SYSTEMATIC REVIEW

EFFECTIVENESS OF RESPIRATORY MUSCLE TRAINING FOR PULMONARY FUNCTION IN POST OPERATIVE PATIENTS

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ABSTRACT

Introduction: In cardiopulmonary respiratory muscles plays a vital role which is mostly affected in postoperative patients and leads to further respiratory complications. Training of respiratory muscles is important to improve the respiratory health status so that the threat of respiratory complications is reduced. This review aims to see whether it is effective to improve pulmonary function in postoperative patients.

Material & Methods: Literature for this review was searched by using databases like PubMed, Pedro, Cochrane, and google scholar. In this review the included articles were published between 2010 to 2020. All RCT articles were included in this review showing results regarding the effectiveness of the respiratory muscle technique.

Results: The review comprises 6 studies all of which show that the respiratory muscle technique is effective.

Conclusion: In order to improve the pulmonary function of postoperative patient's respiratory muscle training is effective.

Key Words: Inspiratory Muscle Training, Respiratory Function, Respiratory Muscle Training, Trunk Stability**.**

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INTRODUCTION

Inspiratory along with expiratory muscle proper working is needed for an effective respiratory function.[1] The respiration process of air exchange from the lungs to the blood stream causing ventilation involves the use of respiratory muscles.[2] The diaphragm is an important muscle which normally helps in the phenomena of the respiratory process it also helps in stabilizing the trunk as well by contracting and working side by side with abdominal and pelvic floor muscles in keeping the trunk stable. In case of weakness of respiratory muscles there is low tidal pressure and also decreased tolerance to exercise which is mainly due to change in thoraco-abdominal motion.[3] Surgery results in respiratory muscle weakness due to changes in the mechanics and function of respiratory muscle.[4] Respiratory muscle weakness results in trunk postural abnormality along with that it disturbs proper

respiratory function which affects patients every day basic activities along with patient social life.[5] Post-operative patients tend to be at increasing risk of developing respiratory complications resulting in problems with ventilation, decrease lung volume and dysfunction of respiratory muscle. It may lead to complications as a result of the operation or any surgery such as atelectasis, pneumonia, and dysfunction of the diaphragm which results in poor health status improvement in post-operative patients. Patients with respiratory complications result in poor recovery.[6] Respiratory techniques are used to improve pulmonary functions along with this it also helps in reducing complications after surgery. Exercises such as respiratory exercises or techniques are also used to avoid and reduce such complications and to improve patients' health status. Inspiratory muscle training and expiratory muscle training are part of these respiratory exercises which are proven to be very beneficial in improving lung overall function and reducing complication risk.[7] There are different types of exercises which improve respiratory functions such as IMT which increases strength and improves endurance of inspiratory muscle and create the hyperventilating effect for a longer period. Along with these it also increases exercise tolerance and reduces dyspnoea which is important in performing basic functional activities.[3]

Many devices for respiratory training are also used for patients who are suffering from COPD, asthma, stroke etc. These devices help in improving the strength of the respiratory muscles.[2] All of these respiratory training techniques help us not only decrease pulmonary complications but also with the restorative proper functioning of respiratory muscles and also in decreasing hospital stays and improving patient's overall health condition.[8]

Postoperative pulmonary complications are a significant concern following various surgical procedures, particularly in patients with compromised respiratory function. These complications, including atelectasis, pneumonia, and respiratory failure, can lead to prolonged hospital stays, increased healthcare costs, and even mortality. Respiratory muscle weakness, resulting from surgical trauma, immobility, and reduced lung capacity, is a common contributing factor to these complications. Consequently, strategies aim at improving strength and function of respiratory muscles that have gained attention as potential interventions to reduce postoperative pulmonary complications.

Objective:

This review has the objective to identify the effectiveness of training in respiratory muscle to prevent complications and in improving pulmonary function as it improves health-related functions in post-operative survivors. Tragically, such examinations are generally focused on one plan only and convey restricted outside legitimacy. Further preliminaries to explore the potential benefits of RMT and the best strategies to boost its efficacy are under careful consideration.

Key research questions

The research question is "Whether respiratory muscle training is an effective program for improving pulmonary function in postoperative patients?" Respiratory muscle training in post-operative patients is broadly and globally inadequately practised. Apart from these other outcomes like pre and post-operative exercise tolerance, and muscle strength of respiratory muscles as a result of RMT intervention can be seen along with the relationship between the outcome and the intervention see a large about of investigation done on this topic.

MATERIAL AND METHODS

Research protocol

Review literature seek had been accomplished in cooperation with Supervisor and Supervisor as a part of a (Cochrane Handbook for Systematic Reviews of Interventions). For this review intervention studies are used for writing the literature review. In the start, extensive multiple databases search had been done for literature. Unique search engine such as (Pedro, PubMed, and Cochrane library) were used for literature which gave us the result of 387 articles. Other databases like Google scholar were used for literature that ensued two articles. But 6 studies had been screened for applicable titles and abstracts on the bases of selection criteria.

Literature Search Strategy

All the literature searched were between 2010 to 2020 with specific keywords "inspiratory muscle training, expiratory muscle training,

respiratory muscle training, respiratory muscle technique, chest physiotherapy, pulmonary function and respiratory exercise". Boolean operators such as “AND”, “OR” AND “NOT” were also used for an advance search. Databases searched included Google Scholar, PubMed, HEC digital library and some others such as Psycinfo etc. There was no hand-searching performed. Only RCTs which included reports related to the effectiveness of respiratory muscle training, unpaid, available in full-length text and published in the English language were included in this review. On the hand paid, only abstracts, irrelevant, unclear studies, observational studies, and non-RCTs were excluded. A total of 387 studies were found initially that were somewhat related to the topic, after careful screening by reading title, abstracts and full study, only 6 met inclusion criteria.

Outcome of Interest

Outcomes of variables of pulmonary function such as the first second forced expiratory volume (FEV1), forced vital capacity (FVC), and peak expiratory flow (PEF) and parameters of respiratory muscle weakness such as maximal expiratory pressure (MEP) and maximal inspiratory pressure (MIP); Functional capacity including 6 min walking test (6-MWT), Barthel index (MBI), Berg balance scale (BBS), and dyspnea (Borg scale), they were incorporated in this study

Data extraction

For each study, the following characteristics were collected: general information of patients which included mean age, mean duration, percentages of male and female in sample size, country of study, year in which study got published, name of the first author, sample size and concerned data according to inclusion and exclusion criteria.

Quality Appraisal

In order to assess the quality of the included studies Pedro scale was used. It is a very helpful tool to assess randomized control trials. Their total score of Pedro spans from zero to eleven; so greater the score the higher quality of evidence.[9] The highest score of the study was 8 for two studies.[10-11] and the lowest score was found to be 7 for the remaining 4 studies.[12,13,14,15].

RESULTS

Increased inspiratory pressure of 27cm H2O (15 to 40), expiratory strength of 42cm H2O (25 to 59), inspiratory endurance of 33 breaths (20 to 47) and reduce dyspnea -1.3 out of 5.0 (-2.1 to -0.6) conducted by (De Menezes et al in 2018)[10] was found in research. The no significant change of PImax from the preoperative to the discharge value was 65.1 ± 15.5 to 68.2 ± 19.2 cmH2O in SG and 59.2 ± 13.7 to 44.3 ± 14.8 cmH2O in CG. The change of PEmax from the preoperative to the discharge value was 80.4 ± 24.9 to 81.5 ± 24.9 cmH2O in SG and 85.4 ± 38.2 to 61.3 ± 25.4 cmH2O in CG. A significant difference between SG and CG in terms of the RMT effect. There was a significant difference found in the 6MWT when the mean differences were compared between the groups (85.72). Total time span of hospital stay was significantly shorter in the SG (number of days for SG 9.1 ± 3 and CG 12.9 ± 4.2 was found in the research conducted by Taskin et al in 2018.[15] Raquel et al 2011 showed group differences for the MIP and IME measures. There were significant change that were observed for only the experimental group for MIP (67.814.6 at baseline to 102.226.0cmH2O at post-training) and IME (31.819.3 to 49.221.1cmH2O).[13] In 2015 Monique et al showed that significantly improved % PImax and % PEmax and reduced respiratory complications by 14% was seen.[11] Stefan et al 2015 showed that maximal inspiratory 14 cmH2 O and d expiratory 15 cm H2 O peak expiratory cough flow of voluntary cough 74 L/min (14) and mouth pressure.

DISCUSSION

Previous studies like De Menezes et al in 2018 concluded in his study that high-intensity training of respiratory muscles is a technique that is effective in improving respiratory muscles along with the strength and endurance and in decreasing shortness of breath.[10] Another study conducted by H. Taskin et al in 2018 concluded that respiratory muscle training has a positive and better effect on improving respiratory endurance, muscle strength, and reducing the length of hospital stay.[15] Another study that was carried out in 2020 (by Mei et al) stated that 6 weeks, RMT does improve fatigue, and increases muscle strength, lung volume and respiratory flow.[12] Raquel et al 2011 concluded that RMT is an effective technique for increasing strength and

endurance.[13] In 2014 Stefan et al conducted research in which it concluded that respiratory muscle technique improves cough flow but does not show a bit of significant variation between the two classes in respect of muscle strength respiratory muscles.[14] Another study in 2015 by Monique et al concluded that RMT improves muscle strength and reduces complications.[11]

Hence based on all previous studies this review concludes that respiratory muscle techniques do improve muscle strength improves pulmonary function in postoperative patients but the pieces of evidence present were not strong enough. Further RCTs researches can be done on this topic to support the finding of this review.

Respiratory muscle training can encompass a range of interference, namely training of inspiratory or expiratory muscles, which may vary in terms of protocols, intensity, duration, and devices used. The heterogeneity in intervention approaches across different studies may make it challenging to compare and synthesize the results, potentially limiting the generalizability of findings.

CONCLUSION

The review concludes that training of respiratory muscles is a productive technique for increasing function of pulmonary system among post-operative patients. As the number of researches on this topic was less so further study can be done to provide a strong evidence related this research finding.

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Table-I: Table showing studies and its outcomes

Author	Year	Study design	Intervention	Outcome	Conclusion
Menezes et al., 2019 (10)	2019	RCT	The study had two groups: an experimental group and a control group. The experimental group received 40-minute high-intensity home-based respiratory muscle training, 7 days per week, for 8 weeks. The control group received a sham intervention of similar dose, but it did not involve respiratory muscle training.	MIP MEP Dyspnea 6-MWT	High-intensity home-based respiratory muscle training was found to be effective in increasing strength and endurance of respiratory muscles and reducing dyspnea in individuals with respiratory muscle weakness post-stroke. The study's results indicate that this approach produced a greater magnitude of effect compared to studies that used standard protocols.
Liaw et al., 2020 (12)	2020	RCT	The participants were assigned at random to two groups: a control group that received rehabilitation treatment alone (n=10) and an experimental group that received rehabilitation treatment along with respiratory muscle training (RMT) (n=11). The RMT consisted of inspiratory training starting from 30% of maximal inspiratory pressure (MIP) and progressing to 60% of MIP, and expiratory training starting from 15% of maximal expiratory pressure (MEP) and progressing to 75% of MEP. The training was administered 5 days per week for a duration of 6 weeks.	FEV1 MEP MIP MBI Dyspnea FVC	The RMT program can help improve respiratory muscle strength, lung volume, respiratory flow, dysarthria, and reduce fatigue levels.

Britto et al., 2011 (13)	2011	RCT	The study interventions involved home-based training, where the experimental group had their resistance adjusted every two weeks to 30% of maximal inspiratory pressure (MIP). The control group underwent the same protocol but without the threshold resistance valve. Both groups received home training for 30 minutes a day, 5 times a week for 8 weeks.	MIP	These findings suggest that IMT may benefit people with stroke, and it is feasible to include it in rehabilitation interventions for this population.
Kulnik et al., 2015 (14)	2015	RCT	The participants were unaware of their treatment allocation and were randomly assigned to one of three groups for a duration of 4 weeks: daily expiratory training group (n=27), inspiratory training group (n=26), or a sham training group (n=25). All groups used threshold resistance devices for training.	MIP MEP	The respiratory muscle function and cough flow tend to improve over time after an acute stroke. However, additional training of inspiratory or expiratory respiratory muscles does not accelerate or enhance this improvement.
Messagi-Sartor et al., 2015 (11)	2015	RCT	109 patients who had experienced their first ischemic stroke within two weeks. They were randomly assigned to either an inspiratory and expiratory muscle training (IEMT) group (n=56) or a sham IEMT group (n=53). The IEMT group performed 5 sets of 10 repetitions of respiratory muscle training, twice a day, 5 days per week for 3 weeks, at a workload equivalent to 30% of maximal respiratory pressures. The study was blinded, and the main outcome measured was respiratory muscle strength (PImax, PEmax). Respiratory complications were also recorded after 6 months.	MIP MEP	The study found that inspiratory and expiratory muscle training (IEMT) resulted in a significant improvement in respiratory muscle strength in stroke patients. The results suggest that IEMT could be used as an additional therapeutic tool to reduce respiratory complications at 6 months post-stroke.
Taskin H., 2020 (15)	2020	RCT	In a study, 20 subjects were in the study group (SG) and received respiratory muscle training (RMT) along with regular chest physiotherapy after surgery, while 20 subjects were in the control group (CG) and only received regular chest physiotherapy.	PI max PE max. Exercise capacity Pain	Adding respiratory muscle training (RMT) to chest physiotherapy after pulmonary resection surgery can result in improved respiratory muscle strength, exercise capacity, and

reduced length of hospital stay.

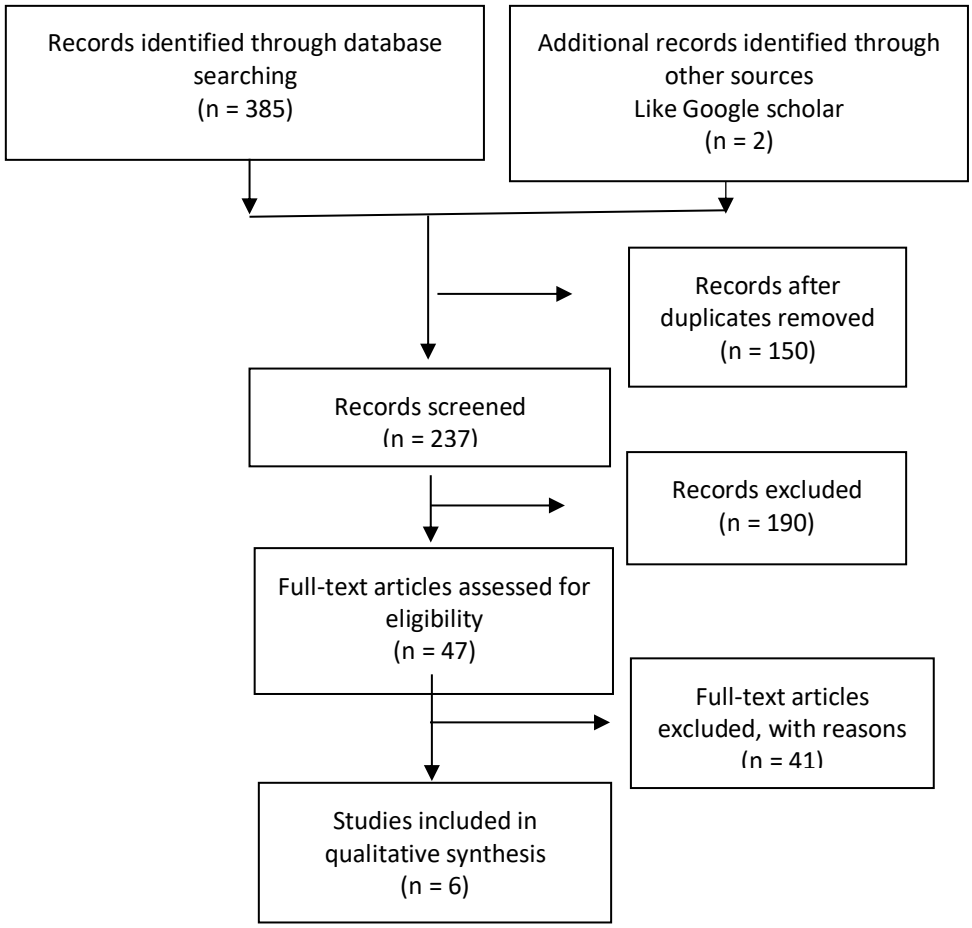

Figure 1: FLOW DIAGRAM