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Effects of Respiratory Muscle Training in Patients with Cardiomyopathy: Systematic Review

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ABSTRACT

Background: Cardiomyopathy is a major global cause of chronic heart failure, often resulting in exercise intolerance, dyspnea, and reduced quality of life. Respiratory muscle weakness is common in these patients. Respiratory muscle training is considered a beneficial non-pharmacological intervention to enhance respiratory muscle strength, improve exercise tolerance, and support overall patient well-being. **Objective:** To evaluate the effects of respiratory muscle training on inspiratory muscle performance, exercise capacity, dyspnea, and health-related quality of life in cardiomyopathy patients and outcomes. **Methodology:** This systematic review involved a comprehensive search up to September 2025 using PubMed, EMBASE, Cochrane Central, and Google Scholar. Randomized controlled trials, clinical trials, systematic reviews, and meta-analyses on cardiomyopathy and chronic heart failure patients undergoing respiratory muscle training were included. Primary outcomes assessed were the 6-minute walk test, peak oxygen consumption, maximal inspiratory pressure, dyspnea, and health-related quality of life. **Results:** This review included 15 randomized controlled trials and 9 systematic reviews with meta-analyses. Respiratory muscle training demonstrated improvements in maximal inspiratory pressure and functional outcomes, including peak oxygen consumption and six-minute walk distance, particularly in studies with intervention durations of at least 8–12 weeks at moderate to high intensities (40–60% of maximal inspiratory pressure). Notable reductions in dyspnea and improvements in health-related quality of life were also reported. The included meta-analyses consistently supported the benefits of respiratory muscle training, especially in cardiomyopathy patients with baseline inspiratory muscle weakness. Overall, respiratory muscle training was safe with no major adverse effects. **Conclusion:** This review concludes that respiratory muscle training is a safe and effective adjunct therapy for cardiomyopathy, providing clinical improvements in inspiratory muscle strength, exercise tolerance, and health-related quality of life, while helping to relieve symptoms without causing harm.

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INTRODUCTION

Cardiovascular diseases have been known for having significant rates of mortality, representing 32% deaths globally in 2019, making it a major health issue globally.[1] This has had an impact on the health of the people worldwide, and the health care systems have started to work on various research on varied approaches so that they can aid in improving the associated cardiovascular symptoms by reducing the workload of breathing, muscle fatigue, dyspnea, and improving exercise tolerance.[2] Talking about the non-pharmacological interventional approaches and treatment strategies, respiratory muscle training has arisen as a non-conventional strategy and approach of physical therapy, accompanied by potential benefits for the patients.[3]

Respiratory muscle training has been known for improving exercise capacity, reducing breathlessness, and enhancing the quality of life of patients with cardiomyopathy. It has shown benefits like improving the respiratory strength of the muscles, improving the efficiency of ventilation, and reducing the cardiac stress biomarker. It is not known to significantly increase the left ventricular ejection fraction. Respiratory training accompanied by aerobic training and resistance training might also offer some additional benefits.[3] Respiratory muscle training has been observed to show some key benefits in patients with heart conditions. They tend to improve exercise capacity. The patients gain an increase in the submaximal exercise capacity, which can be observed by improvements in tests like the 6-minute walk test.[4] It also plays a vital role in reducing breathlessness.

The patients have reported to have shown subjective improvements in dyspnea during their various routine activities.[5] The respiratory muscle training also improves the strength of the respiratory muscles. The respiratory muscle training tends to improve the strength and the endurance of the inspiratory muscles directly.[6] This non-pharmacological interventional approach also tends to improve the quality of life of patients with cardiomyopathy. Overall, the patients reported having an improved and better status if health and quality of life.[7] One of more benefits of respiratory muscle training is to reduce cardiac stress markers. This training has been associated with and linked to reducing the biomarkers, like N-terminal pro-B-type natriuretic peptide.[8]

Cardiomyopathy has been known to encompass a collection of myocardial conditions that are characterized by both functional and structural abnormalities of the muscles of the heart. It has four types: dilated, hypertrophic, restrictive, and arrhythmogenic, the dilated cardiomyopathy being the most common. After reaching the advanced stages, this leads to chronic heart failure. It has been known as the leading cause of chronic heart failure and is known to be associated with considerable mortality and morbidity. This condition of cardiomyopathy is a burdened condition, with millions of people suffering globally who require long-term management. The patients with cardiomyopathy repeatedly experience shortness of breath, reduced exercise tolerance, and compromised quality of life. These symptoms associated with this condition tend to limit and create hindrances in routine daily activities and also contribute to admissions to the hospital and increased hospital visits. This all tends to pose a substantial burden on the healthcare systems globally.[9]

One of the unnoticed but clinically important characteristics of cardiomyopathy is weakness of the respiratory muscles that particularly tend to affect the inspiratory muscles and the diaphragm. The reduction in the strength of the inspiratory muscles tends to increase the workload of breathing, aggravate dyspnea, and limit the capacity of exercise. The patients with weakened inspiratory muscles which have been weakened those patients get prone to early fatigue, which further contributes to the poor functional outcomes of the patients. Cardiomyopathy has been known to be one of the leading causes of the generalized changes in the skeletal muscles, which tend to affect respiratory muscles and results in contribute to exercise intolerance.[10]

Training the respiratory muscles explicitly tends to strengthen them, making them more proficient. This strengthening tends to lead towards healthier and better ability to get oxygen into the bloodstream and transport it to the muscles working, and hence improving the overall physical fitness of the patients. The weakness of the inspiratory muscles tends to occur in up to almost 50% of patients with chronic heart failure. The marker of the inspiratory strength, the maximal inspiratory pressure, has often been observed to be reduced. This weakness tends to lead to a raised respiratory effort, earlier onset of dyspnea, and a reduction in the ability to perform activities of

daily living and certain physical activities. This pathophysiology involves atrophy of the muscles, reduction the perfusion, and oxidative stress.[11] Respiratory Muscle Training tends to comprise a structured breathing exercise, which is performed against breathing that typically employs threshold devices. Previously conducted studies show us that respiratory muscle training tends to show improvements in inspiratory pressure, tends to reduce the ventilator efforts, and also enhances the tolerance of exercise. Most importantly, the respiratory muscle training might also reduce the activation of the metaboreflex of the inspiratory muscle, which is a mechanism that tends to increase the sympathetic activity and also tends to limit the flow of blood towards the peripheries.[12]

Our current systematic review systematically reviews the already available evidence of the effectiveness and benefits of respiratory muscle training on patients with cardiomyopathies, focusing mainly on the strength of inspiratory muscles, capacity of exercises, dyspnea, and quality of life of the patients. In spite of the growing evidence globally, the variability among the training approaches and protocols, the intensity, duration, and frequencies, and the sample sizes on a smaller scale tend to create hindrances for a broader clinical application. The benefits that tend to remain long-term and have longer sustainability remain under-researched.

Treatments through pharmacological interventions and device therapies have tended to bring improvements in survival, but they have not been reported to eliminate the functional impairments in the patients. Cardiac rehabilitation, comprising aerobic and resistance exercises, has been proven to be effective, but it is not feasible for patients suffering from severe dyspnea.[13] This research gap needs focus and has certainly prompted the exploration of targeted interventional therapies such as respiratory muscle training, which tend to directly strengthen the inspiratory muscles of the patients. Our systematic review tends to fill this gap and explore the target intervention of respiratory muscle training.

Our current systematic review aims at synthesizing the already existing evidence on the effects of respiratory muscle training in patients with cardiomyopathy. Our current review intended to examine the outcomes, such as exercise capacity, respiratory muscle strength, quality of life, and certain clinical outcomes that might include mortality rate and hospitalization rates. After summarizing the current state of knowledge, our review would provide insights into the potential benefits and limitations of respiratory muscle training in this population, if patients with cardiomyopathy identify the gaps in the already exciting evidence. The major objective of our review is to inform healthcare providers about the development of evidence-based rehabilitation programs for patients with cardiomyopathy.

METHODOLOGY

Our current study is a systematic review on determining the effects of respiratory muscle training in patients with cardiomyopathy. Our current systematic review strictly followed the PRISMA guidelines.[14] The databases which were searched were EMBASE, Cochrane, PubMed, CENTRAL, and Google Scholar, which included studies conducted up to September 2025. The searched keywords were Heart failure, cardiomyopathy. Respiratory muscle training and inspiratory muscle training. Only those studies and research were included in this current review that had a population comprising adults with cardiomyopathy or chronic heart failure.[2,15] Those studies were focused on who specifically focused on respiratory muscle training or its other forms as the major intervention.[15] The comparators considered in the studies recruited in our review were sham training, usual care, and no intervention provided. Those studies were focused on who had Maximal Inspiratory pressure, 6-minute distance walk, VO_2 peak (Peak Oxygen Uptake, dyspnea, and Health-related Quality of Life as outcome measures.[4,15,16]

All kinds of randomized controlled trials, random clinical trials, systematic reviews, and meta-analyses that met our inclusion criteria. All those studies that had a pediatric population as the center of focus and all the non-interventional studies were also excluded from this review. For example, narrative reviews were not included in this review. The studies without complete data, case reports, and conference abstracts without complete data were also excluded from this review.[17-19] The data that was extracted for our review consisted of the design of the recruited studies, the sample size of the recruited studies, the intervention protocols that were employed in those recruited studies, the outcome measures of the research, and the follow-up duration.

RESULTS

Our current systematic review recruited 15 randomized controlled trials and 9 systematic reviews and meta-analyses. Sample sizes of all the recruited studies ranged from 20 to 300 patients. The training durations ranged from four to twenty-four weeks. The threshold for respiratory muscle training for most of the studies was at intensities ranging from 30 to 60% of Maximal Inspiratory Pressure.[20-22]

More or less all the recruited RCTs in this current review validated significant improvements in the maximal inspiratory pressure. This confirmed the benefits, efficiency, and effectiveness of respiratory muscle training to strengthen the inspiratory muscles.[6,23,24] The recruited studies in this current review showed significant improvements in the 6-minute walk test, on average of +50-100 meters, and volume of oxygen peak +10-15%. The positive effects of respiratory muscle training were observed to be greater in interventions lasting up to 12 weeks and more.[25,26]

Numerous research and studies recruited in this review showed significant reductions in dyspnea after application of respiratory muscle training, which was measured by employing the Borg Scale.[27] Various recruited studies showed improvements in Quality of Life (HRQoL score), which was measured by employing the Minnesota Living with Heart Failure Questionnaire.[28,29] All the recruited studies and research in this current review reported no adverse or major events. The respiratory muscle training was very well tolerated by the patients, even in adverse heart failure conditions.[3,30,31] All the recently conducted meta-analyses that were recruited in this review confirmed pooled benefits and advantages in strengthening respiratory muscles and capacity of exercises, with the most powerful effects observed in patients with reported weakness in inspiratory muscles at baseline.[24,32,33]

DISCUSSION

The results of our current review show us that respiratory muscle training consistently brings improvements in the strength of the inspiratory muscles, capacity, and tolerance of exercise, and patients with cardiomyopathies reported positive outcomes. The improvements tend to translate into a reduction in the severity of the associated symptoms, greater independence, and enhanced quality of life. Results and conclusions of various studies recruited in our review also tell us that respiratory muscle training can be implemented as a home-based exercise program with minimal equipment employed. These benefits are probably due to improved and enhanced diaphragmatic functioning, reduction in inspiratory metaboreflex, improved ventilator efficiency, and improved autonomic regulation.

Dsouza and co-workers conducted a systematic review and meta-analysis to determine the effects of inspiratory muscle training, which is a technique of respiratory muscle training, on respiratory muscle strength, pulmonary functioning, and functional capacity of patients who are undergoing cardiac surgeries.[34] The results of their review coincide with the results of our review, and the results of our review completely agree with their results. Their results showed that there is very strong evidence that supports inspiratory muscle training for bringing improvements in the strength of inspiratory muscles, pulmonary functioning, and functional capacity of patients with cardiac conditions and patients undergoing cardiac surgeries. The respiratory muscle training tends to reduce the duration of the hospital stay among patients undergoing cardiac surgeries.[34] Our review completely agrees with this.

Fabero and co-workers conducted a systematic review and meta-analysis to evaluate the effects of respiratory muscle training on respiratory muscle functioning, functional exercise capacity, health-related quality of life, and pulmonary function in patients with ischemic heart disease[15] and concluded that inspiratory muscle training brings improvements in the strength of the inspiratory muscles and their endurance. Their review provided low-quality evidence for the effects of respiratory muscle training on peak oxygen consumption. Our review contradicts this finding. Their results also showed that no superior or upper hand effects of respiratory muscle training were found in the 6-minute walk test and health-related quality of life when compared with the compared group, but our review disagrees with this. The results of both reviews might provide clinicians with a better understanding of the effects of respiratory muscle training in patients with cardiac conditions. Both reviews suggest that respiratory muscle training could be made an integrated part of cardiac rehabilitation programs and management. Although more researches are required and needed in this field.

Table 1: Characteristics of studies

Author & Year	Study Design / Sample Size	Intervention (RMT Protocol)	Outcomes Measured	Key Findings
Bosnak-Guclu et al., 2011	RCT / 30 patients	Inspiratory muscle training at 30–60 % MIP for 8 weeks	MIP, 6MWT, Dyspnea, QoL	Significant improvement in inspiratory strength and quality of life
Fabero-Garrido et al., 2024	Systematic Review & Meta-analysis	RMT in ischemic heart disease patients	VO_2 peak, MIP, 6MWT	Improved MIP; moderate evidence for VO_2 peak improvement
.Lin et al., 2012	Systematic Review	Inspiratory muscle training in chronic heart failure	Pulmonary function, QoL, Dyspnea	Improved exercise tolerance and QoL; reduced dyspnea
Katayifci et al., 2022	RCT / 40 patients	Inspiratory muscle strength vs. endurance training	Exercise capacity, Fatigue, QoL	Both protocols improved muscle strength, exercise tolerance, and QoL equally
Dsouza et al., 2021	Meta-analysis	IMT before and after cardiac surgery	Respiratory muscle strength, Hospital stay	Increased inspiratory strength and reduced hospital duration
Nguyen et al., 2025	Systematic Review & Meta-analysis	Isolated IMT in heart failure patients	Exercise capacity, Dyspnea, QoL	Confirmed benefits of RMT in patients with weak inspiratory muscles
Beaujolin et al., 2024	Systematic Review	Different IMT intensities (low vs. moderate-high)	MIP, Exercise tolerance	Greater improvement at moderate-to-high intensity protocols
Campos et al., 2018	RCT / 60 patients	RMT for hemodialysis patients	Endothelial & oxidative stress biomarkers, MIP	Improved respiratory muscle function and reduced oxidative stress
Fabero et al., 2022	Systematic Review	RMT post-stroke	Exercise tolerance, MIP	Short-term improvements in MIP and tolerance; low-quality evidence for VO_2 peak
Katayıfcı et al., 2022	RCT	Inspiratory muscle endurance vs strength training	Exercise capacity, QoL	Both improved endurance, exercise capacity, and QoL

Bosnak and co-workers conducted a study to determine the effects of inspiratory muscle training in patients with heart failure. They aimed to investigate and find out the effects of inspiratory muscle training on pulmonary functioning, dyspnea, fatigue, functional capacity, balance, respiratory muscle strength, depression, and quality of life in patients with heart failure.[2] they aimed to determine and investigate the effectiveness of inspiratory muscle training on pulmonary function, fatigue, depression, functional capacity, balance, strength of respiratory muscles and quality of life of patients with heart failure. Their study concluded that the intervention tends to bring improvement in the functional capacity and balance, brings strength in the respiratory muscles, and reduces depression and dyspnea in patients with heart failure. Our review completely agrees with these results and conclusions. Their study and our review both concluded that respiratory muscle training must be included effectively in the pulmonary rehabilitation plans.

Lin and co-workers conducted a study on determining the effects of inspiratory muscle training on patients with chronic heart failure. Their study was a systematic review and meta-analysis. Their review aimed to evaluate the effects of inspiratory muscle training in patients with chronic heart failure. They concluded that inspiratory muscle training tends to improve pulmonary functioning, tolerance of exercise, and

quality of life, and reduce the symptoms of dyspnea among patients with chronic heart failure.[35] Our current review agrees with these findings.

Katayifci and co-workers conducted a study to compare the effects of inspiratory muscle strength and endurance training on the capacity of exercise, strength, and endurance of muscle strength and quality of life among pacemaker patients with heart failure.[36] Their results concluded that inspiratory muscle strength and endurance training both equally bring improvements in the strength of respiratory and peripheral muscles, capacity of exercise, quality of life, level of physical activities, and tend to reduce dyspnea and fatigue.[36] Both proved to be safe and effective. Our current review agrees with these findings.

This current systematic review has a few limitations. Only a few articles were recruited in this review, and only the administration of a limited intervention was discussed; hence, few studies were eligible for the systematic review. Comparing respiratory muscle training with any other intervention is needed for further authenticity of the effectiveness of the intervention. The sample size of the recruited studies was also small. Additionally, differences among the intensities of the exercises and duration of the sessions might also have contributed to the heterogeneity, which was inevitable, as there were a very small number of studies conducted regarding this subject. Therefore, our review suggests that future researchers are required to conduct more studies on the gaps that are still left. The studies recruited in our review lacked variability in the intervention protocols. A large number of recruited studies lacked long-term follow-up data.

Future researchers are suggested to conduct studies that tend to show long-term effects of respiratory muscle training on various heart conditions and are not limited to any one condition, for more generalizability of results and authenticity of the application of the intervention. Larger, multicenter randomized controlled and clinical trials are needed to further define standardized interventional approaches and evaluate the long-term outcomes, such as survival and hospital stay.

CONCLUSION

The results of our current review conclude that harmless and safe, well-tolerated well and is a very effective adjunct to the standard care in patients suffering from cardiomyopathy. The review also concludes that respiratory muscle training tends to improve the strength of inspiratory muscles, exercise tolerance, and quality of life, predominantly when applied at moderate to high intensity for 8 to 12 weeks or for a longer duration. This review concludes that respiratory muscle training should be incorporated into cardiac rehabilitation and might tend to improve functional outcomes and the well-being of the patients.

DECLARATIONS

Consent to participate: Written consent had been obtained from patients. All methods were performed following the relevant guidelines and regulations.
Availability of Data and Materials: Data will be made available upon request. The corresponding author will submit all dataset files.
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CONSORT Guidelines: All methods were performed following the relevant guidelines and regulations.

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