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REVIEW

Breathing Exercises in the Treatment of COPD: An Overview of Systematic Reviews

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Background: The effectiveness of breathing exercises in the treatment of chronic obstructive pulmonary disease (COPD) has been demonstrated in several systematic reviews (SRs), but a comprehensive review is still lacking. The aim of this study was to synthesize evidence from SRs, to summarise the effects of breathing exercises interventions for COPD patients.

Methods: We conducted an overview of the SRs of breathing exercises in the treatment of COPD. We include Systematic Reviews of randomized-controlled clinical trials. In the included COPD, control of breathing exercises alone was the only variable and no restriction was placed on relevant outcome measures. The SRs were screened by computer retrieval from the Chinese National Knowledge Infrastructure (CNKI), WanFang database, Chinese Science and Technology Journal Database (CSTJ), Chinese Biological Medicine (CBM), MEDLINE (PubMed), Embase, Cochrane library, and Web of Science. The Risk of Bias in Systematic reviews (ROBIS) tool, the Preferred Reporting Items for Systematic Reviews and Meta-analysis (PRISMA) statement, a Measure Tool to Assess Systematic Reviews (AMSTAR) 2, and the Grades of Recommendations, Assessment, Development and Evaluation (GRADE) were used to evaluate the risk of bias, reporting quality, methodology quality, and evidence quality.

Results: Nine SRs met the inclusion criteria and were included in the overview, 4 SRs in Chinese, and 3 SRs in English. All the SRs were published between 2015–2021. According to the ROBIS tool, 4 SRs (57.14%) were rated as low risk of bias. The PRISMA scale showed that 5 SRs had some defects, and 2 SRs were relatively complete. Reporting deficiencies exist primarily in protocol and registration (28.6%), search (42.9%), risk of bias across studies (0%), additional analyses (42.9%), and funding (28.6%). Based on the AMSTAR-2 scale, 3 SRs were low quality, and the other 4 SRs were very low. The result of evidence quality assessment showed that among the 34 outcomes involved in the 7 studies, 19 were low-level outcomes, 15 were very low-level outcomes, and there were no moderate and high-level quality outcomes. Limitations and publication bias were two major factors that reduced the quality of evidence.

Conclusion: Breathing exercises in certain can improve pulmonary function, exercise endurance, dyspnea, quality of life, and respiratory muscle strength of COPD patients. However, there is an urgent need for high-quality studies to guide clinical practice due to certain deficiencies in reporting quality and the low quality of methodology and outcomes.

Keywords: breathing exercises, chronic obstructive pulmonary disease, overview, systematic reviews

Introduction

Chronic obstructive pulmonary disease (COPD) is a preventable and treatable disease characterized by persistent respiratory symptoms and restricted airflow.[1,2] As a common multiple respiratory disease, COPD has a high prevalence and mortality rate and is expected to become the 5th-largest burden disease in the world by 2030.[3] The treatment methods for COPD include pharmacotherapies and non-pharmacotherapies. The standard treatments of COPD include bronchodilators, inhaled glucocorticoids, and theophylline drugs. However, due to physical factors or other reasons, several patients have developed

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certain adverse effects to these pharmacotherapies,[4] such as increased heart rate, dizziness, headache, dysuria, nausea, and vomiting. Therefore, more and more attention was paid to nonpharmacological treatments.

Pulmonary rehabilitation (PR), as a comprehensive treatment program, is to formulate an individualized treatment scheme for patients based on a comprehensive evaluation of patients' overall condition to improve the physical and mental condition of patients with chronic respiratory diseases.[5] Its application in clinical treatment is receiving more and more attention. Breathing exercise is an important part of the global lung rehabilitation program for COPD patients,[6] including training in breathing patterns (pursed-lip breathing, diaphragmatic breathing, whole-body breathing exercises, etc.) and exercise of breathing muscles (inspiratory muscle training and expiratory muscle training). Compared with other treatment methods, breathing exercises are simple to operate, have no site restrictions, and do not require excessive capital investment, which can greatly improve patients' initiative and compliance.

In recent years, a growing number of studies have proved that breathing exercises can significantly improve lung function and dyspnea, increase exercise endurance and improve the quality of life of patients with COPD.[7–11] With the development of evidence-based medicine, the systematic reviews (SRs) of breathing exercises of COPD patients are also increasing year by year, but the quality of the reports is uneven, which brings great challenges to researchers' clinical decision-making. For example, Langer et al[12] and Basso-Vanelli et al[13] found inspiratory muscle training (IMT) improved respiratory muscle strength and endurance, dyspnea, and exercise tolerance in patients with COPD. However, Figueiredo et al[14] found IMT improved inspiratory muscle strength, functional capacity, and pulmonary function, without changing dyspnea and quality of life.

This is the first overview that comprehensively assessed SRs of breathing exercises for COPD patients. The aim of this overview is to critically assess the quality of relevant SRs and present an objective and comprehensive evaluation on effectiveness of breathing exercises for COPD, which can provide a scientific basis for clinical decision-making.

Materials and Methods

The overview protocol was registered in the PROSPERO (International prospective register of systematic overview) database (No. CRD42022329999).

Search Strategy

Relevant literature was searched from the Chinese National Knowledge Infrastructure (CNKI), WanFang database, Chinese Science and Technology Journal Database (CSTJ), Chinese Biological Medicine (CBM), MEDLINE (PubMed), Embase, Cochrane Library, and Web of Science up to March 30, 2022. The retrieval words are the combination of subject words and free words. The keywords include chronic obstructive pulmonary disease, COPD Chronic obstructive airway disease, COAD, chronic obstructive lung disease, respiratory muscle training, inspiratory muscle training, ventilation muscle training, breathing exercise, respiratory exercise, respiratory training, meta-analysis, systematic review, etc. The search strategy is shown in Table S1.

Inclusion Criteria

The inclusion criteria are described below.

Types of Studies

SRs of breathing exercises for COPD, in Chinese and English.

Types of Participants

Patients with a definite diagnosis of COPD, meeting any diagnostic standard at home and abroad, regardless of clinical stage and severity rating.

Types of Interventions

The experimental group received at least one form of breathing exercise (inspiratory muscle training, expiratory muscle training, diaphragmatic breathing, pursed-lip breathing, yoga breathing, respiratory gymnastics, etc.), and the control

group received routine treatment (such as vital sign testing and dietary care), placebo, blank control (no interventions), or other treatments (conventional Western medical treatments).

Types of Outcome Measures

The outcome measures are as follows:

1. Pulmonary function: forced expiratory volume in the first second (FEV_1), forced vital capacity (FVC), the percentage of forced expiratory volume in the first second to the expected value (FEV_1%), the ratio of forced expiratory volume to forced vital capacity in the first second (FEV_1/FVC).
2. Exercise capacity: six-minute walking distance (6MWD).
3. Quality of life: St. George's Respiratory Questionnaire (SGRQ).
4. Dyspnea: modified Medical Research Council (mMRC) scale or other related scales.
5. Respiratory muscle strength: maximum inspiratory pressures (PImax), maximum expiratory pressures (PEmax).

Exclusion Criteria

The SRs were excluded if one of the following criteria was met: duplicated publications; updated SRs; network meta-analysis; conference abstracts or systematic reviews' protocols.

Screening and Data Extraction

According to the inclusion and exclusion criteria, two researchers independently conducted literature retrieval, screening and data extraction, and cross-checking. If there is a dispute, the third researcher will be asked to assist in the judgment. Use EndNoteX9 to check duplicates, delete duplicate documents, and then use Excel to record and extract the data. Extracted data include title, first author, year of publication, relevant data of the original research included (research type, sample size, intervention measures, outcome indicators, etc.), quality evaluation methods, main conclusions, etc. When necessary, complete information can be obtained by tracing and searching the included original research or attempting to contact the corresponding author for as complete information as possible.

Assessment of Included SRs

The quality of the final included literature and conducted cross-checking was independently evaluated by two researchers. If the evaluation is inconsistent, discuss or ask a third researcher to intervene.

Risk of Bias Evaluation

The ROBIS tool was used to evaluate the level of bias presented in the included SRs. The process includes three phases: (1) assess the relevance (optional) to evaluate the degree of coincidence between the target problem and the problem to be solved in the review; (2) identify concerns with the review process, including 4 domains (study eligibility criteria, identification and selection of studies, data collection and study appraisal, synthesis and findings); (3) judge risk of bias in the review. Each domain has signaled questions and a judgment of concerns about the risk of bias in the domain, and the results are rated as "high risk", "low risk", or "unclear risk".[15]

Report Quality Evaluation

PRISMA statement[16] was used to assess the report quality of the included SRs. It consists of 27 statements, of which 1 point is for a standardized and complete report, 0.5 points for a partial report, and 0 points for a non-report. A score of ≤15 was considered to be a relatively serious information c, >15–21 was considered to be a report with some deficiencies, and >21–27 was considered to be a relatively complete report.

Methodological Quality Evaluation

AMSTAR-2 scale[17] was used to assess the methodological quality of the included SRs. AMSTAR-2 scale contains 16 items, and the grade of literature quality is mainly based on 7 critical items: items 2, 4, 7, 9, 11, 13, and 15. According to

the compliance of critical items and non-critical items, it is divided into four quality levels: high, medium, low, and critically low. 0–1 non-critical item do not meet the requirements is considered high quality; more than one non-critical item is not met (when multiple non-critical items fail to meet the requirements, the confidence of the systematic review can be reduced from intermediate to low level), as medium quality; one critical item does not meet with or without non-critical items non-compliance is considered low quality; more than one critical item does not meet the requirements, with or without non-critical items non-compliance, is considered critically low quality.

Evidence Quality Evaluation

The quality of outcomes of included SRs was evaluated by the GRADE system.[18] The GRADE system divides the evidence into four levels: high, moderate, low, and very low, based on five degrading factors (risk of bias, inconsistency, indirection, imprecision, and publication bias). Randomized controlled trials (RCTs) are specified as high quality, downgrade 1 is moderate, downgrade 2 is low, and downgrade 3 is very low.

Results

Literature Search

According to the formulated search strategy, 801 related documents were preliminarily retrieved. We used EndNoteX9 to check the duplicates. After checking, 645 articles remained. 583 records were excluded through reading the title and abstract, and 55 were excluded after downloading the full text. The reasons for exclusion are presented in Table S2. Finally, 7 studies were included. The process of study selection is shown in Figure 1.

Characteristics of Included SRs

A total of 7[19–25] SRs were included in this study, 4[19–22] SRs in Chinese, and 3[23–25] SRs in English, all of which were published in journals from 2015 to 2021. The number of original studies included ranged from 8 to 17, and the sample size ranged from 593 to 1098. The subjects were all patients with COPD, of which 4[19,20,22,23] were diagnosed as patients with stable COPD, and 5[19–21,23,25] described the diagnostic criteria. In terms of quality assessment tools, 1[19] SR used the Jadad scale, 4[20–22,24] SRs used the Cochrane risk of bias tool, 1[25] SR used both the Jadad scale and Cochrane risk of bias tool, and 1[23] SR used PEDro scale. The characteristics of included SRs are presented in Table S3.

Risk of Bias of Included SRs

The ROBIS tool evaluation results are shown in Table 1 and Figure S1. Phrase 1 which is optional was not performed in our study. Domain 1 assessed whether study eligibility criteria were prespecified, clear, and appropriate to the review question, and 7 SRs (100%) were at low risk of bias. Domain 2 assessed whether any original studies that meet the inclusion criteria have been omitted, and 2 SRs (28.57%) were rated as low risk of bias. Domain 3 assessed whether bias occurred during data extraction or quality evaluation of the original studies, and 7 SRs (100%) were at low risk of bias. Domain 4 assessed whether used appropriate methods to combine data from the primary studies, including qualitative and quantitative synthesis, and 4 SRs were at unclear risk of bias. The final phrase considered the overall risk of bias, and 4 SRs (57.14%) were rated as low risk of bias.

Report Quality of Included SRs

The PRISMA scale report quality evaluation shows that the score of the included SRs ranged from 15.5 to 24. There were no SRs with a score of ≤15 points; 5[19,20,22–24] SRs with a score of 15–21 points; 2[21,25] SRs with a score of ≥21 points. All SRs completely reported the rationale, objectives, data collection process, risk of bias in individual studies, summary measures, synthesis of results, risk of bias within studies, results of individual studies, and conclusions. Reporting deficiencies mainly exist in the following items: protocol and registration (28.6%), search (42.9%), risk of bias across studies (0%), additional analyses (42.9), and funding (28.6%). The report quality of included SRs is shown in Table 2 and Figure S2.

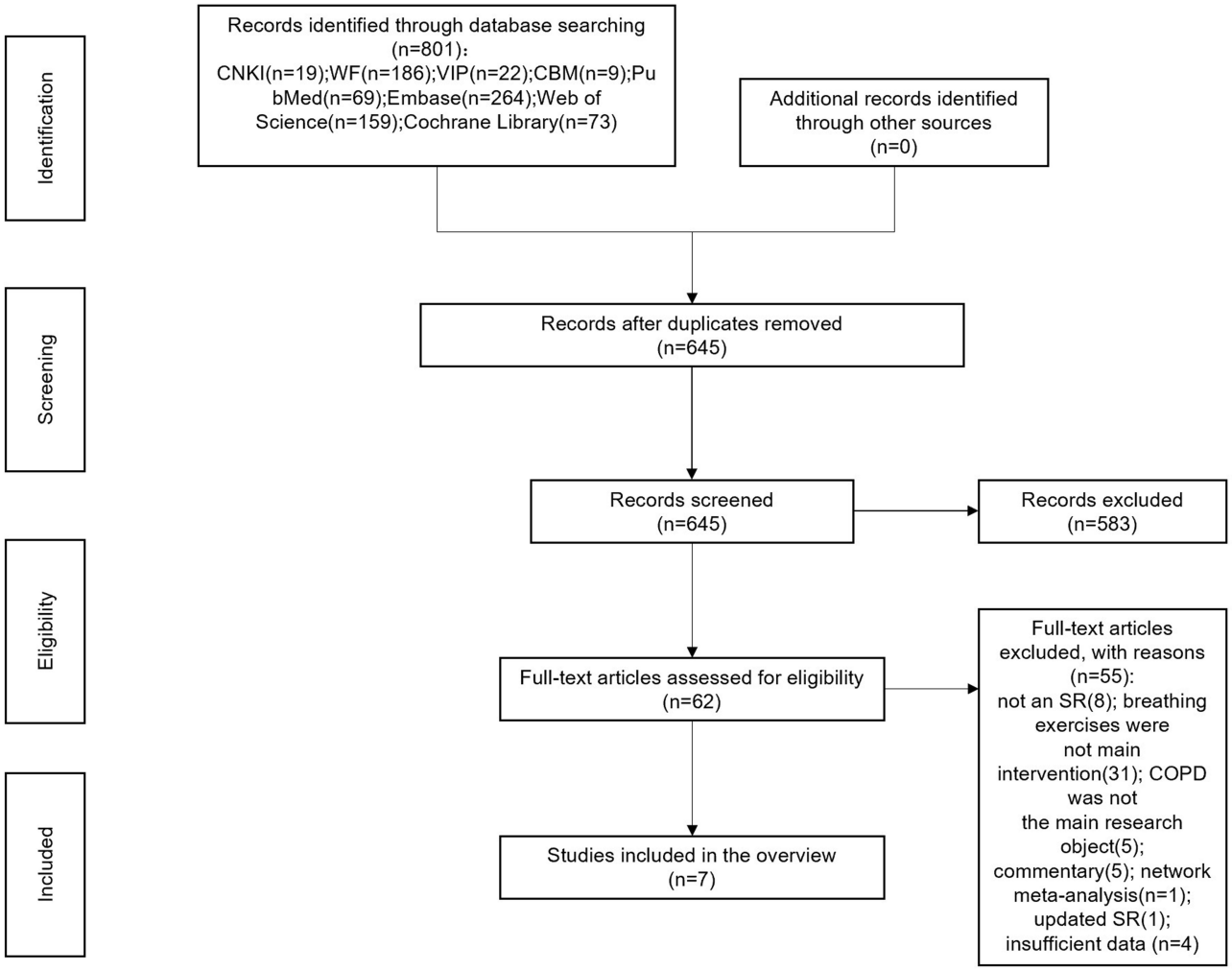

Figure 1 Flowchart of literature screening.

Methodological Quality of Included SRs

The results of the AMSTAR-2 assessment are presented in Table 3 and Figure S3. The overview shows that 3[20,23,25] were low quality, and 4[19,21,22,24] SRs were critically low quality. Focus on the evaluation results of critical items: 4[19–22] SRs did not state the review methods; 7[19–25] SRs did not search the relevant grey literature; 1[21] SR did not provide the exclusion list, and 6[19,20,22–25] SRs provided the exclusion list, but not detail enough; 7[19–25] SRs used a satisfactory tool to evaluate the risk of bias in individual studies, and selected appropriate statistical methods to merge the research results in meta-analysis; 2[19,24] SRs did not consider the risk of bias when interpreting or discussing the results of each study; only 2[20,21] SRs evaluated and discussed the publication bias.

Evidence Quality of Included SRs

34 outcomes were evaluated by the GRADE system. Further details can be seen in Table S4. The results showed that there were 19 low-level outcomes, 15 very low-level outcomes, and there were no moderate and high-level quality outcomes. Limitations and publication bias are two major factors that reduce the evaluation of evidence quality.

Pulmonary Function

The main outcomes of pulmonary function were FEV1, FVC, FEV1%, and FEV1/FVC. Six[19–21,23–25] articles reported the effect of breathing exercises on pulmonary function of COPD patients. Except for one SR showed no significant difference, the other 5[19–21,23,24] SRs showed that breathing exercises could significantly improve the pulmonary function

Table 1 Tabular Presentation of Risk of Bias of Included SRs

Review	Phrase 2				Phrase 3
	1. Study Eligibility Criteria	2. Identification and Selection of Studies	3. Data Collection and Study Appraisal	4. Synthesis and Findings	Risk of Bias in the Review
Liao 2015	☺	☹	☺	?	☹
Zhang 2016	☺	☹	☺	?	☹
Zhao 2019	☺	☹	☺	?	☺
Huang 2019	☺	☹	☺	?	☹
Lu 2020	☺	☺	☺	☹	☺
Yang 2020	☺	☹	☺	☹	☺
Yun 2021	☺	☺	☺	☹	☺

Abbreviations: ☺, low risk; ☹, high risk; ?, unclear risk.

Table 2 Report Quality of Included SRs

	Section	Topic	Yes	Partial Yes	No	Compliance (%)
1	Title	Title	6[19–22,24,25]	0	1[23]	88.9
2	Abstract	Structured summary	0	7[19–25]	0	0
3	Introduction	Rationale	7[19–25]	0	0	100.0
4		Objectives	7[19–25]	0	0	100.0
5	Methods	Protocol and registration	2[23,25]	1[24]	4[19–22]	28.6
6		Eligibility criteria	5[20,21,23–25]	2[19,22]	0	71.4
7		Information sources	6[20–25]	0	1[19]	85.7
8		Search	3[19,21,25]	0	4[20,22–24]	42.9
9		Study selection	5[20–23,25]	0	2[19,24]	71.4
10		Data collection process	7[19–25]	0	0	100.0
11		Data items	0	7[19–25]	0	0
12		Risk of bias in individual studies	7[19–25]	0	0	100.0
13		Summary measures	7[19–25]	0	0	100.0
14		Synthesis of results	7[19–25]	0	0	100.0
15		Risk of bias across studies	0	0	7[19–25]	0
16		Additional analyses	3[21,22,25]	0	4[19,20,23,24]	42.9
17	Results	Study selection	6[19,20,22–25]	1[21]	0	85.7
18		Study characteristics	1[24]	6[19–23,25]	0	14.3
19		Risk of bias within studies	7[19–25]	0	0	100.0
20		Results of individual studies	7[19–25]	0	0	100.0
21		Synthesis of Results	7[19–25]	0	0	100.0
22		Risk of bias across studies	3[20,21,25]	0	4[19,22–24]	42.9
23		Additional analysis	4[20–22,25]	0	3[19,23,24]	57.1
24	Discussion	Summary of evidence	0	7[19–25]	0	0
25		Limitations	6[19,20,22–25]	0	1[21]	85.7
26		Conclusions	7[19–25]	0	0	100.0
27	Funding	Funding	2[24,25]	0	5[19–23]	28.6

of COPD patients. Among them, 4[19–21,24] SRs used the outcome FEV1, 3[19,21,24] SRs had a low-quality level, and 1[20] SR had a very low-quality level; 3[19,21,24] SRs used the outcome FVC, 2[21,24] SRs had a low-quality level, and 1[19] SR had a very low-quality level; only 1[23] SR used the outcome FEV1%, and the quality level was very low; 6[19–21,23–25] SRs used the outcome FEV1/FVC. The quality grade of 3[21,23,25] SRs was low, and the other 3[19,20,24] SRs were very low.

Table 3 Tabular Presentation of Methodological Quality of Included SRs

Review	Item																Overall Quality
	1	2*	3	4*	5	6	7*	8	9*	10	11*	12	13*	14	15*	16	
Liao[19] 2015	Y	N	Y	PY	N	Y	PY	PY	Y	N	Y	N	N	N	N	N	Critically low
Zhang[20] 2016	Y	N	Y	PY	Y	N	PY	PY	Y	N	Y	Y	Y	Y	Y	N	Low
Zhao[21] 2019	Y	N	Y	PY	N	Y	N	PY	Y	N	Y	N	Y	N	Y	N	Critically low
Huang[22] 2019	Y	N	Y	PY	Y	Y	PY	Y	Y	N	Y	Y	Y	N	N	N	Critically low
Lu[23] 2020	Y	Y	Y	PY	Y	Y	PY	Y	Y	N	Y	N	Y	Y	N	N	Low
Yang[24] 2020	Y	Y	Y	PY	N	Y	PY	Y	Y	N	Y	Y	N	Y	N	Y	Critically low
Yun[25] 2021	Y	Y	Y	PY	Y	Y	PY	Y	Y	N	Y	Y	Y	N	N	Y	Low

Notes:*Critical item; Item 1; Did the research questions and inclusion criteria for the review include the components of PICO? Item 2. Did the report of the review contain an explicit statement that the review methods were established prior to the conduct of the review and did the report justify any significant deviations from the protocol? Item 3. Did the review authors explain their selection of the study designs for inclusion in the review? Item 4. Did the review authors use a comprehensive literature search strategy? Item 5. Did the review authors perform study selection in duplicate? Item 6. Did the review authors perform data extraction in duplicate? Item 7. Did the review authors provide a list of excluded studies and justify the exclusions? Item 8. Did the review authors describe the included studies in adequate detail? Item 9. Did the review authors use a satisfactory technique for assessing the risk of bias (RoB) in individual studies that were included in the review? Item 10. Did the review authors report on the sources of funding for the studies included in the review? Item 11. If meta-analysis was performed did the review authors use appropriate methods for statistical combination of results? Item 12. If meta-analysis was performed, did the review authors assess the potential impact of RoB in individual studies on the results of the meta-analysis or other evidence synthesis? Item 13. Did the review authors account for RoB in individual studies when interpreting/discussing the results of the review? Item 14. Did the review authors provide a satisfactory explanation for, and discussion of, any heterogeneity observed in the results of the review? Item 15. If they performed quantitative synthesis did the review authors carry out an adequate investigation of publication bias (small study bias) and discuss its likely impact on the results of the review? Item 16. Did the review authors report any potential sources of conflict of interest, including any funding they received for conducting the review?
Abbriviations: Y, yes; PY, partial yes; N, no.

6MWD

The included 7[19–25] SRs all reported the effect of breathing exercises on 6MWD in patients with COPD. The quality level of 3[23–25] SRs was low, and 4[19–22] SRs were very low. The results of the meta-analysis showed that: only 1[22] SRs showed no statistically significant difference, considering the possibility of the small sample size and/or irreversible pulmonary fibrosis structural changes in COPD patients; the remaining 6[19–21,23–25] SRs showed that breathing exercises can significantly improve the exercise endurance in COPD patients.

SGRQ

There are 4[21–23,25] SRs reporting the effect of breathing exercises on SGRQ in COPD patients. The quality level of 2[21,23] SRs is low, and 2[22,25] SRs are very low. 1[22] SR used descriptive analysis showed that after IMT intervention, the quality of life of patients was significantly improved; 3[21,23,25] SRs used meta-analysis: 1[25] showed that there was no significant difference between the experimental group and the control group, and 2[21,23] showed that breathing exercises could significantly improve the quality of life of patients.

Dyspnea

Four[21–23,25] SRs reported the effect of breathing exercises on dyspnea in patients with COPD. The quality level of 2[22,23] SRs was low, and 2[21,25] SRs was very low. Two[22,25] SRs used descriptive analysis, one showed that IMT could relieve dyspnea in COPD patients, and the other one showed that breathing exercises did not significantly improve dyspnea; 2[21,23] SRs used meta-analysis: one SR showed no statistically significant difference, another one showed that breathing exercises could significantly improve dyspnea in COPD patients.

Respiratory Muscle Strength

The outcomes of respiratory muscle strength are mainly PImax and PEmax. Three[22,23,25] SRs reported PImax: 2[22,23] SRs have a low-quality level, and 1[25] SR have a very low-quality level. The meta-analysis results showed that breathing exercises can significantly improve the inspiratory muscle strength of patients. Two[23,25] SRs reported PEmax: 1[23] SR was rated as low quality, the other one was rated as very low quality. One[23] SR showed that breathing training could significantly improve the expiratory muscle strength of patients, and another one conducted a subgroup analysis based on

different ethnic groups. The results showed that the expiratory muscle strength of Caucasian people was improved, but not increased in Asian people. Considering that this may be due to differences in interventions for patients of different races, as well as differences in the severity of COPD.

Discussion

This is the first overview of SRs to investigate the effectiveness of breathing exercises in COPD patients, with the aim of providing more scientific evidence for clinical decision-makers. We rigorously appraised the included SRs with the ROBIS tool, PRISMA statement, AMSTAR-2 scale, and GRADE system. Based on ROBIS tool, 4 SRs (57.14%) were rated as low risk of bias. With PRISMA checklist, we found that 5 SRs had some defects, and 2 SRs were relatively complete. The results of AMSTAR-2 suggested that 3 SRs were low quality, and the other 4 SRs were very low. GRADE evidence quality evaluation showed that among the 34 outcomes involved in the 7 studies, 19 were low-level outcomes, 15 were very low-level outcomes, and there were no moderate and high-level quality outcomes.

According to the ROBIS tool, we found a relatively high risk of bias in domain 2 and domain 4 of Phase 2. Domain 2 assessed whether omitted any original studies that meet the inclusion criteria. The results indicated that the researchers should involve appropriate databases and electronic sources to identify published reports, include methods additional to database searching, and use an appropriate and sensitive search strategy when conducting SRs/meta-analyses. In domain 4, the risk of bias in the synthesis of findings was high. Although all SRs synthesized data, we could not determine whether the data synthesis and analysis methods were appropriate for the research question posed, which may lead to the loss of some research results. The robustness of study results should be assessed by funnel plots or sensitivity analyses, and biases in primary studies should be taken into account.

The overview results of the PRISMA statement and AMSTAR-2 scale showed the included SRs had some reporting weaknesses and the overall methodological quality needed to be improved. This is mainly because although the included SRs followed the PICO principles, they did not design a reasonable study protocol and register before the start of the study; the grey literature was not searched when searching literature; the detailed list and reasons for the excluded SRs were not provided when screening literature; the analysis and discussion did not include an explanation for the risk of heterogeneity and bias; the source of funding and potential conflicts of interest were not disclosed. Therefore, it is suggested that researchers should strictly adhere to the PRISMA statement and AMSTAR-2 scale in future evaluation.

Although the conclusion of the SRs included in this study showed that breathing exercises have a certain effect on COPD patients, the GRADE systematic evaluation showed that the overall quality of evidence for the outcome indicators of the included SRs is low. Limitations and publication bias were the main factors for downgrading. The main reasons for the limitation were that the original study included in the literature did not completely and clearly report the randomization methods, blinding, allocation concealment, and loss of follow-up; the main reasons for publication bias were that the small number of included studies, all positive results and no assessment of publication bias. Therefore, in clinical research, we need to improve the quality of the original research as much as possible, and strictly standardize the research methods, so as to obtain more real and objective evidence support.

This overview suggests that although the quality of the available evidence is low, there is a certain role for breathing exercises in COPD patients. The specific modalities of breathing exercises in the included SRs were breathing gymnastics, IMT, EMT, PLB, DB, combined or not with other treatments (including usual care and medication). Regardless of the modality of breathing exercises, all of them have a certain positive effect on COPD. All seven included SRs reported on exercise endurance, with six showing that breathing exercises significantly improved patients' exercise endurance; six reported on lung function, with five showing that patients' lung function improved; and four reported on the quality of life, with three showing that patients' quality of life could be improved. Breathing exercises can not only exercise the respiratory muscles of COPD patients, improve their dyspnea symptoms, increase tolerance to physical activity, enhance physical fitness, and enable them to establish an effective breathing pattern, but can also be associated with the prevention and reduction of pulmonary function impairment due to hypoxia, carbon dioxide retention, and other causes. Adhering to respiratory training on the basis of conventional drug therapy can delay the progress of slow obstructive pulmonary disease to a certain extent.

To improve the evidence base for breathing exercises, there are several concerns that need to be resolved, including the heterogeneity of the primary studies and the lack of systematic evaluation and interpretation of the overall quality of the evidence within SRs. First, there was generally clinical heterogeneity across studies included within SRs, in terms of participants (phase of COPD), interventions (type, intensity, and frequency) and outcomes. The results of heterogeneous studies were often pooled within meta-analyses, influencing the results and conclusions of SRs. Importantly, meta-analyses only combine the results of studies with sufficient homogeneity.[26] Second, the quality of evidence includes consideration of within-study RoB (methodological quality), directness of evidence, heterogeneity, precision of effect estimates and risk of publication bias.[27] Therefore, systematic evaluation of certainty of evidence generated in the overview is difficult to achieve for several different methodological reasons, including the lack of standard methods for overviews, the use of overall scores to summarize RoB assessment and the certainty assessment of evidence. While the GRADE approach provides a systematic method for assessing the certainty of evidence, there remains uncertainty about the best way to implement this within overviews.[28]

Implications for Future Practice and Research

Due to its superior availability and relatively low clinical side effects, breathing exercises have become an important supplementary and alternative therapy for COPD. We found some positive evidence supporting the use of breathing exercises for COPD, although the GRADE quality of evidence was assessed as low. Because of these issues, more rigorous larger-scale and well-designed RCTs are needed to provide higher-quality evidence and assess the efficacy of breathing exercises for COPD. First, RCTs should follow appropriate guidelines, such as AMSTAR-2 scale and CONSORT40 (Consolidated Standards of Reporting Trials). Second, many different types of breathing exercises are used in clinical practice to treat COPD. Therefore, future comparative studies of different breathing exercise interventions are needed to determine the most effective method of breathing exercises. Third, all SRs must be pre-registered to promote transparency of processing and to avoid the risk of methodological bias. In addition, a critical assessment of the safety of breathing exercises for COPD needs to be conducted in clinical trials.

Limitations

There are several limitations in this overview. First, this study only included the studies published in Chinese or English, which were manually searched by researchers, and the relevant gray literature was not searched, so there was a certain selective bias. Second, although some overlap of primary articles within the included SRs could be expected, we did not explore these overlaps systematically. As a result, this may lead to inaccurate reporting of data, such as the number of participants and primary studies. Third, due to the apparent clinical and statistical heterogeneity among the included systematic reviews and the complex categories of interventions, we only provide a narrative summary of the effectiveness of interventions rather than a quantitative analysis. Finally, although the researchers strictly follow the PRISMA statement, AMSTAR-2 scale, and GRADE system assessed the quality of included SRs, the interference of subjective factors cannot be avoided in the evaluation, which will also produce a certain bias.

Conclusions

What is the exact effect of breathing exercises in the treatment of COPD? In our study, the methodological quality of the included SRs was varied, as well as the quality of evidence underlying these outcomes, which made it difficult to draw firm conclusions on this question. Therefore, more high-quality and large sample randomized controlled trials are urgently needed in the future. At the same time, it is hoped that researchers can strictly follow the PRISMA statement and AMSTAR-2 scale to standardize the research protocols and improve the level of evidence when conducting SRs, in order to obtain more high-quality research and provide a scientific decision-making basis for clinicians.

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Author Contributions

All authors made a significant contribution to the work reported, whether that is in the conception, study design, execution, acquisition of data, analysis and interpretation, or in all these areas; took part in drafting, revising or critically reviewing the article; gave final approval of the version to be published; have agreed on the journal to which the article has been submitted; and agree to be accountable for all aspects of the work.

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Disclosure

The authors declare that they have no conflicts of interest.

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