SYSTEMATIC REVIEW

EFFECTS OF DIFFERENT EXERCISE THERAPIES ON OBSTRUCTION, DYSPNEA, AND QUALITY OF LIFE IN COPD PATIENTS: A SYSTEMATIC REVIEW

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ABSTRACT

Objective: Chronic obstructive pulmonary disease (COPD) is the third leading cause of death, causes pulmonary and extra-pulmonary symptoms, and also impacts the quality of life. Rigorous evidence on manual and mechanical chest physiotherapy is still scarce. Therefore, this review aims to evaluate the effects of different exercise therapies on obstruction, dyspnea, and quality of life in COPD patients.

Materials and Methods: We performed a systematic review of randomized controlled trials published from 2011 to 2020 to evaluate the effects of exercise therapies on obstruction, dyspnea, and quality of life in obstructive patients. Databases such as Medline, BioMed Central, CINHAL, and Cochrane were reviewed. Methodological quality and risk of bias were assessed using the Cochrane tool.

Results: Most of the trials supported the effectiveness of mechanical chest physiotherapy in improving obstruction, dyspnea, and quality of life.

Conclusion: High-to-moderate evidence shows that mechanical chest physiotherapy is useful in the improvement of obstruction, dyspnea, and quality of life in COPD patients.

Keywords: Borg dyspnea scale, COPD, High-frequency chest wall oscillation, mMRC dyspnea scale, St. George Respiratory Questionnaire, Spirometry

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INTRODUCTION

According to the WHO-Global initiative for Chronic Obstructive Pulmonary Disease (GCOPD), Chronic Obstructive Pulmonary Disease (COPD) has pulmonary and extra-pulmonary symptoms, which impact the quality of life[1]. The prevalence of COPD as a health problem is increasing. There has been a need for advances in the rehabilitation field to control COPD symptoms[2]. In 2010, it was ranked as the third worldwide cause of death; however, it will be the fourth-largest cause of death by 2030[3]. Due to the high prevalence of smoking in some high-income countries, the burden of COPD has been reported to be high in these settings[4]. More than 10% of elder individuals with COPD are greater than 40 years[5]. It is characterized by chronic airflow limitation, limb muscle dysfunction, and major systematic dysfunction[6]. It is a mixture of parenchymal alveolar disease (emphysema) and small-airway disease (obstructive bronchiolitis) and the FEV1/FVC less than 0.7 shows that the airflow limitation is not completely reversible[7, 8].

According to the American Thoracic Society/European Respiratory Society procedure report on respiratory rehabilitation, increasing the accessibility of pulmonary rehabilitation is an important concern[9]. Physiotherapy is an integral part of the management of COPD patients and high-frequency chest wall oscillation technique (HFCWO) and airway clearance techniques (ACT) are harmless procedures in patients with COPD[10].

Physiotherapy rehabilitation (PR) has been evidenced to be effective in increasing exercise tolerance[11]. PR includes HFCWO yields compression of the rib cage wall through blowup sheath connected to air thump generator[12]. HFCWO creates a cough-like expiratory flow bias that enhances mucociliary transport and removes secretions from alveoli, bronchi, and bronchioles. [13-15]. Exercise therapies support the recovery after an acute exacerbation in COPD patients[16]. Intrapulmonary percussive device (IPV) could be effective in COPD patients[17].

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Physiotherapy improves the quality of life, reduces breathlessness, and increases exercise tolerance through therapeutic exercises[18]. Conventional chest physical therapy (CPT) is a combination of huffing, coughing, percussion, shaking, vibration, and postural drainage, which is effective in mucus clearance in chest diseases[19]. Aerobic exercises also improve exercise tolerance in obstructive patients[20].

There are few numbers of studies to find out the effects of chest physiotherapy in COPD patients and rigorous review on the effects of chest physical therapy (CPT) is still scarce. Therefore, this systematic review aims to evaluate the effects of manual and mechanical chest physiotherapy among patients with COPD and bronchiectasis

MATERIALS AND METHODS

A systematic review was conducted on randomized controlled trials that assessed the effects of PR in obstructive patients. The review was conducted in consideration to follow the guidelines as defined in the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) Statement[21]. All grading of COPD plus Spirometrically defined finding of COPD reliable using GOLD principles and bronchiectasis patients (forced expiratory volume in 1: forced vital capacity [FEV1: FVC] <70%)[22] were used. CPT (HFCWO and manual chest physiotherapy) was used as an intervention which was to compare CPT versus control (or usual care, pharmacological therapy, vibratory sensation, and chest physiotherapy. Spirometry, MMRC dyspnoea scale, Borge dyspnea scale, St. George respiratory questionnaire (SGRQ), and 6MWT were used as outcomes. Only Randomized Controlled trials RCTs) were included. Studies that ensured a huge proportion of missing data and implemented insufficient numerical analysis, not in English or else translated and Studies beyond 2011 were excluded from this systematic review. Six electronic databases such as Google Scholar, Medline, BioMed Central, CINHAL, and Cochrane were reviewed in March 2021. Medical subject headings (MeSH) terms included “COPD”, “HFCWO”, “mMRC dyspnea scale”, “spirometry”, St. George respiratory questionnaire” and “pulmonary rehabilitation” were used. “AND” Boolean logic operator was used for a combination of terms. Titles and/or abstracts were reviewed and those articles not meeting eligibility criteria were excluded. The remaining articles were read in detail and considered according to PRISMA guidelines.

Initial screening was carried out by two authors (F.H. and H.A.S.). Then the detailed evaluation of full text and analysis against inclusion and exclusion criteria was performed by two viewers (F.H. and A.A.). The primary search sought a total of 152 studies, some studies were not freely accessible and others were irrelevant. Finally, the trials included in this review met the eligibility criteria on the effects of CPT on obstruction, dyspnea, and quality of life in obstructive patients. The information like author, year of publication, sample size, target population, intervention applied, frequency, and outcome measures were extracted from included trials. The risk of bias was evaluated using the Cochrane tool[23]. It evaluates biases in various manners, which include random sequence generation, allocation concealment, blinding of participants, blinding of outcome assessment, incomplete outcome data, and selective reporting.

RESULTS

Selection of studies

The searches generated over 152 studies and subsequent screening of titles and abstracts, 80 complete articles were reviewed. Subsequently the complete analysis procedure 25 studies were considered appropriate for inclusion. Out of 25 studies, 15 eligible RCTs were included in the systematic review.

Ten studies were omitted because some articles were irreverent, some were not available in English, some full texts were not available and some methodological quality was not good. A total of 15 RCTs were analyzed in this review[24-38]. Figure 1 shows the PRISMA flow diagram of the selection strategy of the trials. The RCTs included in this review comprise a total sample size of 1831 and investigated the effects of exercise therapies on obstruction, dyspnea and/or quality of life in obstructive patients. The trials published from 2011 to 2020 are included in this review.

The sample size of a study related to the effects of standard physical therapy on obstruction in COPD was 54, which lacks sample size calculation. However, the study used spirometry to measure obstruction[25] (Table 1). The sample size of the two studies related to the effects of mechanical chest physical therapy on dyspnea in COPD was 90. However, the study used the mMRC dyspnea scale to measure dyspnea[27,33] (Table 1). The sample size of the four studies related to the effects of manual and mechanical chest physical therapy on quality of life in COPD was 192. However, the study used SGRQ to measure the quality of life[29-30, 32, 38] (Table 1).

The sample size of the two studies related to the effects of manual and mechanical chest physical therapy on both obstruction and dyspnea in COPD was 160. However, the study used spirometry and SGRQ to measure obstruction and dyspnea[24, 31] (Table 1). The sample size of the six studies related to the effects of manual and mechanical chest physical therapy on both dyspnea and quality of life in COPD was 1,335. However, the study used mMRC dyspnea scale or Borg dyspnea scale and SGRQ to measure dyspnea and quality of life. [26, 28, 34-37] (Table 1). Data extraction and quality assessment Chronic obstructive pulmonary disease: COPD; Acute exacerbation of chronic obstructive pulmonary disease: AECOPD; Exper-

imental group: EG; Control group: CG; High-frequency chest wall oscillation: HFCWO; Positive expiratory pressure: PEP; Neuromuscular electrical stimulation: NMES; Intrapulmonary ventilation: IPV; Saint George respiratory questionnaire: SGRQ; Modified medical research council: mMRC; 6-minute walking distance: 6MWD; Forced expiratory volume: FEV Risk of bias within studies and quality appraisal. All trials had no risk of bias in random sequence generation, fewer studies had a lower risk of bias in allocation concealment, most studies had a higher risk of bias in blinding of participants and personnel, and in the blinding of outcome assessment, only a few studies had unclear risk of bias in incomplete outcome data and all studies had a low risk of bias in selective reporting as shown in table 2 [24-38].

SYNTHESIS OF RESULTS

Most trials support the effectiveness of manual and mechanical chest physiotherapy in improving obstruction, dyspnea, and quality of life.

Table 1: Features of the articles in this systematic review

Authors	Year	Sample Size	Target Population	Group	Intervention	Outcome measures
Mahajan et al.24	2011	52	COPD and asthma patients	EG	4 session/3 times a day/15 minutes each received HFCWO	SQ; Borg Modified Scale; Spirometry (FEV1)
				CG	sham device provided a vibratory sensation	
Tang CY et al.25	2012	54	AECOPD	EG	2 sessions/day and 15 min each exercise session received standard physical therapy, upper and lower limb resisted and aerobic exercises	FEV1%; spirometry testing; 3 min walk test
				CG	1 session/day physical therapy including sputum clearance technique and functional training	
Cross JL et al.26	2012	526	COPD	EG	Manual chest physiotherapy and airway clearance technique	SGRQ; Quality of life index; and mMRC dyspnea scale
				CG	Chest clearance alone	
Nicolini A et al.27	2013	30	Bronchiectasis	EG 1	15 days/2 times a day/ 30min/session received HFCWO	Dyspnea and mMRC dyspnea scale
				EG 2	15 days/2 times in a day/45 min/ session received traditional technique of air-way clearance	
				CG	Medical therapy only	
Osadnik CR et al.28	2014	90	COPD	EG	5 repetitions/session of PEP and usual care with 20 min duration each	SGRQ; FEV1; mMRC dyspnea scale; 6MWD
				CG	Usual care	
Pradella CO et al.29	2015	50	COPD	EG	24 sessions received warm-up, aerobic activity, stretching, and relaxation 3 times/week and duration of the program	SGRQ; 6MWD
				CG	No intervention	
Maddock M et al.30	2016	52	COPD	EG	Daily over 6 weeks NMES	FEV1; 6MWT; SGRQ;
				CG	Placebo NMES	
Farag TS et al.31	2017	108	AECOPD	EG 1	4 weeks/3 session/week of 20-30 min/session HFCWO with AECOPD medications	Spirometry; mMRC scale and 6MWD
				EG 2	4 weeks/3 session/week Flutter with AECOPD medications	
				CG	Treated with medication only	
Khan W et al.32	2018	30	COPD	EG	Chest physiotherapy and standard medical treatment	SGRQ
				CG	Standard medical treatment	

Nicolini A et al.33	2018	60	COPD	EG 1	14 days/2 times in a day /15 min / session received physiotherapy and IPV	mMRC Dyspnea scale; SGRQ; mMRC dyspnea scale
				EG 2	14 days/2 times in a day/20 min/ session received percussive device physiotherapy and HFCWO	
				CG	Treated with physiotherapy alone	
Varas AB et al.34	2018	33	COPD	EG	A community-based 8-week program consisting of exercise training	mMRC dyspnea scale
				CG	Recommendations to walk more every day	
Silva CM et al.35	2018	51	COPD	EG	8 weeks/3 sessions/week received warm-up, aerobic exercise, inspiratory muscle training, three sets of upper limb resistance exercise, stretching and followed by a massage	6MWT and SGRQ
				CG	Received warm-up, aerobic exercise, inspiratory muscle training, and stretching followed by a massage	
Schultz K et al.36	2018	602	COPD	EG	3 weeks received highly intensive inspiratory muscle training	6MWD and SGRQ
				CG	Received sham inspiratory muscle training	
Gurudut P et al.37	2019	33	COPD	Group 1	Calisthenics	Modified Borge scale and SGRQ
				Group 2	Yoga	
				Group 3	Chest Physiotherapy	
Shamakh M et al.38	2020	60	COPD	Group 1	6 months received ACBT's	Quality of life
				Group 2	ACBT's plus PEP	
				Group 3	ACBT's plus Acapella	

Chronic obstructive pulmonary disease: COPD; Acute exacerbation of chronic obstructive pulmonary disease: AECOPD; Experimental group: EG; Control group: CG; High-frequency chest wall oscillation: HFCWO; Positive expiratory pressure: PEP; Neuromuscular electrical stimulation: NMES; Intrapulmonary ventilation: IPV; Saint George respiratory questionnaire: SGRQ; Modified medical research council: mMRC; 6-minute walking distance: 6MWD; Forced expiratory volume: FEV

Table 2: Author judgments regarding the risk of bias assessment

Domains	Random sequence generation	Allocation concealment	Blinding of participants and personnel	Blinding of outcome assessment	Incomplete outcome data	Selective reporting
Mahajan AK al., 2011[24]	✔	✔	✔	✔	✔	✔
Tang CY et al., 2012[25]	✔	✔	✖	✖	✔	✔
Cross JL et al., 201226	✔	✖	✖	✖	✔	✔
Nicolini A et al., 2013[27]	✔	✔	✖	✖	✔	✔
Osadnik CR et al., 2014[28]	✔	✔	✖	✖	✔	✔
Pradella CO et al., 2015[29]	✔	✔	✖	✖	✔	✔
Maddock M et al., 2016[30]	✔	✔	✔	✔	✔	✔
Farag TS et al., 2017[31]	✔	✔	✖	✖	✔	✔
Khan W et al., 201832	✔	✖	✖	✖	✔	✔
Nicolini A et al., 2018[33]	✔	✔	✖	✖	✔	✔

Varas AB et al., 2018[34]	✔	✔	✘	✘	✔	✔
Silva CM et al., 2018[35]	✔	✔	✘	✘	?	✔
Schultz K et al., 2018[36]	✔	✘	✘	✘	?	✔
Gurudut P et al., 2019[37]	✔	✘	✘	✘	✔	✔
Shamakh M et al., 2020[38]	✔	✘	✔	✔	✔	✔

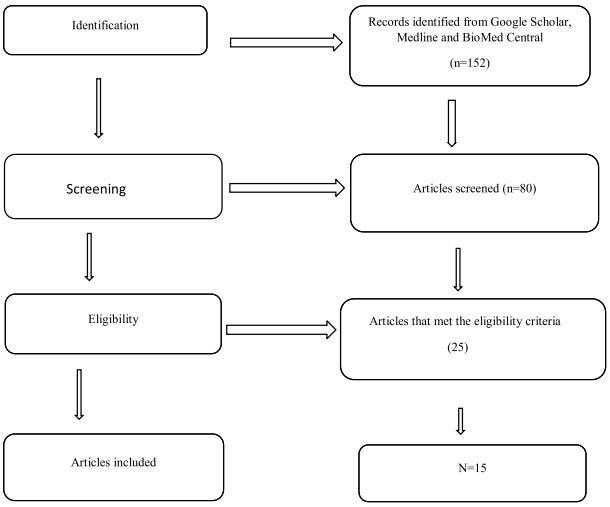

Fig 1: Flow chart according to PRISMA strategies

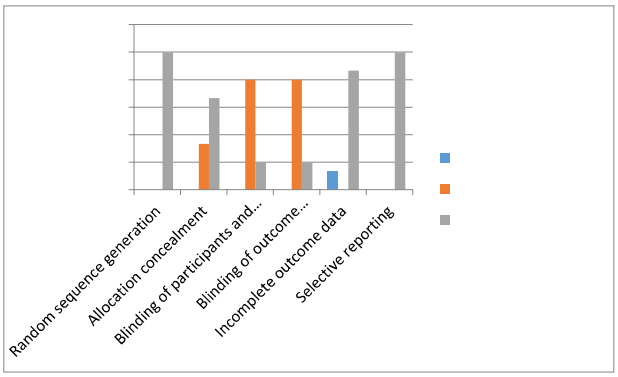

Fig 1: Flow chart according to PRISMA strategies

DISCUSSION

This systematic review has critically analyzed RCTs conducted over the past 10 years (2011-2020) to assess the effects of different exercise therapies on obstruction, dyspnea, and quality of life in obstructive patients. The review consists of 15 trials with a total sample size of 1831 obstructive patients.

A study conducted by Mahajan AK et al. that HFCWO significantly improved dyspnea in COPD patients[24] because it is easy to use for obstructive patients and no need for assistance in mechanical chest physiotherapy, so it will be used by obstructive patients itself to relieve their obstruction, dyspnea and quality of life. Tang CY et al. reported that standard physical therapy is effective in the management of COPD to improve their exercise capability and improvement in activities of daily living[25].

Cross JL et al., conducted a study that manual chest physiotherapy has no part in controlling COPD symptoms[26] because it's difficult for the patient to visit a daily hospital for manual chest physiotherapy that's why obstructive patients did not prefer manual chest physiotherapy. Nicolini A et al. conducted a study that HFCWO with traditional chest physiotherapy revealed a substantial improvement in lung capacities and volumes as well as in ADL's[27].

In contrast, Osadnik CR et al. study proved that positive expiratory pressure (PEP) has no part in controlling COPD symptoms such as dyspnea, sputum and cough because the device only creates positive pressure and assists expiration it has no role in mucus clearance and dyspnea[28] Pradella CO et al., a study found that home-based pulmonary rehabilitation improved quality of life in COPD patients[29].

Maddock M et al. conducted a study that neuromuscular electrical stimulation to quadriceps muscle enhanced efficient exercise capability and recovery from disuse atrophy of lower limb muscles[30] Farag TS et al. study concluded that HFCWO and Flutter device is highly effective in the treatment of patients with AECOPD in terms of improvement in ventilatory function and oxygenation parameters with better exercise tolerance[31].

Khan W et al. analysis shows that chest physiotherapy with standard medical treatment has beneficial effects in pain management and quality of life but it requires the expertise of therapist and when family members apply chest physical therapy that's why it has no such good effects[32] Nicolini A et al. conducted a study that HFCWO and IPV are also effective in the management of COPD patients[33] Varas AB et al. study shows that community-based exercise training has useful effects in improvement of quality of life[34] Silva CM et al. conducted a study that upper limb resistance exercise improved quality of life in COPD patients[35].

Schultz K et al. study shows that inspiratory muscle training has no effects on quality of life and dyspnea[36] Gurudut P et al. study shows that yoga, chest physiotherapy, and calisthenics are equally effective in improvement of quality of life[37] Shamakh M et al.study conducted a study that shows positive expiratory pressure is effective in improvement of pulmonary functions[38]

Compare with review from Alvarenga et al.[1] that HFCWO technique is effective in COPD patients and this

study has similar results to our study because mechanical chest physical therapy produces vibrations to clear mucus and secretions and helps in the expiration of air that relieves dyspnea and ultimately improves the quality of life in obstructive patients.

One of the strengths of this review is focusing on the use of RCTs (2011 to 2020) with valid and reliable instruments to measure outcomes.

Further high-quality studies with the latest manual and mechanical intervention are needed to clearly understand which type of chest physiotherapy is most effective to achieve a better outcome in the management of obstructive patients and what will be the dose of exercise in obstructive patients.

CONCLUSION

High-to-moderate evidence supports that mechanical chest physical therapy is effective in the improvement of obstruction, dyspnea, and quality of life in COPD patients. HFCWO alone or in combination with standard physical therapy, traditional chest physiotherapy, and flutter device relieve mucus and secretions that help in the expiration and ultimately improves dyspnea and quality of life in obstructive patients and mechanical chest physical therapy requires visits and expertise and patients used by their self while on the other side manual chest physical therapy and home-based pulmonary requires visits and expertise which limit the therapist to continue their pulmonary rehabilitation, so it's feasible for the obstructive patients to use mechanical chest physical therapy to relieve their symptoms and improve quality of life.

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AUTHOR'S CONTRIBUTION

Following authors have made substantial contributions to the manuscript as under

Hussain F: Concept, design of study and manuscript writing

Shaikh HA: Data Collection

Ahmed A: Reviewing and Editing

Authors agree to be accountable for all aspects of the work in ensuring that questions related to the accuracy or integrity of any part of the work are appropriately investigated and resolved.