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Clinical effects of respiratory muscle training in patients with chronic obstructive pulmonary disease

Efeitos clínicos do treinamento muscular respiratório em pacientes com doença pulmonar obstrutiva crônica

Efectos clínicos del entrenamiento de los músculos respiratorios en pacientes con enfermedad pulmonar obstructiva crónica

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ABSTRACT

Objective: This study aimed to synthesize and critically analyze evidence from randomized controlled trials investigating the effects of RMT on functional improvement and other clinical outcomes in patients with COPD. **Methods:** An integrative review was conducted using the National Library of Medicine databases, including PubMed. Randomized controlled trials published between 2020 and 2024 were considered eligible. **Results:** Eight studies met the predefined inclusion criteria and were included in the final analysis. RMT was associated with significant improvements in inspiratory muscle strength, exercise tolerance, dyspnea, and health-related quality of life, both as a standalone intervention and when combined with other rehabilitation strategies. Although not all spirometric parameters demonstrated consistent changes across studies, most trials reported clinically relevant benefits in functional and patient-centered outcomes. **Final considerations:** RMT appears to be a safe, feasible, and potentially effective strategy in the rehabilitation of patients with COPD and may be considered an integral component of comprehensive therapeutic interventions.

Keywords: COPD, Respiratory muscle training, Integrative review.

RESUMO

Objetivo: Sintetizar as evidências de ensaios clínicos randomizados que investigaram os efeitos do treinamento muscular respiratório (TMR) na melhora funcional e em outros desfechos clínicos em pacientes com DPOC. **Métodos:** Foi realizada uma revisão integrativa utilizando as bases de dados da Biblioteca Nacional de Medicina, incluindo o PubMed. Ensaios clínicos randomizados publicados entre 2020 e 2024 foram considerados elegíveis. **Resultados:** Oito estudos atenderam aos critérios de inclusão predefinidos e

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foram incluídos na análise final. O TMR foi associado a melhorias significativas na força muscular inspiratória, tolerância ao exercício, dispneia e qualidade de vida relacionada à saúde, tanto como intervenção isolada quanto quando combinado com outras estratégias de reabilitação. Embora nem todos os parâmetros espirométricos tenham demonstrado alterações consistentes entre os estudos, a maioria dos ensaios relatou benefícios clinicamente relevantes em desfechos funcionais e centrados no paciente. **Considerações finais:** O TMR parece ser uma estratégia segura, viável e potencialmente eficaz na reabilitação de pacientes com DPOC e pode ser considerado um componente integral de intervenções terapêuticas abrangentes.

Palavras-chave: DPOC, Treinamento muscular respiratório, Revisão integrativa.

RESUMEN

Objetivo: Este estudio tuvo como objetivo sintetizar y analizar críticamente la evidencia de ensayos controlados aleatorizados que investigaron los efectos del RMT en la mejora funcional y otros resultados clínicos en pacientes con EPOC. **Métodos:** Se realizó una revisión integradora utilizando las bases de datos de la Biblioteca Nacional de Medicina, incluyendo PubMed. Se consideraron elegibles los ensayos controlados aleatorizados publicados entre 2020 y 2024. **Resultados:** Ocho estudios cumplieron con los criterios de inclusión predefinidos y se incluyeron en el análisis final. El RMT se asoció con mejoras significativas en la fuerza de los músculos inspiratorios, la tolerancia al ejercicio, la disnea y la calidad de vida relacionada con la salud, tanto como intervención independiente como cuando se combinó con otras estrategias de rehabilitación. Aunque no todos los parámetros espirométricos mostraron cambios consistentes en todos los estudios, la mayoría de los ensayos informaron beneficios clínicamente relevantes en los resultados funcionales y centrados en el paciente. **Consideraciones finales:** El RMT parece ser una estrategia segura, factible y potencialmente efectiva en la rehabilitación de pacientes con EPOC y puede considerarse un componente integral de las intervenciones terapéuticas integrales.

Palabras clave: EPOC, Entrenamiento de los músculos respiratorios, Revisión integradora.

INTRODUCTION

Chronic Obstructive Pulmonary Disease (COPD) is a progressive respiratory condition characterized by persistent airflow limitation, generally associated with chronic inflammatory changes in the airways and lung parenchyma. Beyond pulmonary impairment, the disease is associated with significant systemic repercussions that substantially affect patients' functional capacity. According to estimates from the Global Burden of Disease (GBD) study, COPD affects approximately 212.3 million people worldwide and is currently the third leading cause of death globally, accounting for nearly 3 million deaths annually (GBD CHRONIC RESPIRATORY DISEASE COLLABORATORS, 2020). The pathophysiology of COPD involves expiratory airflow obstruction, air trapping, and pulmonary hyperinflation, mechanisms that increase the work of breathing and contribute to the development of dyspnea, the hallmark symptom of the disease. Persistent breathlessness reduces exercise tolerance, promotes physical inactivity, and initiates a cycle of progressive physical deconditioning. Consequently, individuals with COPD frequently experience difficulties performing activities of daily living, such as walking, climbing stairs, carrying out household tasks, and self-care activities, resulting in loss of functional independence and substantial impairment in quality of life. Furthermore, recurrent exacerbations and COPD-related hospitalizations are associated with accelerated decline in lung function, increased healthcare costs, and poorer clinical outcomes, making COPD a major public health challenge worldwide (GBD CHRONIC RESPIRATORY DISEASE COLLABORATORS, 2020).

In this context, Respiratory Muscle Training (RMT) has been widely employed as a therapeutic strategy to mitigate some of the limitations imposed by the disease. Inspiratory muscle weakness, particularly involving the diaphragm and intercostal muscles, is commonly observed in individuals with COPD as a consequence

of chronic pulmonary hyperinflation, altered thoracic mechanics, and persistently increased ventilatory demand. This muscular dysfunction contributes to a greater respiratory effort during daily activities and physical exercise, intensifying the perception of dyspnea and reducing functional performance. RMT promotes physiological adaptations through the application of the progressive overload principle, stimulating increases in respiratory muscle strength and endurance. Evidence has demonstrated that resistance-based respiratory muscle training improves inspiratory muscle function, enhances ventilatory efficiency, reduces the perception of respiratory effort, and increases exercise tolerance (GLOBAL INITIATIVE FOR CHRONIC OBSTRUCTIVE LUNG DISEASE, 2021; WINKLE MJ e SANKARI A, 2023). These benefits result from structural and functional adaptations, including muscular hypertrophy, increased muscle fiber cross-sectional area, enhanced oxidative capacity, and modulation of muscle fiber phenotypes. Consequently, reducing the load imposed on the respiratory muscles may contribute to lower dyspnea perception during exertion and improved functional capacity in patients with COPD. Moreover, emerging evidence suggests that the effects of RMT may be further enhanced when combined with other physiotherapeutic and multidisciplinary interventions, including pulmonary rehabilitation programs, aerobic exercise training, resistance training, noninvasive ventilation, manual therapy, and telerehabilitation strategies, thereby maximizing its impact on clinical and functional outcomes (GLOBAL INITIATIVE FOR CHRONIC OBSTRUCTIVE LUNG DISEASE, 2021; WINKLE MJ e SANKARI A, 203).

Although COPD remains an incurable disease, non-pharmacological interventions play a fundamental role in its management, particularly in reducing symptoms, preserving functional capacity, and improving quality of life. In this regard, RMT represents an important component of respiratory physiotherapy and may be implemented either as a standalone intervention or in combination with other therapeutic modalities. Previous studies have demonstrated that RMT can improve inspiratory muscle strength, exercise capacity, dyspnea control, and functional performance, outcomes that are directly associated with patient autonomy and participation in daily activities (LOTTERS F, et al., 2002; GEDDES EL, et al., 2005; BEAUMONT M, et al., 2018; LIU X, et al., 2024). Given the increasing use of this intervention across different rehabilitation settings and the diversity of protocols described in the literature, a comprehensive synthesis of the available evidence regarding physiotherapeutic interventions incorporating RMT in individuals with COPD is warranted. Therefore, the present study aims to review and critically analyze findings from randomized controlled trials investigating the effectiveness of RMT in improving functional outcomes in this population.

METHODS

This integrative review was conducted to address the following research question: “What are the effects of respiratory muscle training on clinical outcomes, functional capacity, and quality of life in adult patients with Chronic Obstructive Pulmonary Disease (COPD)?” The literature search was conducted in March 2025 and included studies published between January 2020 and December 2024. The databases consulted were the National Library of Medicine (NLM) and PubMed. The search strategy was developed using the Health Sciences Descriptors (DeCS) and Medical Subject Headings (MeSH) terms “Respiratory Muscle Training” and “COPD”, combined using the Boolean operator AND. To increase search specificity, the filters “Randomized Controlled Trial”, “Humans”, and “Last 5 Years” were applied.

Eligibility Criteria

Studies were included if they met the following criteria: (1) randomized controlled trials; (2) participants aged 18 years or older with a confirmed diagnosis of COPD; (3) evaluation of respiratory muscle training as an isolated intervention or combined with another rehabilitation strategy; (4) publication in English, Portuguese, or Spanish; and (5) publication within the last five years. Studies involving other respiratory diseases, mixed populations without separate COPD analysis, animal experiments, conference abstracts, review articles, editorials, and studies whose primary intervention was unrelated to respiratory muscle training were excluded.

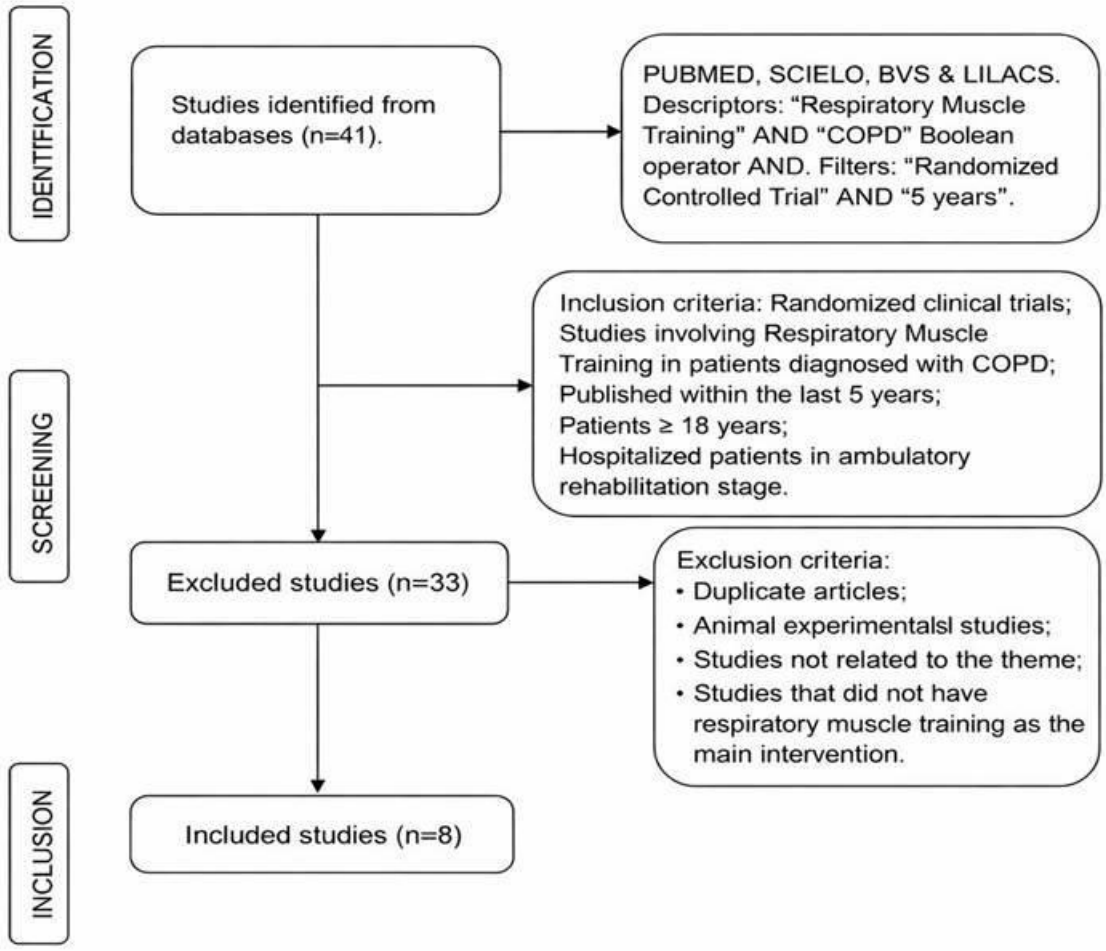
Study Selection and Data Extraction

The literature search yielded 41 potentially eligible studies. Study selection was performed in three stages: title screening, abstract screening, and full-text assessment. Study selection was conducted independently by two reviewers. Disagreements regarding study eligibility were resolved through discussion and reassessment of the full text until consensus was achieved. Studies were included only when respiratory muscle training represented a central component of the intervention and when outcomes in adult patients with COPD were clearly reported.

Data was extracted using a standardized data extraction form developed in Microsoft Excel. The following information was collected: author, year of publication, sample size, mean age of participants, COPD severity, intervention characteristics, training device, training load, weekly frequency, intervention duration, comparator group, and primary outcomes assessed. Outcomes of interest included inspiratory muscle strength, dyspnea, exercise tolerance, pulmonary function, quality of life, hospital readmissions, and functional performance.

Because only randomized controlled trials were included, methodological quality was assessed descriptively, considering randomization procedures, allocation of control groups, completeness of outcome reporting, and follow-up duration. These methodological aspects were considered during data interpretation to enhance the robustness and clinical relevance of the findings. The study selection process is summarized in the flow diagram presented in **Figure 1**.

Figure 1 - Flowchart.



Source: Oliveira AGO, et al., 2026.

RESULTS

Study Characteristics

The eight included studies demonstrated considerable heterogeneity regarding intervention protocols, although all investigated respiratory muscle training (RMT) as a central component of treatment. The interventions included home-based RMT supported by Internet of Things technology, RMT combined with manual therapy, inspiratory muscle training associated with whole-body exercise programs, sequential inspiratory muscle training combined with non-invasive positive pressure ventilation, breathing retraining strategies, and telerehabilitation approaches. The total sample comprised 446 patients with COPD, and intervention duration ranged from 4 to 12 weeks.

Regarding clinical outcomes, improvements in inspiratory muscle strength were among the most consistent findings, with several studies reporting significant increases in maximal inspiratory pressure (PImax). Reductions in dyspnea were also frequently observed through improvements in mMRC and Borg scale scores. Exercise tolerance and functional capacity improved in most studies, as demonstrated by gains in the 6-minute walk test, exercise time, balance performance, mobility, and perceived exertion.

Quality of life outcomes showed favorable results, with reductions in CAT and SGRQ scores and improvements in patient-reported measures. Additionally, one study reported reduced hospital readmission rates following a technology-assisted home-based intervention. Although some studies identified improvements in ventilatory efficiency and selected ventilatory parameters, changes in spirometric measures were less consistent. Overall, the most robust benefits of RMT were observed in functional and patient-centered outcomes, particularly inspiratory muscle strength, dyspnea reduction, exercise tolerance, and quality of life.

Table 1 - Summary of included studies.

Author(Year)	Sample (N)	Intervention	Comparator	Main Outcomes
Chen et al. (2024)	78	IoT-based home RMT (12 weeks)	Usual care	↑ PImax, ↓ mMRC, ↓ CAT, ↓ hospital readmissions
Buran Cirak et al. (2022)	60	RMT + Manual therapy (12 weeks)	RMT alone	↑ PImax, ↑ 6MWT (65m), ↓ mMRC (1 point)
Ceyhan & Tekinsoy Kartin (2022)	67	Pursed-lip breathing + inhaler training (4 weeks)	Inhaler training only	↓ Dyspnea, ↑ QoL
Tounsi et al. (2021)	32	IMT + whole-body endurance training (8 weeks)	Endurance training alone	↑ Berg Balance Scale (6.3 pts), ↑ PImax (15.2 cmH_2O), ↓ TUG (1.4s)
Gonzalez-Montesinos et al. (2021)	20	Nasal restriction device (FeelBreathe®) + exercise (8 weeks)	Exercise alone	↑ Ventilatory efficiency, ↓ VE/VCO_2
Koch et al. (2020)	13	High-intensity IMT + PAV during exercise	PAV alone	↑ Exercise time (111s), ↓ dyspnea, ↓ neuro-ventilatory uncoupling
Lei et al. (2023)	100	Sequential IMT + NIPPV (8 weeks)	NIPPV alone	↑ 6MWT (>50m), ↓ SGRQ (>10 pts), ↓ dyspnea
Ataç et al. (2024)	26	Telerehabilitation with active exercises	Cognitive telerehabilitation	↑ Peripheral muscle strength, ↓ perceived exertion

Abbreviations: IMT, inspiratory muscle training; RMT, respiratory muscle training; PAV, proportional assisted ventilation; NIPPV, non-invasive positive pressure ventilation; PImax, maximal inspiratory pressure; 6MWT, 6-minute walk test; mMRC, modified Medical Research Council dyspnea scale; CAT, COPD Assessment Test; QoL, quality of life; SGRQ, St. George's Respiratory Questionnaire; TUG, Timed Up and Go test; VE/VCO_2, ventilatory equivalent for carbon dioxide.
Source: Oliveira AGO, et al., 2026.

DISCUSSION

Respiratory Muscle Training as a Standalone Intervention

Respiratory Muscle Training (RMT) has been investigated as an independent intervention to improve key clinical outcomes in patients with COPD. The findings from recent randomized controlled trials consistently demonstrate its effectiveness in enhancing inspiratory muscle strength, exercise tolerance, and quality of life, while reducing dyspnea.

Chen Q, et al. (2024) evaluated a 12-week Internet of Things (IoT)-based home RMT program in 78 patients. The intervention utilized a smart system comprising a training device, a cloud platform, and a complementary application to monitor and record inspiratory and expiratory loads, including maximal inspiratory pressure (PImax), maximal expiratory pressure (PEmax), volume, and time. The study reported significant improvements in pulmonary function and reductions in mMRC, CAT, and HAMA scores, as well as a decrease in 6-month hospital readmission rates. While the improvement in PImax was statistically significant, it did not surpass the minimal clinically important difference (MCID), suggesting that while beneficial, the magnitude of change in this specific metric may require further optimization (CHEN Q, et al., 2024).

Corroborating these findings, Buran Cirak Y, et al. (2022) conducted a study with 60 patients to assess the effectiveness of a 12-week RMT program using the Threshold IMT device. The intervention group performed inspiratory muscle training at an intensity of 40% of their initial PImax, twice daily for 15 minutes. This group demonstrated significant improvements in inspiratory muscle strength, with a notable increase in PImax, as well as enhanced functional capacity measured by the 6-minute walk test (6MWT) and reduced dyspnea perception on the mMRC scale. These results underscore the value of RMT as a foundational element in COPD management (BURAN CIRAK Y, et al., 2022).

Beyond the statistically significant improvements observed in maximal inspiratory pressure (PImax), the clinical relevance of respiratory muscle training may be explained by its effects on respiratory mechanics. In patients with COPD, chronic hyperinflation places the inspiratory muscles, particularly the diaphragm, at a mechanical disadvantage, increasing the work of breathing and contributing to exertional dyspnea. By improving inspiratory muscle strength and endurance, RMT may reduce ventilatory overload, decrease the perception of respiratory effort, and improve ventilatory efficiency during physical activity. These physiological adaptations likely contribute to the observed improvements in exercise tolerance, functional performance, and quality of life reported across the included studies. Furthermore, reduced respiratory muscle fatigue may facilitate greater participation in daily activities, helping to break the cycle of inactivity and physical deconditioning commonly observed in COPD.

Combination Therapies: RMT with Exercise and Manual Therapy

The synergistic effects of combining RMT with other rehabilitation modalities have shown enhanced benefits over RMT alone. Several studies have explored these combinations, yielding positive results across a range of functional and patient-centered outcomes.

Tounsi B, et al. (2021) examined the effects of combining specific inspiratory muscle training with a whole-body resistance training program in 32 patients over eight weeks. The IMT was performed using the PowerBreathe device at a load starting at 50% of the initial PImax, which was progressively increased every two weeks. The combined intervention led to a mean increase of 6.3 points on the Berg Balance Scale (BBS), indicating a functional improvement in balance and a reduced risk of falls. Inspiratory muscle strength, as measured by PImax, increased by an average of 15.2 cmH_2O, and the Timed Up and Go (TUG) test time was reduced by 1.4 seconds, suggesting improved functional mobility. Interestingly, no significant change was observed in the distance covered in the 6MWT, indicating that while the intervention positively impacted balance and strength, it did not translate into greater walking distance in this specific cohort (TOUNSI B, et al., 2021).

Buran Cirak Y, et al. (2022) investigated the additive effect of manual therapy. Sixty patients were randomly assigned to either an RMT-only group or a group that received RMT combined with manual therapy (MT) three times per week for 12 weeks. The RMT+MT group demonstrated significantly greater improvements across nearly all measured outcomes compared to the RMT-only group. These included enhanced pulmonary function (FEV1, FVC, PEF), a more substantial increase in PImax (a 20 cmH_2O improvement), a clinically significant increase in 6MWT distance (65 meters), and a meaningful reduction in dyspnea (a 1-point decrease on the mMRC scale). This study strongly suggests that the addition of manual therapy can potentiate the benefits of RMT, leading to more comprehensive functional recovery (BURAN CIRAK Y, et al., 2022).

RMT Combined with Advanced Therapeutic Modalities

The integration of RMT with more advanced techniques, such as non-invasive ventilation (NIV) and proportional assisted ventilation (PAV), has been explored to maximize physiological benefits, particularly in patients with more severe disease.

Lei Y, et al. (2023) conducted a study with 100 patients to evaluate a sequential approach combining non-invasive positive pressure ventilation (NIPPV) with IMT. Patients in the combined group received IMT training with a PowerBreathe K5 device for 30 minutes, followed by 2 hours of NIPPV, twice daily for eight weeks. The results were striking: the sequential NIPPV+IMT group exhibited significant improvements in exercise tolerance, with mean gains in 6MWT distance exceeding 50 meters compared to the control group. Health-related quality of life, as measured by the SGRQ, improved by more than 10 points, a clinically relevant threshold. Furthermore, dyspnea, assessed by both the Borg and mMRC scales, was significantly reduced, demonstrating that this combined approach can effectively address multiple dimensions of the disease (LEI Y, et al., 2023).

Similarly, a proof-of-concept trial by Koch C, et al. (2020) investigated the effects of high-intensity IMT prior to proportional assisted ventilation (PAV) during exercise in 13 patients with severe COPD. The early application of IMT resulted in significant physiological adaptations during subsequent high-intensity exercise with PAV. This included a reduction in minute ventilation at exhaustion by 4 L/min and a decrease in the neuro-ventilatory uncoupling, which contributed to a lower sensation of dyspnea and a 111-second increase in exercise time tolerance. The study highlights the potential of using IMT as a priming strategy to enhance the efficacy of ventilatory support during exercise (KOCH C, et al., 2020).

Innovative Approaches and Alternative Delivery Methods

Recent research has also explored innovative devices and delivery methods for RMT, including telerehabilitation and novel nasal restriction devices, to improve accessibility and patient engagement. Gonzalez-Montesinos JL, et al. (2021) assessed a rehabilitation program utilizing a nasal inspiratory restriction device called FeelBreathe® in 20 patients over eight weeks. Participants were divided into a group that performed physical training with the device (FBG), a group that performed physical training without it (ONBG), and a control group (CG). The FBG group demonstrated significant intragroup improvements in several cardiopulmonary parameters, including reduced oxygen consumption, minute ventilation, and respiratory rate, alongside an increase in total exercise time. However, in the intergroup comparison, the only statistically significant advantage of the FBG over the ONBG was a reduction in the ventilatory equivalent for CO_2. This suggests that while the device has potential to improve ventilatory efficiency, its added benefit over conventional exercise training requires further investigation (GONZALEZ-MONTESINOS JL, et al., 2021).

Ceyhan Y e Tekinsoy Kartin P (2022) explored the impact of a simple, low-cost intervention in 67 patients, combining pursed-lip breathing (PLB) exercises with proper inhaler technique training over four weeks. While not a traditional RMT study using a resistive device, it highlights the importance of breathing retraining. The group receiving the combined intervention showed significant improvements in dyspnea severity and quality of life compared to the group that received only inhaler training, reinforcing that even basic respiratory exercises can yield meaningful clinical benefits (CEYHAN Y e TEKINSOY KARTIN P, 2022).

A notable finding of this review was the heterogeneity of RMT protocols. The included studies differed in training intensity, duration, devices, supervision methods, and the use of adjunct interventions such as exercise training, manual therapy, non-invasive ventilation, and telerehabilitation. Although positive outcomes were consistently reported, this variability limits direct comparisons and hinders the establishment of standardized clinical recommendations. Future studies should prioritize protocol standardization to improve the reproducibility and clinical applicability of findings.

Finally, the potential of telerehabilitation was explored by Ataç A, et al. (2024) in a study of 26 patients. This trial compared synchronous pulmonary telerehabilitation with active exercises to a cognitive telerehabilitation group using motor imagery and action observation. While the primary outcomes focused on peripheral muscle strength and aerobic capacity, the study also captured improvements in perceived exertion and ventilatory parameters, underscoring the feasibility and potential of remote delivery models for comprehensive COPD care, which could include RMT components in the future (ATAÇ A, et al., 2024).

Clinical implications

From a clinical perspective, respiratory muscle training is a safe, low-cost, and feasible intervention that can be integrated into pulmonary rehabilitation programs. Its use may improve inspiratory muscle performance, reduce dyspnea, and enhance functional capacity in patients with COPD. Appropriate assessment, individualized prescription, and professional supervision remain essential to maximize therapeutic benefits (MOTA JC, et al., 2023; SANTOS LJS, et al., 2024).

Recent evidence highlights the potential of telerehabilitation and home-based respiratory muscle training to expand access to pulmonary rehabilitation. Remote monitoring systems and digital health technologies may improve treatment adherence and continuity of care, particularly for patients with mobility limitations or restricted access to specialized centers. However, successful implementation depends on adequate technological infrastructure, patient engagement, and professional supervision to ensure correct training execution and long-term effectiveness (BEAUMONT M, et al., 2018; LIU X, et al., 2024).

Limitations

This review has some limitations that should be acknowledged. First, the literature search was restricted to PubMed and the National Library of Medicine databases, which may have resulted in the exclusion of relevant studies indexed elsewhere. Second, only eight randomized controlled trials met the inclusion criteria, limiting the overall body of evidence available for analysis. Additionally, substantial heterogeneity was observed regarding training protocols, intervention duration, outcome measures, and comparator groups, reducing the possibility of direct comparisons across studies. Differences in the assessment tools used to evaluate dyspnea, functional capacity, and quality of life may also have influenced the interpretation of results. Finally, most studies included relatively short intervention periods and lacked long-term follow-up, making it difficult to determine the durability of the observed benefits.

FINAL CONSIDERATIONS

This integrative review synthesized evidence from recent randomized controlled trials to evaluate the effects of Respiratory Muscle Training (RMT) in adults with Chronic Obstructive Pulmonary Disease (COPD). The findings demonstrate that RMT is an effective therapeutic strategy for improving key clinical outcomes, particularly reducing dyspnea, increasing exercise tolerance, and enhancing quality of life. Furthermore, the evidence consistently indicates that RMT promotes clinically meaningful gains in inspiratory muscle strength, as reflected by improvements in maximal inspiratory pressure, which may contribute to enhanced ventilatory efficiency, reduced respiratory effort, and better functional performance during daily activities and exercise. However, the heterogeneity observed across intervention protocols — including variations in training load, duration, frequency, delivery methods, and combination with other rehabilitation modalities — limits the formulation of standardized, evidence-based clinical recommendations. Despite these limitations, the consistency of positive findings across studies supports the integration of RMT into pulmonary rehabilitation programs for individuals with COPD. The observed benefits in inspiratory muscle function, dyspnea

perception, exercise capacity, and health-related quality of life reinforce its clinical relevance as both a standalone intervention and an adjunct to comprehensive rehabilitation strategies. Future research should prioritize adequately powered multicenter randomized controlled trials employing standardized training protocols, larger and more diverse patient populations, and prolonged follow-up periods to determine optimal intervention parameters, evaluate long-term effectiveness, and establish robust clinical practice guidelines. In conclusion, RMT represents a valuable, safe, and promising component of comprehensive care for individuals with COPD.

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