA: short-acting beta<sub>2</sub>-agonists; sx: symptoms; TV: television; tx: treatment; UK: United Kingdom;  $\mu$ mol: micromole(s); VCR: video cassette recorder; w: week(s); y: year(s)

**Evidence Table 5b. Description of intervention groups: hyperventilation reduction breathing techniques versus nonhyperventilation reduction breathing techniques**

Study	Intervention group	Description	Intervention session	Homework	Additional components
Bowler 1998 <sup>33,56,71</sup>	IG1 (BBT)	BBT training consisted of the teaching of a series of exercises in which subjects reduced the depth and frequency of respiration. Instructor (a representative of Buteyko Australia) provided F/U calls as necessary (mean 7, range 0 to 20). Pts experiencing difficulty w/ BBT given additional classes (7 subjects).	Seven or more 60 to 90-min session over 7 days, F/U calls as needed (range 0-20), duration NR.  (7 to 10.5 or more hours face-to-face)	Encouraged to practice several times a day.	NR
	IG2 (abdominal breathing)	Given general asthma education and relaxation techniques; taught abdominal breathing exercises that did not involve hypoventilation. Instructor provided one F/U call to each pt.	Seven 60-90-min session over 7 days, one F/U call per person, duration NR.  (7 to 10.5 hours face-to-face).	NR	NR
Cooper 2003 <sup>35</sup>	IG1 (BBT)	Eucapnic BBT as taught by a certified Buteyko practitioner. Pts taught to reduce fx and depth of breathing, use the technique bid to relieve asthma sx (used 420 times over 6m) and use bronchodilator if BBT failed, nocturnal mouth-taping with Micropore hypoallergenic tape. F/U call provided 2w after training and open communication with trainer available. Avoid certain foods (e.g., highly processed food and additives), avoid stress, avoid oversleeping.	Five 2-hour sessions, over weekends or successive evenings.  (10 hours total).	Home exercises with an audiotape or CD with technique reminders.	Also included dietary restrictions, stress management and instruction to avoid oversleeping.
	IG2 (yoga breathing device)	Pink City Lung exerciser (yoga breathing device) imposed a 1:2 ratio on the duration of inspiration compared with expiration. Device set at largest aperture, pts asked to breathe at rate which they felt no resistance and could feel no chest movement. Over time decrease aperture size to gradually reduce respiratory rate. Use beta <sub>2</sub> -agonist only for sx relief. PCLE used bid (420 times over 6m).	One session, 6m practice.  (Hours NR)	Use PCLE bid.	NR

Study	Intervention group	Description	Intervention session	Homework	Additional components
Cowie 2008 <sup>36</sup>	IG1 (BBT)	Received BBT instruction by an accredited Buteyko practitioner in the early evening for 5 consecutive days. Pts instructed in techniques designed to reduce (normalize) their ventilation including holding their breathing at FRC and avoid breathing through the mouth (e.g., mouth-taping at night).	Five sessions over 5 days.  (Hours NR)	Encouraged to practice training repeatedly throughout the day.	NR
	IG2 (physiotherapy)	Received breathing instruction in early evening on 5 consecutive days from a registered physiotherapist. Pts instructed to developed slow, controlled exhalation, down into FRC toward their residual volume, pace breathing.	Five sessions over 5 days.  (Hours NR)	NR	NR
Slader 2006 <sup>41</sup>	IG1 (BBT)	BBT components: hypoventilation, breathing hold at functional residual capacity; accompanied by footage of scenery. Pts provided an instruction and daily exercises videos required to watch at least once daily while practicing breathing exercises bid. Unblinded researcher contacted pts biweekly to review essentials, answer questions and clarify concerns; offered in-person tuition. Practice shorter version as needed for relief, use reliever if sx persist.	420 13-min sessions, six F/U calls with study staff over 30w.  (90 hours practice with video if fully compliant)	NR	NR
	IG2 (controlled breathing)	Components: shoulder rotations, forward curls, arm raises w/ controlled inspiratory-expiratory cycles; "control of breathing" through good posture and relaxation; route of breathing not specified w/ both mouth and nasal breathing demonstrated. Pts provided an instruction and daily exercises videos required to watch at least once daily while practicing breathing exercises bid. Unblinded researcher contacted pts biweekly to review essentials, answer questions and clarify concerns; offered in-person tuition. Practice "control of breathing" exercises (physical maneuvers optional) as needed for relief, use reliever if sx persist.	420 13-min sessions, six F/U calls with study staff over 30w.  (90 hours practice with video if fully compliant)	NR	NR

Abbreviations: BBT: Buteyko breathing technique; bid: twice daily; CD: compact disc; FRC: functional residual capacity; F/U: followup; fx: frequency; min: minute(s); m: month(s); NR: not reported; PCLE: Pink City Lung exerciser; pts: patients; sx: symptoms; w/: with; w: weeks.

**Evidence Table 5c. Change in asthma symptoms: hyperventilation reduction breathing techniques versus nonhyperventilation reduction breathing techniques**

Study	Symptom outcome (unit)	Follow-up	Group	N randomized	Follow-up N	Baseline mean (SD)	Mean change (SD) from baseline	p-value for difference between groups at followup	Standardized Effect Size Hedges' d (95% CI) (coded lower=better)	Additional asthma symptom outcomes
Bowler 1998 <sup>33,56,71</sup>	None	13w	IG1 (BBT)	19	18	NA	NA	NA	NA	NSD in number of participants in each group with exacerbations requiring hospitalization or short course of prednisone at 8m.
			IG2 (abdominal breathing)	20	19	NA	NA			
Cooper 2003 <sup>35</sup>	Mini-Juniper AQLQ, symptoms subscale  (higher=better)	13w	IG1 (BBT)	30	26	5.0 (1.0)	0.42 (-0.17,1.6)†	0.6 (for difference between all three groups)	Insufficient data to calculate	<b>Three groups differed across median daily symptom scores at 26w, p=0.003.*</b> NSD between groups in the number of exacerbations at 26w.
			IG2 (yoga breathing device)	30	25	5.0 (0.8)	0.50 (-0.38,1.21)†			
		26w	IG1	30	23	5.0 (1.0)	1.08 (0.08,1.92)†	0.2 (for difference across all three groups)	Insufficient data to calculate	
			IG2	30	24	5.0 (0.8)	0.58 (0, 1.21)†			
Cowie 2008 <sup>36</sup>	Controlled asthma (number of participants)	26w	IG1 (BBT)	65	56	26 (40%)‡	44 (68%)‡	0.40	NA	
			IG2 (physiotherapy)	64	63	28 (64%)‡	45 (70%)‡			
Slader 2006 <sup>41</sup>	ACQ, total score  (lower=better)	12w	IG1 (BBT)	28	28	1.46 (0.61)	-0.12 (0.46)	0.23	0.33 (-0.24, 0.90)	Almost no group differences on daytime symptom intensity, nighttime
			IG2 (controlled breathing)	29	29	1.37 (0.55)	<b>-0.28 (0.45)*</b>			
		28w	IG1	28	23	1.46 (0.61)	<b>-0.38 (0.42)*</b>	0.47	-0.14	

Study	Symptom outcome (unit)	Follow-up	Group	N randomized	Follow-up N	Baseline mean (SD)	Mean change (SD) from baseline	p-value for difference between groups at followup	Standardized Effect Size Hedges' d (95% CI) (coded lower=better)	Additional asthma symptom outcomes
			IG2	29	25	1.37 (0.55)	<b>-0.32 (0.42)*</b>		(-0.71, 0.43)	symptom intensity, patient and clinician global rating of asthma control, and symptom free days at 12 and 28w. Both groups improved on ACQ and physician global assessment over time; IG2 improved over time on daytime and nighttime symptoms while IG1 did not.

\*Statistically significant change from baseline or between groups (p<0.05)

†Median or median change from baseline (IQR)

‡Number of participants (%) reporting controlled asthma at followup

Abbreviations: ACQ: Asthma Control Questionnaire; AQLQ: Asthma Quality of Life Questionnaire; BBT: Buteyko breathing technique; CG: control group; CI: confidence interval; IG: intervention group; IQR: inter-quartile range; NA: not applicable; NSD: no significant difference; SD: standard deviation; w: week(s)

**Evidence Table 5d. Change in asthma medication use: hyperventilation reduction breathing techniques versus nonhyperventilation reduction breathing techniques**

Study	Reliever medication outcome (unit)	Follow-up	Group	N randomized	Follow-up N	Baseline mean (SD)	Mean change (SD) from baseline	p-value for difference between groups at followup	Standardized Effect Size Hedges' d (95% CI)	Controller and additional medication outcomes
Bowler 1998 <sup>33,56,71</sup>	Daily adjusted beta <sub>2</sub> -agonist dose, median (mcg)	13w	IG1 (BBT)	19	18	943 (NR)†	-904 (NR)†	<b>0.002*</b>	Insufficient data to calculate	NSD between groups and little change in either group in absolute median daily inhaled steroid doses 13w; no group differences in prednisone use at 8m.
			IG2 (abdominal breathing)	20	19	843 (NR)†	-57 (NR)†			
Cooper 2003 <sup>35</sup>	Beta <sub>2</sub> -agonist use, median (puffs/d)	26w	IG1 (BBT)	30	23	2 (0, 4)†	-2 (-4, 0)†	<b>0.005 (for difference across all three groups)*</b>	Insufficient data to calculate	NSD between all three groups and little change in any group in median number of days taking increased ICS dose or median number of prednisolone courses per subject at 26w. percent reduction in inhaled steroids (n=39).
			IG2 (yoga breathing device)	30	24	2 (0, 4)†	0 (-2, 0)†			
Cowie 2008 <sup>36</sup>	None	26w	IG1 (BBT)	65	56	NA	NA	NA	NA	<b>IG1 showed greater reduction in ICS use (p=0.02), and greater likelihood of discontinuing LABA (p=0.005).*</b>
			IG2 (physiotherapy)	64	63	NA	NA			
Slader 2006 <sup>41</sup>	Reliever use (puffs/d)	12w	IG1 (BBT)	28	28	2.9 (2.2)	<b>-1.4 (1.3)*</b>	0.17	0.36 (-0.16, 0.89)	Similar pattern of results for number of reliever free days and ICS use: both
			IG2 (controlled breathing)	29	29	3.1 (2.3)	<b>-1.9 (1.4)*</b>			
		28w	IG1	28	23	2.9 (2.2)	<b>-1.8 (1.3)*</b>	0.99	-0.02	

Study	Reliever medication outcome (unit)	Follow-up	Group	N randomized	Follow-up N	Baseline mean (SD)	Mean change (SD) from baseline	p-value for difference between groups at followup	Standardized Effect Size Hedges' d (95% CI)	Controller and additional medication outcomes
			IG2	29	25	3.1 (2.3)	-1.8 (1.5)*		(-0.59, 0.55)	group improve, no group differences at 12 or 28w. ICS use reduced by 50 percent in both groups at 28w.

\*Statistically significant change from baseline or between groups (p<0.05)

†Median or median change from baseline (IQR)

‡Number of participants (%)

Abbreviations: BBT: Buteyko breathing technique; CG: control group; d: day(s); CI: confidence interval; ICS: inhaled corticosteroids; IG: intervention group; IQR: inter-quartile range; LABA: long-acting beta<sub>2</sub>-agonist; mcg: microgram(s); NA: not applicable; NR: not reported; SD: standard deviation; w: week(s)

**Evidence Table 5e. Change in quality of life: hyperventilation reduction breathing techniques versus nonhyperventilation reduction breathing techniques**

Study	Quality of life outcomes	Follow-up	Group	N randomized	Follow-up N	Baseline mean (SD)	Mean change (SD) from baseline	p-value for difference between groups at followup	Standardized Effect Size Hedges' d (95% CI) (coded higher= better)	Functioning or additional quality of life outcomes
Bowler 1998 <sup>33,56,71</sup>	AQLQ-Marks, median (lower= better)	13w	IG1 (BBT)	19	18	3.0 (NR)	-1.2 (NR)†	0.09	Insufficient data to calculate	
			IG2 (abdom. breathing)	20	19	3.0 (NR)	-0.4 (NR)†			
Cooper 2003 <sup>35</sup>	AQLQ-Juniper, total score (higher= better)	13w	IG1 (BBT)	30	26	5.1 (1.0)	0.45 (0.11, 1.47)†	0.4 (for difference across all three groups)	Insufficient data to calculate	<b>BBT improved more in SF-36 role limitations due to physical problems at 13w.* BBT improved more in SF-36 role limitations due to physical problems and social functioning at 26w.*</b> NSD between groups on other components of the SF-36 at 13 and 26w.
			IG2 (yoga breathing device)	30	25	4.9 (0.8)	0.45 (-0.13, 1.11)†			
		26w	IG1	30	23	5.1 (1.0)	1.03 (0.19, 1.69)†	0.2 (for difference across all three groups)	Insufficient data to calculate	
			IG2	30	24	4.9 (0.8)	0.57 (0.07, 1.10)†			
Cowie 2008 <sup>36</sup>	Mini-AQLQ, total score (higher= better)	26w	IG1 (BBT)	65	56	4.6 (NR)	<b>0.96 (1.04)*</b>	1.0	Insufficient data to calculate	
			IG2 (physiotherapy)	64	63	4.7 (NR)	<b>0.95 (1.15)*</b>			
Slader 2006 <sup>41</sup>	AQLQ-Marks, total score (lower= better)	12w	IG1 (BBT)	28	25	0.77 (0.50)	0.03 (0.42)	0.29	-0.14 (-0.68, 0.41)	
			IG2 (controlled breathing)	29	27	0.54 (0.30)	-0.02 (0.30)			
		28w	IG1	28	23	0.77 (0.50)	-0.17 (0.32)	0.27	0.23 (-0.34, 0.80)	
			IG2	29	25	0.54 (0.30)	-0.1 (0.28)			

\*Statistically significant change from baseline or between groups (p<0.05)

†Median or median change from baseline (IQR)

Abbreviations: abdom: abdominal; AQLQ: Asthma Quality of Life Questionnaire; BBT: Buteyko breathing technique; CG: control group; CI: confidence interval; IG: intervention group; IQR: inter-quartile range; NR: not reported; NSD: no significant difference; SD: standard deviation; SF: social functioning (e.g., SF-36 Health Survey); w: week(s)

**Evidence Table 5f. Change in pulmonary function: hyperventilation reduction breathing techniques versus nonhyperventilation reduction breathing techniques**

Study	FEV <sub>1</sub> outcome (unit)	Follow-up	Group	N randomized	Follow-up N	Baseline mean (SD)	Mean change (SD) from baseline	p-value for difference between groups at followup	Standardized Effect Size Hedges' d (95% CI)	Additional pulmonary function outcomes
Bowler 1998 <sup>33,56,71</sup>	FEV <sub>1</sub> , predicted (%)	13w	IG1 (BBT)	19	18	75 (17)	-3 (13.21)	0.40	-0.16 (-0.80, 0.49)	Groups differed in minute volume at 13w, p=0.004. * NSD between groups at 13w in end-tidal CO <sub>2</sub> and pre-bronchodilator PEF (morning).
			IG2 (abdominal breathing)	20	19	73 (19)	-1 (11.4)			
Cooper 2003 <sup>35</sup>	FEV <sub>1</sub> (L)	26w	IG1 (BBT)	30	25	2.58 (0.76)	0.06 (0.26)	0.4 (for difference across all three groups)	0.29 (-0.28, 0.87)	NSD between group at 12 and 26w in provocative dose causing a fall of 20 percent in FEV <sub>1</sub> .
			IG2 (yoga breathing device)	30	24	2.64 (0.94)	-0.002 (0.14)			
Cowie 2008 <sup>36</sup>	FEV <sub>1</sub> , predicted (%)	26w	IG1 (BBT)	65	56	83 (19.2)	-0.05 (0.47)	0.60	-0.09 (-0.45, 0.27)	
			IG2 (physiotherapy)	64	63	79 (21.6)	-0.01 (0.37)			
Slader 2006 <sup>41</sup>	FEV <sub>1</sub> , predicted (%)	12w	IG1 (BBT)	28	28	80.8 (16.1)	-1.1 (10.5)	0.30	0.17 (-0.35, 0.69)	NSD between groups at 12 or 28w in predicted FVC, end-tidal CO <sub>2</sub> , and mannitol responsiveness.
			IG2 (controlled breathing)	29	29	78.9 (17.0)	<b>-3.0 (11.8)*</b>			
		28w	IG1	28	23	80.8 (16.1)	-2.0 (10.6)	0.23	0.11 (-0.46, 0.67)	
			IG2	29	25	78.9 (17.0)	-3.2 (10.9)			

\*Statistically significant change from baseline or between groups (p<0.05)

Abbreviations: BBT: Buteyko breathing technique; CI: confidence interval; CO<sub>2</sub>: carbon dioxide; FEV<sub>1</sub>: forced expiratory volume in 1 second; FVC forced vital capacity; IG: intervention group; L: liter(s); NSD: no significant difference; PEF: peak expiratory flow; SD: standard deviation; w: week(s)

## Appendix D: List of Excluded Studies

1. Abramson M, Borg B, Doran C, et al. A randomised controlled trial of the Buteyko method for asthma. *Int J Immunorehabil* 2004;6(2):244. PMID: 11059522. **Abstract only, insufficient data to evaluate inclusion.**
2. Agent P. Breathing training improves subjective health status but not pathophysiology in asthmatic adults. *Journal of Physiotherapy* 2010;56(1):60. PMID: 20500141. **Synopsis of a potentially relevant study.**
3. Anokhin MI, Sergeev VN, Domanskii VL. Biological feedback correction of respiration during treatment of bronchial asthma. *Biomed Eng (NY)* 1996;30(1):26-29. PMID: None. **Other quality issues.**
4. Anonymous. Breathing exercises help cut asthma symptoms. *Practice Nurse* 2007 Jul 13;34(1):8. PMID: None. **Synopsis of a potentially relevant study.**
5. Anonymous. Breathing training leads to improved asthma-specific health status. *AJP* 2010;91(1076):62-63. PMID: None. **Unable to obtain, unlikely a trial.**
6. Anonymous. Inconclusive study of yoga as an adjunct therapy for asthma. 5th Annual Symposium Complementary Health Care; Exeter. 1998. p. 164. PMID: None. **Synopsis of a potentially relevant study.**
7. Anonymous. Randomised controlled trial of treating dysfunctional breathing to reduce breathlessness in severe asthma. *Curr Control Trials*. 2011. PMID: None. **Ongoing trial, no outcomes at time of review.**
8. Asher MI, Douglas C, Airy M, et al. Effects of chest physical therapy on lung function in children recovering from acute severe asthma. *Pediatr Pulmonol* 1990;9(3):146-51. PMID: 2277735. **Management of serious acute exacerbations.**
9. Austin G, Brown C, Watson T, et al. Buteyko breathing technique improves exercise capacity and control of breathing in uncontrolled asthma. European Respiratory Society Annual Congress; Vienna, Austria. 2009. p. E4306. PMID: None. **Not a study of breathing techniques.**
10. Austin G, Brown C, Watson T, et al. Buteyko breathing technique reduces hyperventilation-induced hypocapnea and dyspnoea after exercise in asthma. American Thoracic Society International Conference; San Diego, CA. 2009. p. A3409. PMID: None. **Not a study of breathing techniques.**
11. Beth Israel Medical Center. Integrative medicine approach to the management of asthma in adults. *clinicaltrials.gov* 2011;NCT00843544 PMID: None. **Ongoing trial, no outcomes at time of review.**
12. Bhikshapathi DVRN, Jayanthi C, Kishan V, et al. Influence of yogasanas on the physiology, therapy and theophylline pharmacokinetics in bronchial asthma patients. *Acta Pharm Sci* 2007;49(2):187-94. PMID: None. **Unable to obtain, no further information.**
13. Bingol Karakoc G, Yilmaz M, Sur S, et al. The effects of daily pulmonary rehabilitation program at home on childhood asthma. *Allergol Immunopathol (Madr)* 2000 Jan;28(1):12-14. PMID: 10757852. **Other quality issues.**
14. Birch M. Asthma and the Buteyko breathing method. *Aust Nurs J* 2001 Mar;8(8):35. PMID: 11894574. **Synopsis of a potentially relevant study.**
15. Birkel DA, Edgren L. Hatha yoga: improved vital capacity of college students. *Althern Ther Health Med* 2000 Nov;6(6):55-63. PMID: 11076447. **Not one of specified study designs.**
16. Bowler SD, Green A, Mitchell CA. Positive evidence of the effectiveness of Buteyko breathing techniques in asthma. *Focus Alt Comp Ther* 1999;4:207-08. PMID: None. **Synopsis of a potentially relevant study.**

17. Bruton A. Breathing and relaxation training improves respiratory symptoms and quality of life in asthmatic adults. *Aust J Physiother* 2008;54(1):76. PMID: 18298365. **Synopsis of a potentially relevant study.**
18. Carvalho LC, Albuquerque HF, Pontes C, et al. Computerized Biofeedback Tool: Application in Electromyogram-Biofeedback. A New Beginning for Human Health. Annual International Conference of the IEEE Engineering in Medicine and Biology; 2003 Sep 17; Cancun, Mexico. 2003. p. 1609-12. PMID: None. **Not one of specified study designs.**
19. Chiang LC, Ma WF, Huang JL, et al. Effect of relaxation-breathing training on anxiety and asthma signs/symptoms of children with moderate-to-severe asthma: a randomized controlled trial. *Int J Nurs Stud* 2009 Aug;46(8):1061-70. PMID: 19246041. **Not a study of breathing techniques.**
20. Cooper SE, Osborne J, Newton S, et al. The effect of two breathing exercises (Buteyko and Pranayama) on the ability to reduce inhaled corticosteroids in asthma: a randomised controlled trial. *American Thoracic Society 99th International Conference 2003:B023*. PMID: None. **Unable to obtain, likely from another reviewed study.**
21. Cowie RL, Conley DP, Underwood MF, et al. A randomized controlled trial of buteyko technique for asthma management. *Proceedings of the American Thoracic Society. American Thoracic Society International Conference; 2006 May 19; San Diego, CA. 2006. p. A530*. PMID: None. **Unable to obtain, likely from another reviewed study.**
22. Dahl J, Gustafsson D, Melin L. Effects of a behavioral treatment program on children with asthma. *J Asthma* 1990;27(1):41-46. PMID: 1968453. **Not one of specified interventions.**
23. Foglio K, Bianchi L, Bruletti G, et al. Long-term effectiveness of pulmonary rehabilitation in patients with chronic airway obstruction. *Eur Respir J* 1999 Jan;13(1):125-32. PMID: 10836336. **Not a study of breathing techniques.**
24. Girodo M, Ekstrand KA, Metivier GJ. Deep diaphragmatic breathing: rehabilitation exercises for the asthmatic patient. *Arch Phys Med Rehabil* 1992 Aug;73(8):717-20. PMID: 1642520. **High or differential attrition.**
25. Goncalves RC, Nunes MPT, Cukier A, et al. Comparison between breathing exercises and aerobic conditioning on symptoms, quality of life and exhaled nitric oxide in asthmatic adults. *Eur Respir J* 2006;28:370s. PMID: None. **Not one of specified comparators.**
26. Huntley AL, Marks GB. Sahaja yoga has limited effects in the management of asthma. *Focus Alt Comp Ther* 2002 Sep;7(3):275-76. PMID: None. **Only comparator includes relaxation training.**
27. Kuiper D. Dysfunctional breathing and asthma. Trial shows benefits of Buteyko breathing techniques. *BMJ* 2001 Sep 15;323(7313):631-32. PMID: 11575317. **Synopsis of a potentially relevant study.**
28. Lehrer P, Hochron S, Carr R, et al. Biofeedback for increasing respiratory sinus arrhythmia as a treatment for asthma. *30th Annual Convention of the Association for the Advancement of Behavior Therapy; 1996 Nov 21; New York. New York: Association for the Advancement of Behavior Therapy; 1996*. PMID: None. **Not a study of breathing techniques.**
29. Lewis S, Cruft S, Egbagbe E, et al. A controlled trial of the effect of a breathing exercise device in asthma. *Eur Respir J Suppl* 1996;9:337s. PMID: None. **Synopsis of a potentially relevant study.**
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