Comparative Effectiveness Review
Number 71

Effective Health Care Program

Breathing Exercises and/or Retraining Techniques in the Treatment of Asthma: Comparative Effectiveness

Executive Summary

Background

In 2009, an estimated 8.2 percent of Americans (9.6 percent of children and 7.7 percent of adults) had asthma, and the prevalence of asthma has increased substantially in recent years.[1,2] In 2007, asthma accounted for 456,000 hospitalizations and more than 3,447 deaths.[3]

The goal of asthma treatment is to achieve asthma control, as evidenced by normal or near normal pulmonary function, maintenance of normal activity levels, and minimal need for short-acting $beta_2$-agonist inhalers for "quick relief" of asthma symptoms (≤ twice per week).[4] Persistent asthma treatment includes the use of long-term control medications (most commonly inhaled corticosteroids [ICS]) to reduce airway inflammation and quick-relief medications for acute exacerbations.

While the benefits of asthma treatment generally outweigh the potential risks, these medications can be associated with adverse effects.[5,6] Additionally, some asthma patients have concerns about asthma medications, and some patients would likely prefer to reduce their use of medication if alternative treatments were available.[7,8]

Effective Health Care Program

The Effective Health Care Program was initiated in 2005 to provide valid evidence about the comparative effectiveness of different medical interventions. The object is to help consumers, health care providers, and others in making informed choices among treatment alternatives. Through its Comparative Effectiveness Reviews, the program supports systematic appraisals of existing scientific evidence regarding treatments for high-priority health conditions. It also promotes and generates new scientific evidence by identifying gaps in existing scientific evidence and supporting new research. The program puts special emphasis on translating findings into a variety of useful formats for different stakeholders, including consumers.

The full report and this summary are available at **www.effectivehealthcare.ahrq.gov/reports/final.cfm**.

A number of nonpharmacologic methods for asthma management involve breathing retraining. Some of these, such as the Buteyko and Papworth methods, are

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predicated on the theory that asthma is related to hyperventilation. These treatments seek to reduce hyperventilation by encouraging shallow or slow nasal breathing, breath-holding at the end of expiration, and minimizing sighs and yawns and related breathing patterns that are characterized as "over-breathing."[9] The idea behind these treatments is that hyperventilation leads to a reduction in blood and alveolar carbon dioxide (CO_2), to which the airways respond by constricting to prevent further loss of CO_2. The evidence supporting the hyperventilation theory of the pathophysiology of asthma is mixed. People with asthma do appear to have lower end-tidal CO_2 levels (i.e., blood levels of CO_2 at the end of exhalation) than those without asthma.[10] A reduction in end-tidal CO_2 levels has been shown to increase airway resistance in people with asthma and a history of bronchial hyperresponsiveness to histamine, but not in matched controls without asthma.[11] Further, airway resistance decreases when hypercapnia (high level of CO_2 in the blood) is induced.[11] Another study, however, found that longer breath-holding time was associated with a reduction in end-tidal CO_2, which is counter to Buteyko's theory.[12]

Nonhyperventilation-targeted methods include yoga breathing techniques and other physical therapy methods. Treatment based on yoga theory generally encourages slowing and regularizing the breath by prolonging the expiratory phase, enhancing abdominal/diaphragmatic breathing, and imposing resistance on both inspiration and exhalation.[13] Other physical therapy methods may use elements consistent with these traditions to reduce the rate of breathing, or in other ways control the depth, flow, or timing of breathing. Physical therapists may also prescribe exercises that increase inspiratory and expiratory muscle strength. Devices such as breathing trainers or biofeedback may aid this training.

Twenty-seven percent of children with asthma report using complementary and alternative medicine approaches to manage their asthma, and this approach was usually a breathing technique of some kind.[14] The specific techniques used are unknown, however, and it appears the breathing exercises are not guided by a practitioner in most cases.

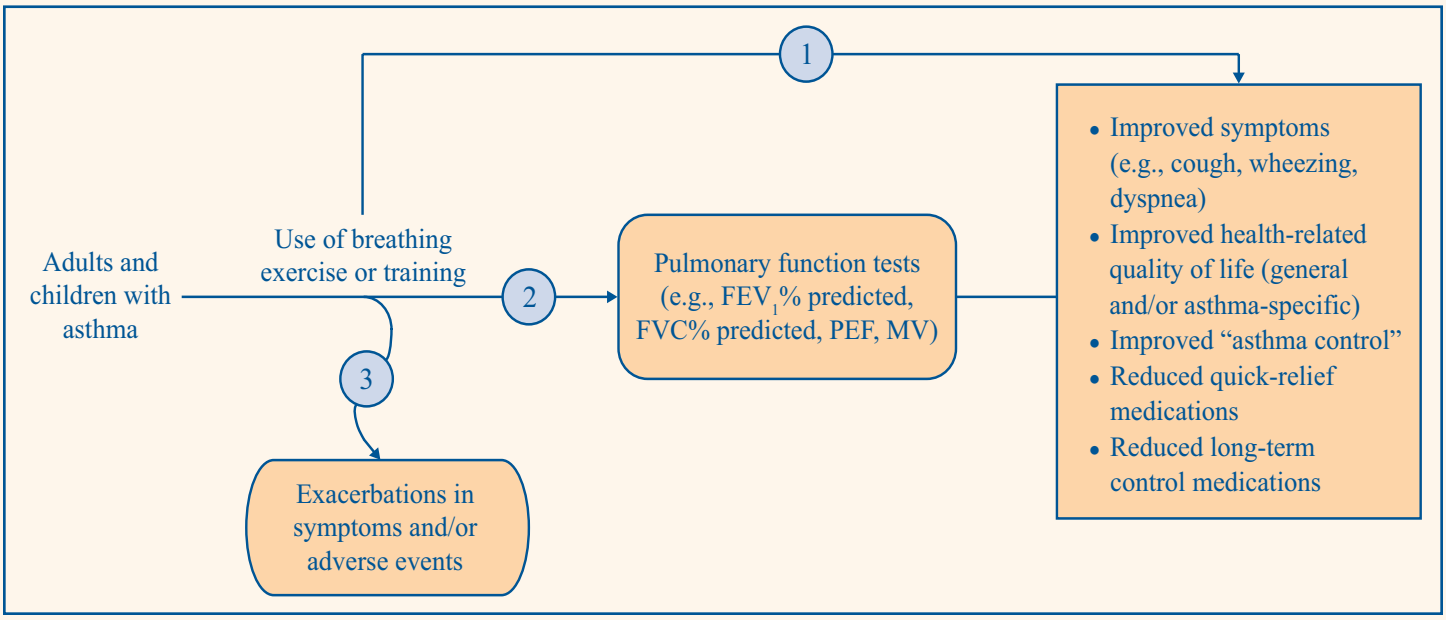
Objectives

The current review examines the effect of breathing retraining methods on asthma symptomatology, medication use, quality of life, and pulmonary function in both adults and children. We also examine adverse effects of these techniques. The analytic framework we developed to guide our review is shown in Figure A. The Key Questions for this review are as follows:

1. In adults and children 5 years of age and older with asthma, does the use of breathing exercises and/or retraining techniques* improve health outcomes, including symptoms (e.g., cough, wheezing, dyspnea); health-related quality of life (general and/or asthma-specific); acute asthma exacerbations; and reduced use of quick-relief medications or reduced use of long-term control medications, when compared with usual care and/or other breathing techniques alone or in combination with other intervention strategies?
    a. Does the efficacy and/or effectiveness of breathing techniques for asthma health outcomes differ between different subgroups (e.g., adults/children; males/females; different races or ethnicities; smokers/nonsmokers; various types and severities of asthma; and/or different coexisting conditions)?
    b. Does the efficacy and/or effectiveness of breathing techniques for asthma health outcomes differ according to variations in implementation (e.g., trainer experience) and/or nonbreathing components of the intervention (e.g., anxiety management)?
2. In adults and children 5 years of age and older with asthma, does the use of breathing exercises and/or retraining techniques improve pulmonary function or other similar intermediate outcomes when compared with usual care and/or other breathing techniques alone or in combination with other intervention strategies?
    a. Does the efficacy and/or effectiveness of breathing techniques for other asthma outcomes differ between different subgroups (e.g., adults/children; males/females; different races or ethnicities; smokers/nonsmokers; various types and severities of asthma; and/or different coexisting conditions)?
    b. Does the efficacy and/or effectiveness of breathing techniques for other asthma outcomes differ according to variations in implementation (e.g., trainer experience) and/or nonbreathing components of the intervention (e.g., anxiety management)?

*For example: the Buteyko breathing technique; inspiratory muscle training; breathing physical therapy, including paced and pursed lip breathing exercises; the Papworth method; biofeedback- and technology-assisted breathing retraining; and yoga breathing exercises.

Figure A. Analytic framework



FEV_1 = forced expiratory volume in 1 second; FVC = forced vital capacity; MV = minute volume; PEF = peak expiratory flow

3. What is the nature and frequency of serious adverse effects of treatment with breathing exercises and/or retraining techniques, including increased frequency of acute asthma exacerbations?

    a. Do the safety or adverse effects of treatment with breathing techniques differ between different subgroups (e.g., adults/children; males/females; different races or ethnicities; smokers/nonsmokers; various types and severities of asthma; and/or different coexisting conditions)?

Methods

The Oregon Evidence-based Practice Center drafted a topic refinement document with proposed Key Questions after consulting with key informants. The public was invited to comment on the Key Questions during a 4-week period. After reviewing the public commentary, the Agency for Healthcare Research and Quality approved the final Key Questions and the review commenced.

We engaged a technical expert panel (TEP) that included five individuals who specialized in asthma management from the fields of Family Medicine, Community Health and Nursing, Psychology, Physical Therapy, and Pediatrics to provide input during the project. The TEP was established to ensure the scientific rigor, reliability, and methodological soundness of the research. The TEP provided comments on the methods protocol and provided input on substantive issues such as typical use of asthma medication, clinical value of outcomes, and clinical importance of effect sizes.

A research librarian performed comprehensive literature searches in MEDLINEPsycInfo; Embase; Cumulative Index to Nursing and Allied Health Literature (CINAHL); Physiotherapy Evidence Database (PEDro); Cochrane Central Register of Controlled Trials (CCRCT); AltHealthWatch; Allied and Complementary Medicine (AMED); Manual, Alternative and Natural Therapy Index System (MANTIS); and Indian Medical Journals (IndMED) from 1990 through December 2011. We supplemented these searches with manual searches of reference lists contained in all included articles, in relevant review articles, and on Web sites advocating the use of breathing techniques. The research librarian also performed the grey literature searches.

We included English-language trials of breathing retraining techniques that included participants aged 5 years or older, reported at 4 week post-baseline or later asthma symptoms, asthma medication use, quality of life, functioning, or pulmonary function. Included trials used a control group or comparison with another breathing training technique. For the question of harms, we would also have included large observational studies as well as trials if any were identified. We had no restriction on geographic location and did not include trials that used relaxation techniques as a comparator.

Two independent reviewers assigned ratings of "good," "fair," or "poor" quality to each trial. Discrepancies were resolved by discussion or consultation with the larger review team. Trials given a final rating of "poor" quality were excluded. We used the following major elements to assign quality ratings:

- The presence of adequate randomization methods (use of computer-generated random number tables or other process considered truly random)
- Allocation concealment
- Similarity of groups at baseline
- The specification of eligibility criteria
- Reliable and valid measurement of baseline asthma status (optimal assessment included use of pulmonary function testing to confirm reversible component)
- Retention (retention of 90% or more overall was considered good; 60 to 89% was adequate, and less than 60% was considered a fatal flaw; differential attrition of 10 to 19 percentage points was considered potentially problematic and 20 percentage points or more was considered a fatal flaw)
- Time until followup (6 months or more was preferable, fewer than 6 weeks was potentially problematic)
- Equal, reliable, and valid measurements
- Blinding of outcome assessors
- Appropriate analyses (e.g., analyzing all participants in the treatment group to which they were initially assigned, use of conservative data substitution [preferably multiple imputation, imputation-based random effects regression or similar models, or use of baseline values] when retention was below 90 percent, adjustment for potential confounders, no use of statistical tests that were inappropriate for the type of data analyzed)

Generally, a good-quality study met all major criteria, although it was possible to get a "good" rating if an item was not reported (so could not be assessed) if the rest of the methods were judged to be "good." A fair-quality study did not meet all criteria, but was judged to have no flaw so serious that it invalidated its results. A poor-quality study contained a serious flaw in design, analysis, or execution, such as differential attrition as described above, or some other flaw judged to be so serious as to cast doubt on the validity of the results, such as large baseline group differences that were not or could not be adjusted for in an analysis, no information about followup and assumption of 100 percent followup was not tenable, or where insufficient information was provided to determine the risk of bias.

We abstracted data from all included studies with a quality rating of "fair" or "good" into a standard evidence table. One reviewer abstracted data, and a second reviewer checked these data. Authors were contacted to clarify methods and results, if needed. Discrepancies were resolved by discussion or consultation with other team members. Major elements abstracted included study location; study design; recruitment setting and approach; inclusion/exclusion criteria; demographic and health characteristics of the sample, including baseline asthma; description of the intervention and control arms; any cointervention components (e.g., advice about diet, relaxation training); compliance with treatment; sample retention; asthma outcomes, including symptoms, quality of life, medication use, and pulmonary function tests; and adverse events. To assess applicability, we used data abstracted on the population studied, the intervention and comparator, the outcomes measured, settings, and timing of assessments to identify specific issues that may limit the applicability of individual studies or the body of evidence to U.S. health care settings, as recommended in the Methods Guide for Effectiveness and Comparative Effectiveness Reviews.[15]

We summarized all included studies in narrative form as well as in summary tables that present the important features of the study populations, design, intervention, outcomes, and results. We divided comparisons into five groups based on the primary intervention focus and control group: (1) interventions focused on hyperventilation reduction breathing training versus control, (2) hyperventilation reduction versus nonhyperventilation reduction breathing training approaches, (3) yoga breathing methods versus control, (4) inspiratory muscle training (IMT) versus control, and (5) breathing approaches that did not focus on hyperventilation reduction versus control. We discuss outcomes separately for each of the five groups. We calculated a standardized effect size (Hedges g) to facilitate comparison of effect sizes across studies reporting different outcomes. Effect sizes larger than 0.80 were considered large effects.[16] We also used previously reported thresholds for clinically significant change in health status for commonly used questionnaires.[17] A change of 0.05 has been suggested for the Juniper Asthma Quality of Life Questionnaires.[18,19] For the St. George's Respiratory Questionnaire (SGRQ), the threshold for clinical significance is estimated to be four units, and patients whose treatment was judged to

have been "very effective" showed an average change of 8.1 units.[17]

Random effects meta-analyses were conducted where there were at least three trials within a group. Meta-analyses were always conducted within groups because of the high degree of clinical and methodological heterogeneity across groups. We used Stata 11.2® for all effect size calculations and meta-analyses (Stata Corp., College Station, TX).

We graded the strength of evidence for primary outcomes using the standard process of the Evidence-based Practice Centers,[20] assigning grades in four domains: (1) risk of bias (low, medium, high), (2) consistency (consistent [no inconsistency present], inconsistent, unknown or not applicable), (3) directness (direct, indirect), and (4) precision (precise, imprecise). Risk of bias is the degree to which the included studies for a given outcome or comparison have a high likelihood of adequate protection against bias. Consistency refers to the degree to which reported effect sizes from included studies appear to have the same direction and magnitude of effect. We could not judge consistency when only one study was included. "Directness" relates to whether the evidence links the interventions directly to health outcomes. "Precision" refers to the degree of certainty surrounding an effect estimate with respect to a given outcome. We assigned an overall strength of evidence grade based on the total number of studies reporting an outcome and the ratings for the four domains for each key outcome. For each comparison, we used four basic grades (as described in the AHRQ Methods Guide): high, moderate, low, and insufficient.[20] We rated the evidence as insufficient when no studies were available for an outcome or comparison of interest, or the evidence was limited to small trials that were methodologically flawed and/or highly heterogeneous.

A full draft report was reviewed by experts and posted for public commentary from November 9, 2011, to December 5, 2011. We received comments, from either invited reviewers or through the public comment website, were compiled and addressed. A disposition of comments will be posted on the Effective Healthcare Program Web site 3 months after the release of the evidence report.

Results

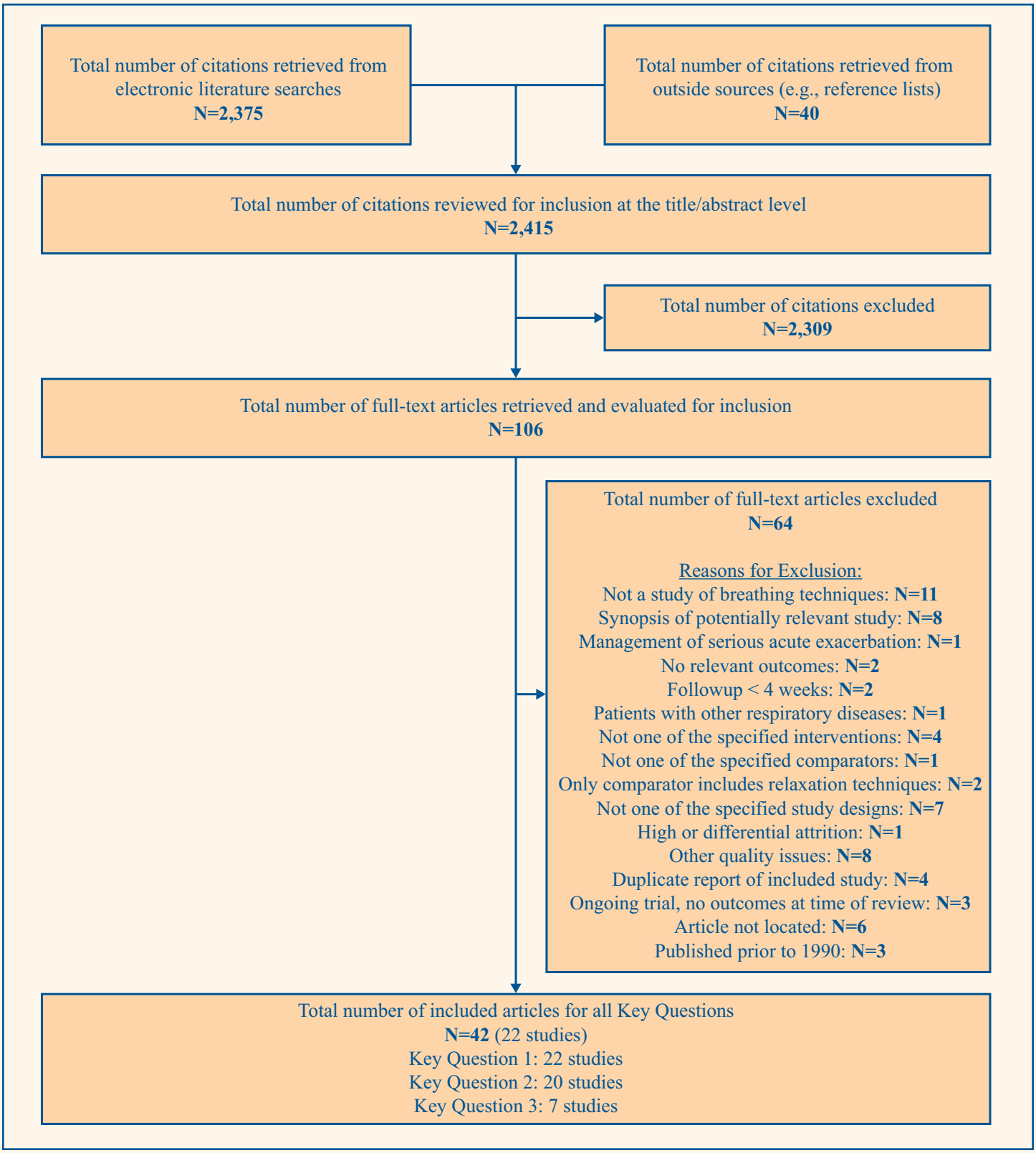
The literature search yielded 2,415 citations. After reviewing abstracts, 106 articles were retained for possible inclusions and full text of the articles was examined (Figure B). After the screening of the full-text articles, 22 studies were judged to have met the inclusion criteria (published in 42 articles).[21-42] All included studies were randomized controlled trials (RCTs) except one, which was a randomized crossover trial.[22] We excluded the remaining 64 full-text articles. The primary reasons for exclusion were that a study was not on breathing techniques, a study did not provide primary data, a study did not use one of the specified study designs, and a study was rated as poor quality.

Researchers conducted all trials with individuals with symptomatic, mostly stable asthma. In some trials, researchers limited their population to individuals with a certain level of beta$_2$-agonist use, suggesting their asthma was not well controlled. Most trials confirmed reversibility of respiratory symptoms through pulmonary function testing. Trials primarily included adults; only one trial of IMT targeted children (ages 8 to 12 years)[36] and only four other trials included people younger than 16 years of age.[21,24,27,29]

Allocation was described as concealed in only 32 percent of the trials. Researchers almost always based their data about asthma symptoms, medication use, and quality of life on self-report, and only 41 percent of the trials reported that outcomes assessment were conducted blindly. Lack of blinding may be especially problematic for pulmonary function testing, which is effort-dependent and involves assessors coaching participants to get an optimal performance. Lack of blinding may also be problematic for self-reported outcomes, where social desirability could introduce bias. Most trials were small, with 68 percent including only 30 or fewer participants per treatment arm. Only one trial included more than 100 participants per treatment arm.[27] Trials were also inconsistent in the degree to which they ensured the sample was limited to people with asthma: 42 percent did not report the use of pulmonary function testing to confirm asthma diagnosis, and 39 percent did not describe excluding participants with other respiratory disorders or people at high risk for other respiratory disorders (e.g., smokers).

Outcome reporting was also variable. Researchers used a wide variety of specific measures within each of the general categories of outcomes (asthma symptoms, medication use, quality of life, and lung function testing), and in some trials, they failed to report important outcomes such as asthma symptomatology and reliever medication use, leaving open the possibility of selective reporting of outcomes.

Figure B. Literature flow diagram



Key Question 1

Hyperventilation Reduction Breathing Techniques Versus Control Group

Key Points:

- We found moderate evidence that hyperventilation reduction breathing technique interventions with 5 or more hours of direct instruction may reduce asthma symptoms and reliever medication use in adults, although evidence was limited to a fairly small number of trials, most of which were at moderate risk of bias due to factors such as small sample sizes, high or differential attrition, and lack of appropriate blinding.
- Evidence is low or insufficient that hyperventilation reduction training affects controlled medication use, quality of life, or functioning in adults and children.

Eight trials (n=1,088) tested a hyperventilation reduction technique versus a control and provided moderate evidence that hyperventilation reduction approaches may improve asthma symptoms and reduce reliever medication use, but do not affect pulmonary function (Table A).[22,23,25-28,30,42] Four trials were fairly intensive and involved at least 5 hours of comprehensive instruction and/or guided practice with the breathing technique.[23,25-27] The group included the only large-scale trial in the review,[27] which reported reductions in asthma symptoms and reliever medication use at a 6-month followup, but was hampered by lower retention in the control groups (82% and 73%) than the Buteyko group (90%). Three trials involved less intensive interventions (video-only or one to two hours of direct instruction), but still attempted somewhat comprehensive breathing retraining approaches.[28,30,42] One additional study examined only a single aspect of the Buteyko breathing technique, mouth-taping at night, in a randomized crossover trial.[22]

Aside from the mouth-taping trial, interventions all encouraged nasal breathing and taught to identify and eliminate "overbreathing" or "dysfunctional" breathing using such means as shallow breathing, intermittent end-tidal breath-holding, or slow diaphragmatic breathing. All but one[42] explicitly reported encouraging daily home practice. Two trials included nonbreathing components covering stress management,[23,26] dietary restrictions,[23] and instruction to avoid oversleeping.[23]

All four of the most intensive and comprehensive interventions reported improvements in asthma symptoms at 6 to 12 months of followup.[23,25-27] The lower intensity trials generally did not find improvements in asthma symptoms after 1 to 6 months.[22,28,30,42] The largest trial showed the largest effect, with standardized mean difference (SMD) of -2.58 (95% CI, -2.86 to -2.29). Symptom ratings on a scale of 0 (no symptoms) to 3 (severe symptoms) dropped from an average of 2.2 at baseline for all groups to 0.7 in the Buteyko group, while the control groups slightly increased to 2.4 to 2.5.[27] Two other trials, both with fairly intensive interventions, reported standardized effect sizes greater than 1.2, which would generally be considered large.[25,26] In the trial by Holloway and colleagues, for example, the Papworth intervention group participants showed 18- to 21-point improvements on the 100-point SGRQ symptom subscale, compared with two-point improvements in the control group at 6 and 12 month followup.[26] This change is even greater than the change on the SGRQ seen in patients whose treatment was judged to be "very effective" in other research.[17]

Similarly, three[23,27,28] of the six trials[22,23,27,28,30,42] reporting reliever medication use showed reductions, including both of the higher intensity trials that reported this outcome.[23,27] Reductions were generally of about 1.5 to 2.5 puffs per day. Quality of life results were reported in six trials.[22,23,26,28,30,42] Two of them showed greater improvements with hyperventilation reduction breathing retraining than control groups[28,30] and two showed mixed results (i.e., results differed at different time points or scales within the same study).[26,42] Hyperventilation reduction approaches did not improve pulmonary function in the five trials that reported this outcome (pooled standardized estimate=0.18, 95% CI, 0.00 to 0.37, k=5, I^2=18.4%).[23,25-27,30]

We rated all trials as fair quality. Three of the four lower intensity trials had only 1 month of followup for some or all outcomes,[22,28,30] and only two of the RCTs randomized more than 50 participants per group.[27,30] Two suffered from fairly high attrition,[23,30] and four had greater attrition in the intervention group by at least 10 percentage points at one or more followups.[23,26,30,42] Allocation concealment was reported in only three trials,[25,27,30] and outcomes assessment was clearly blinded in only four trials.[22,23,25,27]

The applicability of these trials to U.S. practice was acceptable. While all trials were conducted in health care settings outside the United States, they were conducted in English-speaking, developed countries that used care guidelines consistent with U.S. treatment guidelines.

Hyperventilation Reduction Breathing Techniques Versus Other Breathing Techniques

Key Points:

- Hyperventilation reduction breathing techniques may be more likely to reduce reliever medication use in adults than other breathing techniques, but strength of evidence is low.
- Hyperventilation reduction training is no more likely to improve symptoms, controller medication use, or quality of life than other breathing techniques in adults, but strength of evidence is low.

Only medication outcomes showed group differences in the four RCTs (n=285) comparing the use of breathing techniques targeting hyperventilation reduction with other breathing techniques, and all favored hyperventilation reduction techniques (Table A).[21,23,24,29] The strength of the evidence was judged to be low. One trial showed very large reductions in reliever medication use among high medication users: participants in the hyperventilation group went from using approximately 9 to 10 puffs of $beta_2$-agonist per day to approximately one puff every other day, compared with less than one puff per day reduction in the abdominal breathing group.[21] No group differences were reported for asthma symptoms or quality of life. One trial showed reductions in asthma symptoms and medication use in both the hyperventilation reduction and the nonhyperventilation reduction breathing retraining.[29] This was the best quality trial included in the review, and the only minor flaws were retention of less than 90 percent and small sample size.

Yoga Breathing Versus Control

Key Points:

- Yoga may improve asthma symptoms and quality of life in adults, but the strength of evidence for yoga is low due to concerns about the methodological quality of the trials.
- Evidence is insufficient to determine whether yoga can reduce asthma medication use in adults and children.

The five trials (n=360) that compared a yoga group with a control group generally showed improvements in asthma symptoms (Table A), but had a low strength of evidence due to methodological limitations of the included trials.[31-35] Four of the five trials reported reductions in asthma symptoms, although data could not be pooled due to lack of necessary data in several cases.[31,32,34,35] The largest effect size appeared to be found in one of the lower quality trials based in India comparing yoga breathing exercises with meditation.[34] This trial reported a 64 percent reduction in symptoms in the intervention group at 12 weeks, compared with a 6 percent reduction in symptoms in the meditation group.

Another trial with a very intensive intervention reported a very large effect size at 2- and 4-week followup, but the effect was attenuated (yet still statistically significant) after 8 weeks.[35] In this trial and the U.S.-based trial of a comprehensive naturopathic intervention,[32] both the control and intervention groups showed improvements in a Juniper symptom subscale well beyond the level of clinical significance (i.e., improvement of 0.5 points).[17] Greater improvements were apparent, however, in those participating in the yoga interventions than those in the control groups.

Medication use was rarely reported, and evidence was considered insufficient to determine effectiveness. Quality of life was only reported in three of the trials, but did show improvement in two of them (standardized pooled estimate for all three trials=0.66, 95% CI, 0.21 to 1.10, I^2=59.3%).[32,34,35] Strength of evidence was low. All trials were rated fair quality. Three of the trials were extremely intensive and were conducted in India. These trials had minimal applicability for the U.S. health care system because of differences in standard of care, narrow inclusion criteria, and cultural acceptance of yoga. Two of the India-based trials were among the group with fairly substantial methodological issues.[31,34] Two trials included substantial additional components beyond yoga breathing techniques, making isolation of the breathing component impossible.[32,35] The trial with the greatest applicability to the U.S. health care system showed no group differences on any measure.[33]

Inspiratory Muscle Training Versus Control

Key Points:

- Evidence is insufficient to draw conclusions about the effect of IMT on asthma symptoms, medication use, or quality of life in adults and children.

There was insufficient evidence to draw conclusions about the effect of IMT on asthma in five small trials (n=169) (Table A).[36-40] Three of the trials were conducted by a single investigator.[38-40] All trials involved 25 or fewer participants per group and varied substantially in populations, intensity, and approach. All but one[38] had substantial quality issues. These trials also had low applicability to the U.S. health care system.

Nonhyperventilation Reduction Breathing Techniques Versus Control

Key Points:

- Evidence is insufficient to draw conclusions about the effect of other nonhyperventilation reduction breathing techniques on asthma symptoms, medication use, or quality of life in adults and children.

Two trials (n=153) compared a nonhyperventilation reduction breathing technique with a control group and showed no group differences in asthma symptoms, medication use, or pulmonary function (Table A). One trial examined the use of biofeedback targeting heart rate variability (HRV), as well as training in pursed-lip abdominal breathing with prolonged exhalation.[41] This trial had three control groups: biofeedback targeting only HRV, placebo biofeedback involving placebo "subliminal suggestions designed to help asthma," and a waiting list. The other trial compared the use of a device to modify breathing to achieve an inspiration-to-expiration cycle of 1:2, with a sham device that did not modify breathing.[23] Both trials were rated as "fair" quality, and strength of evidence was insufficient.

Key Question 1a

Key Points:

- Evidence is insufficient to determine whether patient characteristics influence treatment effect in adults and children.

The trials included for this Key Question were heterogeneous on too many factors to be able to look across studies to assess the impact of population characteristics on effect size. However, three trials did report subgroup analyses examining differential effects of treatment by different characteristics.[22,30,41] Subgroup analyses were not described as being planned a priori, but were clinically logical subgroups the interventions may be expected to benefit differentially. The United Kingdom trial comparing Papworth-style intervention with asthma education found that results were consistent between those who scored in the "disordered breathing" range on the Nijmegen questionnaire and those who did not.[30] Similarly, the trial of nighttime mouth-taping did not find larger effect among the subgroup of people who were rated as being "mouth breathers" at baseline.[22] Finally, the trial using biofeedback for breathing retraining found that there were no differences in response between those older than age 40 and though younger than 40.[41]

Key Question 1b

Key Points:

- Evidence is insufficient to determine whether the provider's certification and/or training influences effect size in hyperventilation reduction trials in adults and children.
- Exploratory analyses suggest that comprehensive approaches, especially those including additional, nonbreathing components may be more likely to show a benefit than approaches that isolate a single aspect of breathing in adults.
- Exploratory analyses suggest that intensity-matched control groups and control groups that involved either an alternate breathing approach or a technique to reduce autonomic arousal may reduce the likelihood of finding group differences in adults.

We could identify few components that had a clear impact on effect size. Among hyperventilation reduction trials, those involving certified or specially trained Buteyko practitioners[21,23,24,27] were more likely to show reductions in medication use that those that did not, however practitioner training did not appear to affect asthma symptoms results. All trials that reported improvements in quality of life did not use specially trained Buteyko practitioners.[26,28,30,42]

Looking across all trials, interventions that included components beyond breathing retraining[23,26,32,35] were likely to show a benefit more than interventions that isolated one aspect of breathing retraining (e.g., prolonged exhalation,[23,41] mouth-taping,[22] strengthening inspiratory muscles[38-40]). In addition, trials that matched intensity between treatment groups appeared less likely to reduce reliever medication use, although this effect was not seen for other outcomes. Finally, trials that compared breathing retraining with either another breathing technique or an intervention likely to induce relaxation or a reduced state of autonomic arousal were less likely to show group differences on asthma symptoms and quality of life when compared with control groups that did not include either of these components. These analyses were purely exploratory and did not account for effect size, so should be considered only as hypothesis generating and not as conclusive.

Key Question 2

Hyperventilation Reduction Breathing Techniques Versus Control Group

Key Points:

- There is moderate evidence that hyperventilation reduction breathing techniques do not improve lung function in adults.

Hyperventilation reduction techniques did not affect pulmonary function and strength of evidence was judged to be moderate (Table A). All seven trials reported one or more pulmonary function outcomes, primarily forced expiratory volume in 1 second (FEV_1), forced vital capacity (FVC), and peak expiratory flow (PEF).[22,23,25-28,30] Group differences were only found in one trial and only in the comparison with one of the two control groups.[27] Absolute changes in the FEV_1 values in the intervention groups were small (e.g., improvements of 20 milliliters or less in FEV_1 or less than 2% improvement in the percent predicted of FEV_1). Three trials measured end-tidal CO_2,[25,26,30] which is a specific target of interventions to reduce hyperventilation, but only one found group differences at 4, 12, and 26 weeks.[25] Breathing rate was reduced in two of these trials, which suggests that participants did modify their breathing in the way they were instructed, but that modification did not always alter the CO_2 levels as hypothesized by the Buteyko method proponents.[25,26]

Hyperventilation Reduction Breathing Techniques Versus Other Breathing Techniques

Key Points:

- Hyperventilation reduction breathing techniques do not differ from other breathing techniques in terms of effect on pulmonary function in adults, but the evidence to support this is low.

All four trials in this group reported on change in FEV_1 (Table A).[21,23,24,29] No trial found group differences, and there was little change within any of the groups in any trials. Strength of evidence was judged to be low. Only one trial reported PEF, and this trial found no group differences.[21] Other measures of pulmonary function similarly showed no group differences, including end-tidal CO_2,[21,29] provocative dose of methacholine causing a 20 percent reduction in FEV_1,[23] and FVC.[29]

Yoga Breathing Versus Control

Key Points:

- Yoga breathing techniques may improve pulmonary function in adults, but the evidence to support this is low.

The strength of evidence on yoga improving pulmonary function was low. Neither of the U.S.-based trials improved pulmonary function outcomes,[32,33] despite the positive effects on other outcomes for the comprehensive naturopathic treatment program (Table A).[32] Intensive yoga training in India, however, resulted in substantial improvements in pulmonary function,[31,34,35] although the largest effect sizes were seen in the trials with the greatest methodological limitations.[31,34] The trial with the largest effect (and the greatest quality concerns) showed improvement in percent predicted FEV_1 of 12 percentage points, compared with only two percentage points in the control group.[34] The best quality trial of the three Indian trials reported improvements of 7.7 percentage points in the intervention group on percent predicted FEV_1,compared with a 2.6 percentage point reduction in the control group at 8-week followup.[35]

Inspiratory Muscle Training Versus Control

Key Points:

- Evidence is insufficient to determine whether IMT improves pulmonary function in adults and children.

Three of the four trials reporting pulmonary function found greater improvement in FEV_1 or PEF in participants who underwent IMT than those who did not (Table A).[36-38] These data, however, are best considered exploratory pilot trials and evidence insufficient, given their heterogeneity in methods and populations, small size, and quality issues.

Other Nonhyperventilation Reduction Techniques Versus Control

Key Points:

- Evidence is insufficient to determine whether other nonhyperventilation reduction techniques improve pulmonary function in adults and children.

Spirometry results did not change over time in either the trial of prolonged exhalation using a training device[23] or in any of the treatment groups in the biofeedback trial (Table A).[41]

Key Question 2a

Key Points:

- Evidence is insufficient to determine whether patient characteristics influence the effect of treatment on pulmonary function in adults or children.

The best quality trial of yoga conducted in India showing large benefits of treatment reported that participants with exercise-sensitive asthma showed a greater improvement on FEV_1 than those whose asthma was not sensitive to exercise.[35] No other trials reported subgroup analyses for any pulmonary function outcomes, and there was no evidence that this subgroup analysis was planned a priori or that it was a clinically important subgroup expected to differentially benefit from this intervention.

Key Question 2b

Key Points:

- Evidence is insufficient to determine whether certification and/or training of the provider influences effect size in hyperventilation reduction trials.
- Exploratory analyses suggest that control groups that involved either an alternate breathing approach or a technique to reduce autonomic arousal may reduce the likelihood of finding group differences in adults.

Included trials provided little information about which intervention characteristics influence treatment effect on pulmonary function. Benefits were more likely to be seen if the control group did not involve breathing training of any kind or relaxation techniques (42% positive vs. 14% positive with breathing/relaxation comparison group). These data are preliminary, however, and are only valid for hypothesis generation and do not account for effect size.

Key Question 3

Key Points:

- Hyperventilation reduction breathing techniques do not appear to be associated with any harms in adults, other than minor annoyances associated with mouth-taping at night, but the evidence to support this is low.
- Yoga breathing techniques do not appear to be associated with any harms in adults, but the evidence to support this is low.
- There was no evidence on harms associated with IMT or other nonhyperventilation reduction approaches in adults or children.

Breathing retraining techniques appear unlikely to cause harm. Seven trials reported on adverse events, including five trials that examined a hyperventilation reduction approach compared with either a control or another breathing retraining approach.[22,24,26,28,29,32,33] The trial of mouth-taping reported some minor adverse events such as causing sore lips, causing a feeling of suffocation, or disturbing sleep. All other trials reported either no adverse events or no adverse events judged to be related to the breathing retraining.

Key Question 3a

Key Points:

- There was no evidence regarding whether patient characteristics influenced the likelihood of experience harm from any treatment included in the review in adults or children.

No trials examined harms of treatment within subgroups or compared subgroups on likelihood of harms.

Discussion

Summary of Results

The body of evidence suggests that selected intensive behavioral approaches that include breathing retraining or exercises may improve asthma symptoms or reduce reliever medication use in adults with poorly controlled asthma. However, the overall body of evidence primarily consisted of small, methodologically limited trials with widely heterogeneous samples, settings, and treatment approaches, few outcomes beyond 6 months, and inconsistent outcome reporting. Also, primary outcomes (symptom reduction and reliever medication use) were self-reported, making them susceptible to social desirability bias. Hyperventilation reduction techniques provided the strongest evidence for improvement in asthma symptoms and reliever medication use, including the only large-scale trial[27] and the applicability to U.S. health care systems was the best (although still limited, since no trials were conducted in the United States). Reductions in asthma symptoms (when they occurred) were likely clinically significant: standardized effect sizes were frequently greater than 0.80, which is considered a large effect, and scale scores for symptoms and quality of life often changed in an amount associated with clinically significant differences. Reductions in reliever medication use were generally in the 1.5 to 2.5 puffs per day range, which were also likely of clinical significance. This technique, however, did not improve pulmonary function.

Table A. Strength of Evidence								
Outcome	**Group**	**Number of Studies**	**Risk of Bias**	**Consistency**	**Directness**	**Precision**	**Strength of Evidence**	**Comments**
Key Question 1: Asthma symptoms (global symptom severity or control, specific symptoms, exacerbations)	Hyperventilation reduction breathing technique vs. control	8	Medium	Consistent	Direct	Imprecise	Moderate	Effects in 7 comprehensive interventions ranged from no effect to large effect, 5 of 7 reported benefit; 1 narrowly focused trial showed no benefit for mouth-taping.
	Hyperventilation reduction breathing technique vs. nonhyperventilation reduction breathing technique	4	Medium	Consistent	Direct	Imprecise	Low	No trial found a benefit of one approach over another; both groups improved in 2 trials, neither group improved in 2 trials.
	Yoga breathing technique vs. control	5	Medium-High	Consistent	Direct	Imprecise	Low	4 of 5 trials report benefit, 3 with substantial quality concerns.
	IMT vs. control	2	Medium-High	Consistent	Direct	Imprecise	Insufficient	2 small trials with different populations and methods, both show benefit, 1 with high risk of bias.
	Non-hyperventilation reduction breathing technique vs. control	2	Medium	Consistent	Direct	Imprecise	Insufficient	No benefit in trials using biofeedback or breathing device, mixed results in 1 trial of physical therapy.

Table A. Strength of Evidence (continued)								
Outcome	**Group**	**Number of Studies**	**Risk of Bias**	**Consistency**	**Directness**	**Precision**	**Strength of Evidence**	**Comments**
Key Question 1: Medication use (reliever)	Hyperventilation reduction breathing technique vs. control	6	Medium	Consistent	Direct	Imprecise	Moderate	3 trials found reduction in reliever medication and the 3 lowest intensity trials did not.
	Hyperventilation reduction breathing technique vs. nonhyperventilation reduction breathing technique	3	Medium	Consistent	Direct	Imprecise	Low	Greater reduction in use with hyperventilation reduction breathing training in 2 of 3 cases, both groups improved in 1 trial.
	Yoga breathing technique vs. control	2	Medium	Inconsistent	Direct	Imprecise	Insufficient	2 trials with substantial differences in intensity, location, and population, and reported contradictory results.
	IMT vs. control	4	High	Inconsistent	Direct	Imprecise	Insufficient	4 small trials, 3 by 1 author, 3 with high risk of bias, no. 2 shows probable benefit.
	Nonhyperventilation reduction breathing technique vs. control	1	Medium	N/A	Direct	Imprecise	Insufficient	No benefit of treatment.
Key Question 1: Medication use (controller)	Hyperventilation reduction breathing technique vs. control	5	Medium	Inconsistent	Direct	Imprecise	Low	1 of 4 found large benefit, but raw data NR, remaining 3 found no group differences.
	Hyperventilation reduction breathing technique vs. nonhyperventilation reduction breathing technique	4	Medium	Inconsistent	Direct	Imprecise	Low	No differences in effectiveness in 3 of 4 trials.
	Yoga breathing technique vs. control	1	High	N/A	Direct	Imprecise	Insufficient	1 trial with high risk of bias showed benefit of yoga, type of medication not listed, just that it was used “to control dyspnoea.”
	IMT vs. control	0	N/A	N/A	N/A	N/A	Insufficient	0 trials.
	Nonhyperventilation reduction breathing technique vs. control	2	Medium	Consistent	Direct	Imprecise	Insufficient	No benefit of treatment in either trial.

Table A. Strength of Evidence (continued)

Outcome	Group	Number of Studies	Risk of Bias	Consistency	Directness	Precision	Strength of Evidence	Comments
Key Question 1: Quality of life	Hyperventilation reduction breathing technique vs. control	6	Medium	Inconsistent	Direct	Imprecise	Low	Benefit found in 2 of 6, results mixed in another 2 trials.
	Hyperventilation reduction breathing technique vs. nonhyperventilation reduction breathing technique	4	Medium	Inconsistent	Direct	Imprecise	Low	No differences in effectiveness in all cases; both groups met threshold for clinical improvement in 2 trials, but change only statistically significant in 1 of these trials.
	Yoga breathing technique vs. control	3	Medium-High	Consistent	Direct	Imprecise	Low	3 trials, large effect seen in trial with shortest followup. Pooled effect showed benefit.
	IMT vs. control	0	N/A	N/A	N/A	N/A	Insufficient	0 trials.
	Nonhyperventilation reduction breathing technique vs. control	2	Medium	Inconsistent	Direct	Imprecise	Insufficient	2 trials with mixed results.
Key Question 1: Functioning or mental health	Hyperventilation reduction breathing technique vs. control	4	Medium	Consistent	Direct	Imprecise	Low	2 of 2 trials found small benefit for anxiety and depression, 2 of 2 trials found mixed results for functioning.
	Hyperventilation reduction breathing technique vs. nonhyperventilation reduction breathing technique	1	Medium	N/A	Direct	Imprecise	Insufficient	1 study showing greater benefit of Buteyko breathing training than yoga breathing training via device on some functioning subscales.
	Yoga breathing technique vs. control	1	High	N/A	Direct	Imprecise	Insufficient	1 trial with substantial non-yoga components showed benefit.
	IMT vs. control	2	High	Consistent	Direct	Imprecise	Insufficient	2 trials with high risk of bias showing benefit, 1 in children, 1 in adults.
	Nonhyperventilation reduction breathing technique vs. control	1	Medium	N/A	Direct	Imprecise	Insufficient	1 trial with mixed results, benefit primarily seen on role limitations due to physical problems, not other subscales.

Table A. Strength of Evidence (continued)								
Outcome	**Group**	**Number of Studies**	**Risk of Bias**	**Consistency**	**Directness**	**Precision**	**Strength of Evidence**	**Comments**
Key Question 2: Pulmonary function (FEV_1)	Hyperventilation reduction breathing technique vs. control	5	Medium	Consistent	Indirect	Imprecise	Moderate	Small or no benefit found in all trials.
	Hyperventilation reduction breathing technique vs. nonhyperventilation reduction breathing technique	4	Medium	Consistent	Indirect	Imprecise	Low	No benefit for FEV_1 in any trials.
	Yoga breathing technique vs. control	5	Medium-High	Consistent	Indirect	Imprecise	Low	3 of 5 show benefit of yoga, all 3 high-intensity interventions, 2 with large effects.
	IMT vs. control	3	High	Inconsistent	Indirect	Imprecise	Insufficient	2 of 3 trials showed benefit, 2 with high risk of bias.
	Nonhyperventilation reduction breathing technique vs. control	2	Medium	Consistent	Indirect	Imprecise	Insufficient	2 trials with different treatment approaches showing no benefit of treatment.
Key Question 2: Pulmonary function (PEF)	Hyperventilation reduction breathing technique vs. control	3	Medium	Consistent	Indirect	Imprecise	Low	No benefit found in any trial.
	Hyperventilation reduction breathing technique vs. nonhyperventilation reduction breathing technique	1	High	N/A	Indirect	Imprecise	Insufficient	1 trial showing no benefit in either group.
	Yoga breathing technique vs. control	4	Medium-High	Consistent	Indirect	Imprecise	Low	3 of 4 show benefit of yoga, all 3 high-intensity interventions, 2 with large effects.
	IMT vs. control	1	High	N/A	Indirect	Imprecise	Insufficient	1 trial with large effect, high risk of bias.
	Nonhyperventilation reduction breathing technique vs. control	0	N/A	N/A	Indirect	N/A	Insufficient	0 trials.

Table A. Strength of Evidence (continued)								
Outcome	**Group**	**Number of Studies**	**Risk of Bias**	**Consistency**	**Directness**	**Precision**	**Strength of Evidence**	**Comments**
Key Question 3: Harms	Hyperventilation reduction breathing technique vs. control	3	Medium	Consistent	Direct	Imprecise	Low	None found adverse effects related to the intervention, one listed minor annoyances associated with mouth-taping.
	Hyperventilation reduction breathing technique vs. nonhyperventilation reduction breathing technique	2	Medium	Consistent	Direct	Imprecise	Low	No adverse effects related to interventions.
	Yoga breathing technique vs. control	2	Medium	Consistent	Direct	Imprecise	Low	No adverse effects related to yoga.
	IMT vs. control	0	N/A	N/A	N/A	N/A	Insufficient	N/A
	Nonhyperventilation reduction breathing technique vs. control	0	N/A	N/A	N/A	N/A	Insufficient	N/A

FEV_1 = forced expiratory volume in 1 second; IMT: inspiratory muscle training; N/A: not applicable; PEF: peak expiratory flow

Intensive yoga breathing training, on the other hand, did improve pulmonary function in addition to improving symptoms in three trials of intensive yoga breathing training conducted in India.[31,34,35] Quality issues in these trials, however, limit confidence in results and applicability to U.S. health care systems was very low.

Evidence for IMT and other breathing retraining techniques were limited to small, heterogeneous trials best characterized as pilot studies that did not provide sufficient evidence to conclude that they are effective. There were five IMT trials, three of which were conducted by the same researcher, and all but one had substantial methodological limitations. The two small nonhyperventilation reduction trials used very different approaches, and neither showed the intervention to be beneficial.

Specific Versus Nonspecific Effects

Despite the relatively positive results for hyperventilation reduction, improvements could not be definitively attributed to the use of the specific techniques. Subjective assessment of asthma symptoms is responsive to placebo interventions (e.g., sham acupuncture or a placebo inhaler), and participants in hyperventilation reduction interventions were instructed to delay use of reliever medication.[43] Rather than directly improving asthma, trials might have helped participants eliminate overuse of reliever medications, which is still an important positive outcome. Some trials attempted to control for the nonspecific effects of the treatment modality by including comparison groups that involved other, plausible breathing retraining. It is difficult to say, however, whether the treatment providers were comparable in their espousal of the effectiveness of their techniques.

A subset of articles in a Cochrane review on psychological treatments for asthma suggests that relaxation methods may reduce reliever medication use, and breathing retraining techniques may similarly benefit participants by reducing levels of anxiety and/or autonomic arousal.[44]

In summary, there are a number of possible explanations for the improvements in asthma outcomes reported with the use of hyperventilation reduction techniques. Lowered autonomic arousal through relaxation or reduced anxiety may improve asthma symptoms, deliberately delayed use of reliever medication may reduce reliever medication use, lifestyle changes (diet, stress management, nutritional supplements) may affect asthma control, bias in outcome measurement may affect any of outcomes, or the use of the specific breathing techniques may genuinely improve asthma symptoms and lead to reductions in medication use. It is very difficult to isolate critical treatment elements in complex interventions and use of some elements in isolation may underestimate their importance if the components are dependent on each other or interact with each other, or if individuals vary in the degree to which specific components are necessary or sufficient to gain improvements. Thus, critical intervention components often cannot be elucidated, particularly in a relatively poor and heterogeneous body of research.

Strength of Evidence

In most cases, the strength of evidence was insufficient or low. The evidence that hyperventilation reduction breathing techniques can reduce asthma symptoms and reliever medication use was judged moderate, as was evidence that hyperventilation reduction approaches are unlikely to improve pulmonary function.

Applicability

The trials in this review generally had low applicability to U.S. health care, primarily due to the settings in which the trials took place as well as other factors. Only three trials were conducted in the United States.[32,33,41] Trials of hyperventilation reduction techniques had the best applicability, being primarily conducted in health care settings in the United Kingdom and Australia. Guidelines governing the United Kingdom's[45] and the United States'[4] providers are generally consistent, so treatment of asthma is likely similar, although standards of care may still differ slightly and availability of hyperventilation reduction practitioners may also differ. Results were primarily limited to 6 months or less, so applicability is limited to short-term outcomes. However, given the evidence supporting a beneficial effect of hyperventilation reduction training on reliever medication use, in particular, patients with poorly controlled asthma who are motivated to use complementary and alternative methods to reduce their use of medication and avoid overuse of reliever medications may be good candidates to try these techniques, if they can find a practitioner with the appropriate training. There are approximately 50 certified Buteyko practitioners in the United States, practicing in at least 21 states. Most practitioners were located in complementary and alternative medicine settings. Some trials showed a benefit of treatment related methods that were not described as "Buteyko," specifically, conducted by respiratory therapists who were not Buteyko practitioners but had special training in hyperventilation reduction methods. Even among Buteyko practitioners, however, there is disagreement as to what constitutes necessary

and sufficient training, so some certified practitioners likely would not be universally recognized as having the appropriate training.

The yoga and IMT trials had particularly low applicability, as these trials were conducted primarily in India, Brazil, South Africa, and Israel, which are countries with substantial cultural and/or economic differences from the United States, where standards of usual asthma care may differ, and where the availability of practitioners may also differ. Some yoga and IMT trials were even further limited in their applicability to the general U.S. population by limiting samples to males[31] or females only,[39] vegetarians within a fairly narrow age range,[31] people with 6 months of yoga experience and not using medications,[34] and children with untreated asthma.[36] In some of these trials, there was some evidence that the standard of care was likely different from the current U.S. standard of care due to nonuse of controller medications[31,34] or poor success in managing asthma.[36]

Evidence was primarily applicable to adults; only a single trial of IMT targeted children (ages 8 to 12 years),[36] and only four other trials included people younger than 16 years of age, all addressing hyperventilation reduction training.[21,24,27,29] However, it is unlikely that many teens were included in these trials since, where it was reported, the average participant age was in the forties in these studies. Subgroup analyses of teens and/or emerging adults were not reported.

Clinical Implications

One goal of National Asthma Education and Prevention Program (NAEPP)-consistent treatment is for people with asthma to require the use of reliever medications no more than twice per week. Participants in the hyperventilation reduction trials were on average using relievers more frequently than twice per week at baseline, generally averaging about two puffs per day or more. While there are flaws in this research, participants generally reduced reliever medication to a level consistent with NAEPP guidelines, at least in the short term. This was achieved without increases in asthma symptoms, exacerbations, or declines in lung function. For people whose asthma is not well controlled, hyperventilation reduction techniques may provide a low-risk approach to achieve better control and avoid overuse of reliever medications. Participants in the trials were admonished only to reduce the use of controller medications in consultation with their medical providers, and this is a very important safety consideration for all users of these techniques. Inflammation may increase with reduction in controlled medications without the patient realizing it, and lead to longer term exacerbations. Hyperventilation reduction techniques may be a useful asthma management tool, along with medication and other components such as environmental controls, symptom monitoring, and a plan for handling exacerbations.

The body of evidence for yoga is smaller and at higher risk of bias than the evidence for hyperventilation reduction techniques, but there is limited evidence suggesting that intensive yoga training may reduce asthma symptoms and improve lung function. Patients who would like to undertake intensive training need not be discouraged, but again should not change their use of asthma medication without consulting with their medical provider.

Limitations

There were several limitations and potential limitations to our review, both in our approach to the review and in the evidence base. In terms of our approach, potential limitations include the fact that we did not include non-English publications, that we excluded "poor-quality" publications, that we excluded trials that used relaxation training as a comparison group, that we relied on personal communication with authors for some data, and that we were unable to locate seven publications that could possibly have been eligible for inclusion in the review.

The evidence was limited in a number of ways. There were no trials rated as "good" quality and a number of trials could barely be considered "fair" quality. There was only one trial that could be considered large, and more than half of the trials included 25 or fewer participants per treatment group. Outcome reporting was very heterogeneous and inconsistent, with important outcomes missing in many trials, and outcomes assessment was not consistently blinded. In addition, there was little consistency of asthma-related terms used in these trials, and terms were sometimes used vaguely or differently, making it difficult to characterize interventions.

Strengths

The methodological limitations are counterbalanced by some strengths of our report, including extensive grey-literature searching, examination of abstracts of non-English publications, and efforts to contact authors to include all possible eligible English-language trials. These measures were undertaken to limit the effects of publication bias. Other strengths include extensive input from experts during protocol development, rigorous adherence to inclusion/exclusion rules, and conservative use of meta-analysis.

Future Research

Additional evidence would improve our understanding for all intervention types. Future trials should detail breathing retraining techniques, as described by Bruton,[46] and these trials should include asthma symptoms outcomes, reliever medication use, quality of life, and pulmonary function at minimum. In addition, controller medication use should always be described. Best practices regarding randomization, blinding, and followup are also crucial to any further research in this area. For hyperventilation reduction techniques, top priorities for future research include replication of results of the large, good-quality trial with intensity-matched comparator, trials that attempt to isolate the necessity or efficacy of specific components of treatment, and trials focused on hyperventilation reduction techniques in children. A well-designed and executed replication of a high-intensity yoga breathing approach in the United States, without additional nonyoga components would be an important next step for the use of yoga in asthma.

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Full Report

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