Breathing Exercises in Lung Cancer - A Systematic Review

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Abstract

BACKGROUND:
Lung cancer is a leading global cause of cancer-related mortality, with a significant impact on public health. Dyspnea and reduced quality of life are common among lung cancer patients. Breathing exercises have been explored as potential interventions to mitigate these symptoms. This systematic review aims to assess the comparative impact of various breathing techniques on dyspnea and quality of life in individuals diagnosed with lung cancer.

METHODS:
We conducted a comprehensive literature search across multiple databases, including Medline, EMBASE, AMED, and PsycINFO. The eligibility criteria included original research studies, encompassing randomized controlled trials, quasi-experimental investigations, and controlled before-after studies, involving adult individuals diagnosed with lung cancer. We evaluated various breathing techniques, such as diaphragmatic breathing, pursed-lip breathing, and incentive spirometry, and assessed outcomes related to dyspnea and quality of life.

RESULTS
The review included studies from different countries, primarily utilizing randomized controlled trials. The findings revealed that inspiratory muscle training, deep breathing exercises, and diaphragmatic breathing showed promise in reducing dyspnea and improving quality of life among lung cancer patients. Some studies highlighted the benefits of combined interventions, particularly when incorporating aerobic exercise. However, intervention protocols varied across studies, emphasizing the need for standardized guidelines in clinical practice.

CONCLUSION:
This systematic review underscores the potential benefits of breathing exercises in alleviating dyspnea and enhancing the quality of life in lung cancer patients. Multifaceted approaches may offer more comprehensive benefits. Further research with standardized protocols is essential to provide evidence-based recommendations for lung cancer rehabilitation.

KEYWORDS: Breathing exercises, Rehabilitation, Lung Cancer, Pulmonary

INTRODUCTION

Out of the various cancers, lung cancer has been reported to be the number one cause of cancer globally and accounts for approximately 1.8 million annual deaths. Moreover, 2 million people are diagnosed with lung cancer annually. These estimates are approximate with a large number of diagnoses and deaths going undetected, especially in the low- and middle-income countries. Reasons for the increasing prevalence have been attributed to ease of access to tobacco and tobacco products. This has also been suggested to be the reason for comparable incidence in men and women with more women taking up smoking including smoking cannabis as a recreational drug that is increasing in popularity worldwide (Denisenko, Budkevich, & Zhivotovsky, 2018; Fitzmaurice et al., 2019; Travis et al., 2015).

Leading risk factors for lung cancer have been identified as family history, smoking, radon from underground decay of uranium occurring naturally, and occupational hazards from working with various substances including asbestos, increasing air pollution, contact with arsenic, history of pulmonary tuberculosis, and HIV and emerging evidence points at risk from electronic cigarettes and other tobacco products (Thandra, Barsouk, Saginala, Aluru, & Barsouk, 2021).

Lung cancer cases in India are on the increase due to the increase in the various risk factors (Bray et al., 2018) with secondhand smoke being implicated as a risk factor for women with smoking spouses. The quality of life of persons diagnosed with lung cancer has been reported to be related to various factors. These include the stage at which the diagnosis was made, the severity of symptoms, and side effects (Reale & Di Maio, 2020). Other related factors have been identified as the severity and the number of symptoms accompanying the disease such as breathlessness, fatigue, cough, pain, and loss of appetite. Specifically, fatigue dyspnoea and cough have been reported to be related to the psychological dimension of quality of life. Although the course of the disease may not be altered, palliative care to improve symptom management has been recommended to improve the quality of life of the cancer patient and immediate family (Chabowski, Polanski, Jankowska-Polańska, Rosińczuk, & Szymanska-Chabowska, 2016; Polanski, Jankowska-Polanska, Rosinczuk, Chabowski, & Szymanska-Chabowska, 2016). Dyspnoea is a symptom that has been associated with an overall poorer quality of life after a cancer diagnosis. Dyspnoea leads to anxiety and greater distress. Measures to counter this symptom have been reported as various pharmacological measures including selective serotonin reuptake inhibitors, and benzodiazepines when symptoms are severe and the patient is in an advanced stage of the disease. Nonpharmacological measures include psychological interventions and relaxation techniques including yoga and breathing exercises.

The American Society of Clinical Oncology (ASCO) guidelines for the management of dyspnoea in adult patients with lung cancer were developed using an expert panel that reviewed the evidence and formulated recommendations. A systematic review of the Agency for Healthcare Research and Quality (AHRQ) framework was conducted to synthesize evidence for pharmacological and non-pharmacological interventions to address dyspnoea. The systematic review included randomized controlled trials (RCTs) and studies with observational design. The included studies spanned a period up to May 2020. The review which included 48 RCTs and two retrospective cohort studies was unable to find adequate evidence for pharmacological interventions. However, non-pharmacological interventions had limited evidence.

Studies provided evidence for breathing exercises, postural strategies assistive devices, and self-management with mixed results. Moreover, most of these were derived from management strategies for patients with chronic obstructive pulmonary disease (COPD) and were extrapolated to patients with lung cancer. Since these strategies were low cost and low risk, these methods can be recommended for patients.

Breathing exercises including pursed lip breathing, controlled breathing, and diaphragmatic breathing have been reported in patients with lung cancer. A Cochrane systematic review of breathing exercises in these patients found an improvement in exercise capacity but inconsistent evidence of the effect on dyspnoea (Polanski et al., 2016).

A systematic review published in 2018 to find evidence for breathing exercises on postoperative complications after lung resection in lung cancer patients included sixteen RCTs. The review found that breathing exercises were effective in decreasing postoperative pulmonary complications (PPCs) but found no difference in exercise capacity as measured by the 6-minute walk distance (6MWD.), and in addition, found an increase in pulmonary function parameters which were minor (Wang, Liu, Jia, & Xie, 2019).

The role of breathing exercises in alleviating symptoms and improving quality of life in persons with lung cancer has been reported with consistent low-quality evidence. A Cochrane review protocol on the Butkeyo breathing technique on symptom management in patients with asthma rationalizes the objective of the review by stating that although breathing techniques have been used in asthma for symptom control, various breathing techniques have different methods. Buteyko breathing techniques are based on the underlying principle that asthma is the body's reaction to "over-breathing". Buteyko breathing techniques, therefore, aim to increase the patient's awareness of breathing and thus normalize the rate of respiration and tidal volume (Wang et al., 2019). This principle is a paradigm shift from traditional breathing exercises emphasizing diaphragmatic involvement (Holloway & Ram, 2004).

Need for the study: Breathing exercises have been reported to affect dyspnoea and the quality of life of people with lung cancer. However, no well-designed study has been performed to our knowledge that compares various breathing techniques with the established breathing exercises in patients with lung cancer. This leads to the need for this study.

METHODOLOGY

Research question

What is the comparative impact of various breathing techniques, on dyspnea and the quality of life in individuals diagnosed with lung cancer?

Study design

This systematic review is being conducted in strict accordance with the guidelines provided by the Centre for Reviews and Dissemination (Booth, Wright, & Outhwaite, 2010) and follows the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) guidelines (Page et al., 2021) meticulously.

Databases and information sources

A comprehensive literature retrieval was systematically undertaken, employing a pre-established and exhaustive search strategy, across multiple electronic databases. The

databases encompassed in this systematic review encompassed Medline (Ovid), Excerpta Medica Database (EMBASE), Allied and Complementary Medicine Database (AMED), and PsycINFO. In addition to this, a thorough citation search was conducted within Google Scholar to encompass any potentially overlooked articles due to insufficient indexing. Furthermore, a meticulous manual examination was conducted within the Neurology India journal and other scientific journals specialized in neurological rehabilitation. Additionally, the bibliographies of the articles included in the review were meticulously screened to identify any potential additional contributions to the research being conducted.

Search strategy

The keywords were determined through various approaches. Firstly, the authors leveraged their expertise and knowledge in the field to identify relevant terms. Secondly, internationally recognized websites dedicated to lung cancers, such as the American Lung Association (https://www.lung.org), National Cancer Institute (https://www.cancer.gov), and the Lung Cancer Research Foundation (https://www.lungcancerresearchfoundation.org) were consulted to gather additional keywords. Thirdly, a review of the top 20 outcomes derived from a Google search utilizing the phrase 'Lung Cancer" was conducted to pinpoint frequently addressed subjects about the topic at hand. Finally, systematic reviews that address similar themes were consulted to acquire supplementary keywords of relevance (Cooper et al., 2003; Saab et al., 2022). The search strategy is given in Table 1.

Table 1: Search strategy

Condition related terms	
1.	Lung Neoplasms (MeSH)
2.	Lung. ti, ab.
3.	Pulm*.ti,ab.
4.	Neoplas*.ti,ab.
5.	Malignan*.ti,ab.
6.	Tumo*r.ti,ab.
7.	2OR 3 OR 4 OR 5
8.	Cancer. ti, ab.
9.	7 AND 8
10.	1 OR 9
Intervention related terms	
11.	Breathing Exercises (MeSH)
12.	Breathing technique.ti,ab.
13.	Diaphragmatic breathing.ti,ab.
14.	Buteyko breathing
15.	11 OR 12OR 13OR 14
Combined	
16.	10 AND 15

Study selection

A solitary reviewer conducted an extensive literature search across various databases, and the resulting citations were exported to reference management software, specifically Mendeley. The eligibility of trials was independently evaluated by two reviewers. In the initial stage, trials were excluded if both reviewers independently concurred on their exclusion based on a review of the title and abstract. Subsequently, the remaining articles were acquired in full text and scrutinized by the two reviewers in the second stage. Any discrepancies that emerged were deliberated upon until a consensus was achieved. In unresolved disagreements, a third reviewer was available for consultation, although their intervention was not required.

Eligibility criteria

The eligibility criteria are given in Table 2.

Table 2: Eligibility criteria

	Inclusion criteria	Exclusion criteria
Study type	Only original research studies, encompassing randomized controlled trials (RCTs), quasi-experimental investigations, and	Systematic reviews, meta-analyses, case reports, and abstracts were not included in the study.

	controlled before-after studies, were deemed suitable for inclusion.	
Population	Studies that involve adult individuals (18 years or older) diagnosed with lung cancer of any stage or type. Studies with a diverse range of lung cancer histological subtypes capture potential variations in treatment responses.	Studies that exclusively focus on populations with comorbidities that significantly affect dyspnea and quality of life but are not directly related to lung cancer.
Intervention	Studies that investigate various breathing techniques, such as diaphragmatic breathing, pursed-lip breathing, incentive spirometry, and other relevant methods. Studies that explicitly state the protocol and duration of the breathing technique interventions. Studies with variations in the frequency and duration of breathing technique interventions to assess dose-response relationships.	Studies with co-interventions along with breathing exercises Studies with poorly defined or irrelevant comparison groups that do not contribute to the research question.
Outcome measures	Studies had to report outcome measures related to dysnoea and quality of life.	NA

Assessment of methodological quality

The quality assessment tool employed for evaluating the risk of bias was the Joanna Briggs Institute (JBI) risk of bias tool (Barker et al., 2023).

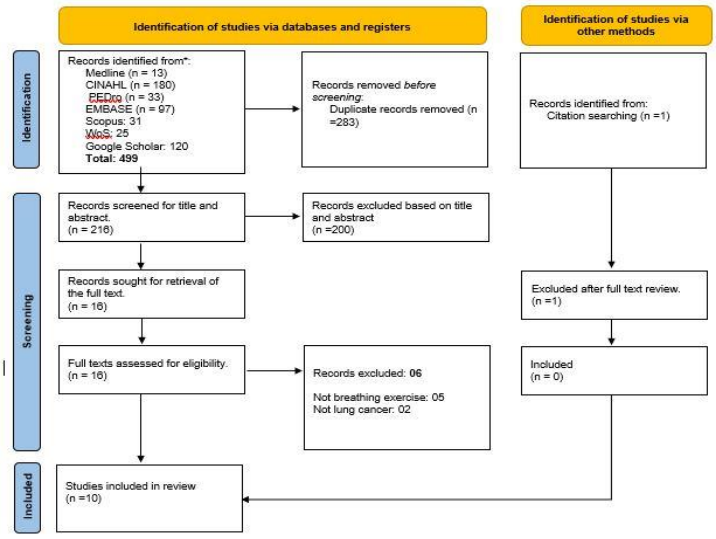
Data extraction

Two independent reviewers conducted autonomous data extraction from the studies incorporated in the research. A predefined data extraction form was employed to gather essential information systematically. The extracted data encompassed details about the interventions (e.g., specific breathing exercises, duration, frequency), the outcome measures assessed, and findings related to dyspnea and quality of life. Any disparities or discrepancies in the extracted data were resolved through a collaborative discussion between the reviewers. Moreover, an alternate reviewer was accessible for consultation, though their intervention proved unnecessary.

RESULTS

The process of literature search is summarised in Figure 1.

Figure 1: Summary of literature search



Quality appraisal using the JBI risk of bias tool is given in Table 3.

Table 3: Quality appraisal

Study	1	2	3	4	5	6	7	8	9	10
Bredin 1999(Bredin et al., 1999)	+	+	+	+	+	-	-	+	+	+
Chen 2021 (Ma et al., 2021)	+	+	+	+	+	-	-	+	+	+
Garcia 2017 (Sebio García et al., 2017)	+	+	+	+	+	+	+	+	-	+
Huang 2017 (Huang et al., 2017)	+	+	+	+	+	-	-	+	+	+
Jastrze˛bski 2015 (Jastrzębski et al., 2015)	+	+	+	+	+	+	+	+	+	+
Jonnson 2019 (Jonsson et al., 2019)	+	+	+	+	+	-	-	+	-	+
Molassiotis 2014 (Molassiotis, Charalambous, Taylor, Stamataki, & Summers, 2015)	+	+	+	+	+	-	-	+	-	+
Saetan 2020 (Saetan, Chaiviboontham, Pokpalagon, & Chansriwong, 2020)	+	+	+	+	+	-	-	+	+	+
Sahin 2022 (Şahin et al., 2022)	+	+	+	+	+	+	+	+	-	+
Yorke 2015	+	+	+	+	+	-	-	+	+	+
Zou 2022 (Zou et al., 2022)	+	+	+	+	+	+	+	+	+	+

The majority of the included studies had good quality and less bias.

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The characteristics of the included studies are outlined in Table 4-6

Table 4: General characteristics of the study

Study	**Country**	**Study design**	**Mean age**	**Sample size** (Men/ Women/ Total)			**Outcome measure**
				Control group	Intervention group	Total	
Bredin 1999(Bredin et al., 1999)	London	Randomized controlled trial	IG-68 CG-67	35/17/52	41/10/51	119	Visual analogue scales measuring distress due to breathlessness, breathlessness at best and worst, WHO performance status scale
Chen 2021 (Ma et al., 2021)	China	Pilot Study	Combined IG-**56.97±7.09** Breathing Exercise-**58±6.92** CG-**54.91± 10.09**	Breathing Exercise-**12/20/32**	Combined IG-**13/21/34**	68	Dyspnea, 6MWT, Inspiratory Capacity

Garcia 2017 (Sebio García et al., 2017)	Spain	Randomized, single-blinded controlled trial.	Rehabilitation G-70.9 ± 6.1 CG-69.4 ± 9.4	11/1/12	9/1/10	40	Health-related quality of life (Short-Form 36)
Huang 2017 (Huang et al., 2017)	China	Randomized controlled trial	Combined PR-**63.0±8.7** Single IMT-**64.1±5.3** CG- **63.6±6.5**	21/9/30	Single IMT-**21/9/30** Combined PR-**20/10/30**	90	Pulmonary Function Test, and Global QoL
Jastrze˛bski 2015 (Jastrzębski et al., 2015)	Poland		Rehabilitation G- 59 ± 7 CG-	//8	10/2/12	20	6MWT, Pulmonary function test, Dyspnea (Modified dyspnea scale of the Medical Research Council; basic dyspnea index)
Jonnson 2019 (Jonsson et al., 2019)	Sweden	Single-blinded randomized controlled trial	Study G-68.7± 7.4 CG- 68.4±8.3	18/35/53	29/25/54	132	6MWT. spirometry, and dyspnea
Molassiotis 2014 (Molassiotis, Charalambous, Taylor, Stamataki, & Summers, 2015)	Hong Kong	Pilot Feasibility randomized trial	69.58±.35		37/9/46	104 CG-23 IG-24	Spirometry, Dyspnea (modified Borg Scale); quality of life using the short form Chronic Respiratory Disease Questionnaire
Saetan 2020 (Saetan, Chaiviboontham, Pokpalagon, & Chansriwong, 2020)	Thailand	Quasi-experimental research study	Experimental G-65.80±8.80 CG-73.00±7.63	6/8/14	9/5/14	28	Dyspnea Scale
Sahin 2022 (Şahin et al., 2022)	Turkey	Single center Prospective study	Median age PR Group-66 CG- 64	28/5/33	25/8/33	66	Pulmonary function test Quality of lie (SF-36)
Yorke 2015	UK	Multi-centre randomized controlled nonblinded parallel group feasibility trial	CG- 67.6± 9.1 RDSI-LC: 67.8± 10.1	25/26/51	22/28/50	101	Breathlessness was assessed using six 0–10 numerical rating scales (NRS) and the Dyspnea-12 (D-12) scale.

							Quality of life was using the EQ-5D-3L.
Zou 2022 (Zou et al., 2022)	China	Randomised controlled trial with repeated measures	EG-60.09 ±9.61 CG-56.84±9.41	26/19/45	18/27/45	183	Pulmonary function test and Borg Scale.

The table summarizes key details from various studies investigating interventions for lung cancer patients. These studies predominantly utilize randomized controlled trials and other research designs. The outcomes measured vary but commonly include dyspnea, exercise capacity (e.g., 6MWT), inspiratory capacity, and quality of life (e.g., SF-36). Additionally, different countries conducted these studies, including China, Spain, Sweden, Hong Kong, Thailand, Turkey, and the UK.

Table 5: Treatment-related characteristics

Study	**Treatment characteristics**		**Follow up duration**
	Group 1	**Group 2**	
Bredin 1999	Patients in the intervention group received tailored breathlessness management (including breathing exercises) and lung function optimization interventions during weekly nursing clinic visits, spanning three to eight weeks.	Standard care*	4 weeks, 8 weeks
Chen 2021	One group only did breathing exercises and the other group did breathing exercises (inspiratory muscle training, incentive breathing for 15 minutes during each session, twice daily) technique and aerobic exercise.	Standard care*	
Garcia 2017	Breathing exercises twice daily at home utilizing a volume-focused incentive spirometer three to five times per week.	Standard care*	3 months
Huang 2017	One group only breathing exercises (abdominal breathing training and thoracic 20 minutes at least four times daily) and the other group breathing exercise technique and aerobic exercise.	Standard care*	
Jastrze˛bski 2015 (Jastrzębski et al., 2015)	Aerobic and respiratory exercises were conducted daily for 30 minutes, five times a	Observation without any physical rehabilitation.	

	week. Additionally, individualized programs included exercises for respiratory and peripheral muscles of the upper and lower extremities, utilizing a cycle ergometer.		
Jonnson 2019 (Jonsson et al., 2019)	Patients performed frequent deep breathing exercises throughout the day during the early postoperative period. They also received hospital-based physiotherapy once or twice daily, lasting around 10-30 minutes per session. This physiotherapy included deep breathing exercises with a positive expiratory pressure (PEP) of 10 cm H2O, as well as exercises to improve thoracic and shoulder range of motion.	Standard care*	3 months
Molassiotis 2014 (Molassiotis, Charalambous, Taylor, Stamataki, & Summers, 2015)	Inspiratory Muscle training .	Standard care*	3 month
Saetan 2020 (Saetan, Chaiviboontham, Pokpalagon, & Chansriwong, 2020)	Breathing exercise and respiratory training	Standard care*	Week 6 and Week 8
Sahin 2022 (Şahin et al., 2022)	Breathing exercises (pursed-lip breathing, diaphragmatic breathing, and thoracic expansion exercises), relaxation and stretching exercises, exercises to strengthen the peripheral muscles and aerobic exercises.	Respiratory exercises only	
Yorke 2015	Controlled breathing techniques, including diaphragmatic breathing exercises and calming practices, were performed twice daily.	Standard care*	12 Weeks
Zou 2022 (Zou et al., 2022)	Breathing exercise pre-surgery thrice daily for 15-20 minutes per session. Post-surgery,	The control group received routine nursing measures	3 Months

	post-surgery breathing exercises with limb movements were conducted for 10-15 minutes, thrice daily.		

*Standard care refers to the treatment and interventions that are routinely performed after lung surgery without any additional focus on pre-surgical breathing exercises.

These interventions range from tailored breathlessness management with weekly nursing clinic visits to home-based breathing exercises, often combined with aerobic exercise. Notably, several studies compared these interventions to standard care, allowing for a comprehensive evaluation of their effectiveness. The follow-up durations vary, with assessments conducted over 4 weeks to 12 weeks, providing insights into both short-term and moderately longer-term outcomes.

Table 6: Principal findings

Study	Principal findings	Effect size
Bredin 1999(Bredin et al., 1999)	The patients in the breathing exercise group demonstrated no statistically significant improvements in dyspnoea, as assessed using Visual Analogue Scales (VAS) to measure distress related to breathlessness (p:0.09). There was no statistically significant difference in the quality of life as assessed using the Rotterdam symptom checklist (quality of life component) (p:0.25).	Dyspnoea VAS: 0.25 Quality of life: 0.031
Chen 2021 (Ma et al., 2021)	Both intervention groups showed significant improvements in dyspnoea, exercise capacity, and inspiratory capacity. Moreover, patients in the combined intervention group experienced even greater improvements in these outcomes compared to those assigned to the breathing exercise group. No between-group difference in dyspnoea (p:0.85). However, there was a statistically significant difference in inspiratory capacity (0.042).	Dyspnoea: 1.2 Inspiratory capacity: 0.32
Garcia 2017 (Sebio García et al., 2017)	Both groups improved significantly after treatment. However, there was no statistically significant difference between groups in dyspnoea (p:	Not reported/ No data available to calculate
Huang 2017 (Huang et al., 2017)	The combined group yielded significant improvements in quality of life than breathing only group (p:0.035)	Effect size: 0.72
Jastrze˛bski 2015 (Jastrzębski et al., 2015)	Statistically significant dyspnoea scores in the intervention group (p:0.05). Only the physical functioning component of the QoL (among 10 items) was statistically significant (p:0.031).	Dyspnoea: 0.61 QoL: 0.68
Jonnson 2019 (Jonsson et al., 2019)	No statistically significant difference between groups in dyspnoea.	Dyspnoea: 0.32
Molassiotis 2014 (Molassiotis, Charalambous, Taylor, Stamataki, & Summers, 2015)	Statistically significant differences in dyspnoea and (p=0.03), ability to cope with breathlessness (p=0.01) in the breathing exercise group.	Dyspnoea: 0.81 Breathlessness: 0.76
Saetan 2020 (Saetan, Chaiviboontham, Pokpalagon, & Chansriwong, 2020)	A statistically significant difference in mean dyspnea scores was observed between the experimental group and the control group (p < .050).	Not reported/ No data available to calculate
Sahin 2022 (Şahin et al., 2022)	In the breathing exercise group, there were significant improvements in quality of life (QoL) measures, including Short Form-36 physical function, mental health, and vitality	QoL:0.8 Dyspnoea: 0.76

	scores. Additionally, dyspnea scores significantly decreased ($p < 0.001$).	
Yorke 2015	Significant improvements in the breathing exercise group ($p < .050$).	Not reported/ No data available to calculate
Zou 2022 (Zou et al., 2022)	No significant difference between groups.	Dyspnoea: 0.32

DISCUSSION:

This systematic review aimed to comprehensively assess the impact of different breathing techniques on dyspnea and quality of life in individuals diagnosed with lung cancer. The findings from the included studies provide valuable insights into the potential benefits of these interventions for improving the well-being of lung cancer patients. In this general discussion, we will first summarize the key findings and their implications. We will then address the strengths and weaknesses of the evidence, and limitations of this review, and offer recommendations for future research in this important area.

Key Findings and Implications

The included studies investigated a wide range of breathing techniques, including diaphragmatic breathing, inspiratory muscle training, deep breathing exercises, and others. The outcomes assessed primarily focused on dyspnea and quality of life. While the heterogeneity in interventions and outcome measures posed challenges, several notable findings emerged.

First, inspiratory muscle training, deep breathing exercises, and diaphragmatic breathing demonstrated promising results in improving dyspnea and quality of life in lung cancer patients. These techniques were associated with statistically significant reductions in dyspnea scores and improvements in various domains of quality of life, such as physical function, mental health, and vitality.

Second, some studies highlighted the importance of combined interventions. For instance, Chen et al. (2021) reported that a combined intervention group, which included both breathing exercises and aerobic exercise, exhibited greater improvements in inspiratory capacity compared to the breathing exercise-only group. This suggests that a multifaceted approach to lung cancer rehabilitation, combining different therapeutic modalities, may yield more comprehensive benefits.

Third, the duration and frequency of breathing exercises varied across studies, making it challenging to establish a standardized protocol. However, the positive outcomes observed in many of these studies underscore the potential benefits of incorporating breathing exercises into the care of lung cancer patients.

Strengths and Weaknesses of the Evidence

The strength of the evidence lies in the diverse study designs included in this systematic review. The incorporation of randomized controlled trials, quasi-experimental studies, and controlled before-after studies enhances the generalizability of the findings to different clinical settings. The rigorous quality appraisal process further ensures that the evidence is derived from studies with a lower risk of bias.

However, the evidence also exhibits weaknesses, primarily stemming from the heterogeneity of interventions and outcome measures. The wide variety of breathing techniques and the lack of standardized outcome measures made it challenging to perform a meta-analysis. Consequently, the synthesis of evidence relied on a narrative approach, limiting the ability to provide quantitative assessments of the interventions' effects.

Additionally, the potential for publication bias and language bias introduces uncertainty into the overall assessment. Studies with positive results may be more likely to be published, leading to an overestimation of treatment effects. Furthermore, the review's language inclusion criteria were not explicitly mentioned, potentially excluding valuable studies published in languages other than English.

Limitations

Several limitations should be considered when interpreting the results of this systematic review. The diversity in breathing techniques investigated across studies introduces variability in the interventions, making it difficult to draw generalized conclusions. Future research could benefit from conducting subgroup analyses based on the types of techniques to provide more targeted recommendations.

Furthermore, the relatively short follow-up durations in many of the included studies limited the assessment of long-term effects. Longitudinal studies with extended follow-up periods would provide valuable insights into the sustainability of the observed improvements in dyspnea and quality of life.

The lack of standardized outcome measures across studies also hindered the ability to conduct a meta-analysis. Future studies in this area should consider using common measures to facilitate data synthesis and comparisons.

CONCLUSION

In conclusion, the findings from this systematic review suggest that various breathing techniques have the potential to improve dyspnea and quality of life in individuals diagnosed with lung cancer. Inspiratory muscle training, deep breathing exercises, and diaphragmatic breathing, in particular, appear promising in enhancing the well-being of these patients. However, the heterogeneity of interventions and outcome measures warrants caution in drawing definitive conclusions.

Future research in this field should prioritize the standardization of outcome measures, enabling more

robust comparisons across studies. Long-term follow-up studies are needed to assess the sustainability of the effects of breathing techniques, and comparative effectiveness studies could provide valuable insights into the relative benefits of different techniques. Additionally, incorporating patient-centered outcomes and exploring multidisciplinary approaches are essential steps toward improving the holistic care of lung cancer patients.

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