

Effectiveness of PTR Home-based Exercise and Education Program in COPD Patients: Systematic Review

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ABSTRACT

Introduction: Pulmonary rehabilitation (PR) in chronic obstructive pulmonary disease (COPD) patients requires time and full adherence to the treatment program. The difficulty of transportation and the patient's economic barriers raise the need for pulmonary telerehabilitation (PTR). The purpose of this study was to summarize existing literature data regarding the effectiveness of PTR home-based exercise and education program in COPD Patients. **Methods:** A systematic review with qualitative descriptive analysis method of the study from the electronic database Pubmed, Willey Online Library, Science Direct, EBSCO, Ovid. **Results:** There are 6 articles included in this study that stated that the effectiveness of home-based PTR exercise and education programs is comparable to hospital-based PR exercise and education programs in evaluating exercise capacity and quality of life. 5 articles had a dropout rate from participants in the intervention group <20% and 1 article had a dropout rate from participants in the intervention group >20%. 3 articles had a dropout rate from control group participants <20% and 3 articles had a dropout rate from control group participants >20%. **Conclusion:** Effectiveness of the PTR home-based exercise and education program is comparable to the effectiveness of the hospital-based PR exercise and education program in evaluating exercise capacity and quality of life with the cost efficiency of treatment.

Keywords: *effectiveness, PTR, patient's, COPD.*

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INTRODUCTION

Chronic obstructive pulmonary disease (COPD) is a human chronic airway obstruction that requires effective and economical methods of pulmonary rehabilitation (Bourne et al., 2017). COPD is the cause of high patient visits to the Emergency Room, outpatient services and the main cause of death that can be intervened by reduced COPD exacerbations at an economical cost (Stamenova et al., 2020). The main intervention for COPD focused on restoring the physical and psychological condition of COPD patients through exercise therapy programs and behavior change education (Cox et al., 2021).

Physical inactivity is a poor predictor of disease recovery in COPD patients (Spruit et al., 2015). Decreased functional status of COPD patients due to pathological changes that appear early in the disease, causing unpleasant symptoms of dyspnea when doing activities (Blondeel et al.,

2018). Physical inactivity in COPD patients is closely related to health status and increased disease burden (Vorrink et al., 2016).

Physical inactivity of COPD patients requires pulmonary rehabilitation as an effective primary option in the treatment of COPD patients (Hansen et al., 2020). Pulmonary rehabilitation as management supporting the recovery of COPD patients (Bairapareddy et al., 2018). The main goal of pulmonary rehabilitation is to increase the physical activity ability of COPD patients to the standard level of normal people without complaints (Blondeel et al., 2018). Pulmonary rehabilitation (PR) has not been used optimally by COPD patients worldwide (Vasilopoulou et al., 2017).

Pulmonary rehabilitation affects increasing exercise tolerance in COPD patients (Kerti et al., 2018). Increased exercise capacity is obtained through endurance and strength training methods

with face-to-face physiotherapy supervision in hospital gymnasiums that require patient motivation to practice (Wilson et al., 2015). 50% of COPD patients refuse pulmonary rehabilitation programs, 30-50% of COPD patients drop out of pulmonary rehabilitation programs that require alternative methods of implementing rehabilitation (Hansen et al., 2017).

Pulmonary rehabilitation of COPD patients had to be stopped considering the risk of spreading COVID-19 during the pandemic (Elbeddini & Tayefehchamani, 2021). Barriers to access to pulmonary rehabilitation in hospitals due to poor mobility accompanied by transportation and economic barriers in COPD patients raise the need for pulmonary telerehabilitation (Tsai et al., 2017). Transportation difficulties and limited accessibility of pulmonary rehabilitation services were the caused of pulmonary rehabilitation coverage for only 5% of the total COPD patients (Cox et al., 2018).

Pulmonary telerehabilitation (PTR) provides safety benefits with an increase in exercise capacity comparable to face-to-face pulmonary rehabilitation in hospitals (Bourne et al., 2017). PTR is safe and effective in increasing exercise capacity which has an impact on decreasing face-to-face pulmonary rehabilitation visits (Taito et al., 2021). While the effect of pulmonary rehabilitation on the parameters of increasing exercise capacity of COPD patients is better than pulmonary telerehabilitation (Hansen et al., 2020). PTR home-based exercise with an education material program was an innovative solution for COPD patients at an affordable cost for treating COPD patients (Guerra-Paiva et al., 2021)

By observing the above description, the purpose of this systematic review is to summarize the data in the existing literature regarding the effectiveness of home-based exercise and education method pulmonary telerehabilitation programs in COPD patients.

METHODS

This research was a systematic review using the PICOS framework, namely stable COPD patients (population/problem), PTR home-based exercise and education program (intervention),

PR hospital-based exercise and education program (comparison), evaluation of exercise capacity (outcome), the data research study was in the article Randomized Control Trial (study design) with qualitative descriptive analysis method. The search for relevant articles was carried out on articles published from 2011 until 2020 in 5 electronic databases: Pubmed, Willey Online Library, Science Direct, EBSCO, Ovid.

Document selection using a combination of keywords: ((COPD) AND ("pulmonary telerehabilitation" OR "respiratory telerehabilitation" OR "telehealth of pulmonary rehabilitation" OR "telehealth of respiratory rehabilitation" OR "online pulmonary rehabilitation")). The results of the article search use the flow chart diagram and PRISMA-P 2009 checklist, eliminate articles that do not match the search topic with identification criteria, article screening, article eligibility, and the last step is included the relevant article.

Inclusion criteria were an open-access journal with full-text articles in a randomized control trial study design; patients who had aged at the research > 18 years and understand to use technology information; patients who had clinical diagnosis stable COPD; patients in the intervention group received a pulmonary rehabilitation program at home with a remote monitoring program use facilitation of information technology or telephone; control group research patients get a pulmonary rehabilitation program in health care facilities. Exclusion criteria were patients who had another unstable pulmonary disease or other main complaints than COPD which is unstable hypertension, unstable cardiovascular disease; the presence of cognitive impairment and comorbid mental illness other than depression and anxiety; articles not written in English were excluded from this systematic review. In addition, the term medical subject title (MESH) was used where appropriate restrictions were applied regarding study design, setting, and time frame.

RESULTS

The process of searching for articles using the keywords pulmonary telerehabilitation on COPD through an electronic database search can



be seen in Figure 1. 318 published articles were identified as pulmonary telerehabilitation articles in COPD patients, 11 articles were deleted because duplication of searches was identified through an electronic database in the Mendeley desktop system, 307 articles were screened by title and abstract, 287 articles were found with a non-research design. The RCT, 1 article was only an abstract, 4 articles of PTR in COPD patients without education and 4 articles of the PTR research protocol in COPD patients were excluded, so that 11 relevant articles were obtained, then 11 articles were selected for eligibility and identified 6 articles that were included in the qualitative synthesis.

The final result of the article review process showed that 6 articles fulfill the eligibility criteria to include in synthesis qualitative with research subjects from Denmark (2 articles), Spain (1 article), Canada (1 article), United Kingdom (2 articles). The study characteristics of the 6 articles included in the qualitative analysis were that stable COPD patients had an average age range of 62 to 71 years. 4 articles (67%) had a percentage predictive value of FEV1 in the range of 30-49% (severe COPD), 2 articles (33%) had a percentage predictive value of FEV1 in the range of 50-79% (moderate COPD). While the anamnesis data of stable COPD patients obtained 4 articles (67%) of the 6 articles studied, almost all patients had a history of active smoking and 2 articles (33%) did

not mention the patient's smoking history in the research report.

Based on data table 1, All articles analyzed in this study stated that PTR home-based exercise program was comparable to the results of the PR hospital-based exercise program on evaluation exercise capacity and quality of life. 5 articles (83 %) from 6 articles stated that the mean dropout rate of the intervention group was < 20 % from participants and only 1 article (17 %) from 6 articles stated that the mean dropout rate of the intervention group was > 20 % from participants. 3 articles (50 %) from 6 articles stated that the mean dropout rate of the control group was < 20 % from participants and 3 articles (50 %) from 6 articles stated that the mean dropout rate of the control group was > 20 % from participants. while for the follow-up program, only 2 articles (33%) of the 6 articles reported a follow-up program with the mean dropout rate of all groups being 27-76% of the participants.

Many pulmonary rehabilitation programs research report a dropout rate of 50% (Chaplin et al., 2017). 50% of COPD patients refuse pulmonary rehabilitation programs, 30-50% of COPD patients drop out of pulmonary rehabilitation programs that require alternative methods of implementing rehabilitation (Hansen et al., 2017). Pulmonary rehabilitation of COPD

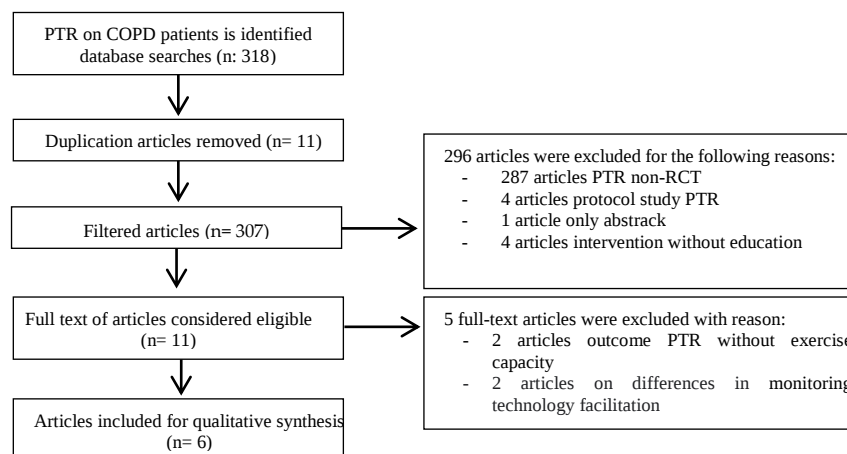


Figure 1. The article search flow chart diagram with PRISMA-P.

Tabel 1. Summary results effectiveness of program telerehabilitation in COPD patients.

Author	Country	Characteritics Subject	Experiment group		Summary of the result
			Experiment group	Control group	
Sticklandet al., 2011.	Canada	Total subject 409 patients (147 IG, 262 CG) has been clinical diagnosis with stable COPD, Mean age: 69.2 (IG) and 69.5 (CG), FEV1% predicted 48.31 (IG) and 48.97 (CG). All patient had a history of heavy smoking.	2 times weekly for 8 weeks in PTR home-based exercise with an education program in local communities supervise by a respiratory therapist via the local site a videoconference with 6 months follow up programs.	2 times weekly for 8 weeks in hospital-based standard PR and education program with a face-to-face method with 6 months follow up programs	PTR home-based program was comparable to hospital-based standard PR in exercise capacity 12 min walk test and quality of life with SGRQ. Cost efficiency can be obtained from a PTR home-based exercise program. Mean drop out rate post intervention (17.6 % (IG), 3 %(CG)) and follow up programs (76.2 % (IG), 47.5 %(CG)).
Bourne et al., 2017.	United Kingdom	Total subject 90 patients (64 IG, 26 CG) were clinical diagnosis stable COPD, Mean age: 69.1 (IG) and 71.4 (CG), FEV1% predicted 58.0 (IG) and 60.5 (CG). all the patients had smoked history.	6 weeks online PR home-based exercise training and education program used material guidelines in the web-based platform.	6 weeks in 10 exercise station hospital-based PR and education program with supervising a face-to-face	The PTR home-based exercise program was comparable to the face-to-face hospital pulmonary rehabilitation program on the exercise capacity evaluation 6 MWT distance and quality of life with SGRQ. the clinical evidence based on the safety tolerance for the action PTR in COPD patients. Percentage all groups average dropout rate post-intervention (90%)
Chaplin et al., 2017.	United Kingdom	Total subject 103 patients (51 IG, 52 CG) were clinical diagnosis stable COPD, Mean age: 66.1 (IG) and 66.4 (CG), FEV1% predicted 55.0 (IG) and 58.7 (CG). Smoked history not declared.	14 sessions in 7 weeks PTR home-based exercise training program (4 weeks supervised and 3 weeks unsupervised) with material education of pulmonary rehabilitation at the support from telephone/email and website.	12 sessions hospital-based pulmonary rehabilitation in 7 weeks with exercise training and education program.	PTR home-based exercise program was comparable to the results of hospital-based PR programs on the exercise capacity evaluation ESWT and CRQ-D. but the criteria for patients drop out from PTR home-based exercise programs were higher than PR hospital-based exercise. Mean drop out rate post intervention (56.9% (IG), 23%(CG))



6 MWD: 6 minute walking test distance, CAT : COPD assessment test, CCQ : Clinical COPD Questionnaire, CG : control group, COPD : chronic obstructive pulmonary disease, CRQ-D : chronic respiratory disease questionnaire-dyspnoea, ESWT : endurance shuttle walk test, FEV1 % predicted : force expiratory volume in 1 second % predicted, PR : pulmonary rehabilitation, PTR : pulmonary tele-rehabilitation, SGRQ : St George's Respiratory Questionnaire (SGRQ).

Author	Country	Characteristics Subject	Experiment group		Summary of the result
			Experiment group	Control group	
Hansen et al., 2020.	Denmark	Total subject 134 patients (67 IG, 67 CG) were clinical diagnosis stable COPD, Mean age: 68.4 (IG) and 68.2 (CG), FEV1% predicted 32.6 (IG) and 33.7 (CG). 98 % of the patients had smoked history.	60 min, 3 times weekly for 10 weeks in PTR home-based exercise program and education program via a videoconference software system installed with 3 months follow up programs.	90 min, 2 times weekly for 10 weeks in hospital-based exercise and education program Pulmonary rehabilitation with 3 months follow up programs	PR program hospital-based was comparable to the results of hospital-based PR programs on the exercise capacity evaluation 6 MWT distance and evaluation quality of life with CCQ. Mean drop out rate post intervention (7.5 % (IG), 36 % (CG)) and follow up programs (27 % (IG), 37.3% (CG)).
Godtfredsen et al., 2020.	Denmark	Total subject 134 patients (67 IG, 67 CG) were clinical diagnosis stable COPD, Mean age (all) 68.3 and FEV1% predicted 33.1 (all). 75% former smoked.	10 weeks of PTR home-based exercise with an education program to improve physical endurance using a standard telehealth program with local site supervision and 12 months follow-up from baseline.	10 weeks of hospital-based PR training and education program with 12 months follow-up used Denmark standard guidelines for PR.	PTR home-based exercise program was comparable to the results of hospital-based PR programs on the exercise capacity evaluation 6 MWT distance and evaluation quality of life with CCQ. Mean drop out rate (7.5 % (IG), 36 % (CG)).
Galdiz et al., 2021.	Spain	Total subject 94 patients (46 IG, 48 CG) were clinical diagnosis stable COPD. Mean age: 62.3 (IG) and 63.0 (CG), FEV1% predicted 45.87 (IG) and 42.93 (CG). Smoked history not declared	12-month pulmonary telerehabilitation maintenance programs after an 8-week intensive outpatient hospital PR program use mobile phone applications on the web-based platform with chest physiotherapy and endurance training with sessions material educational.	The usual care maintenance exercise program and educational materials for pulmonary rehabilitation 12 months in the hospital after an intensive outpatient pulmonary rehabilitation program for 8 weeks in the hospital.	PTR program was both feasible, safe, and comparable to usual care hospital pulmonary rehabilitation for maintaining the quality of life used evaluated parameters CRQ-D. PTR was more effective than the PR program to increased exercise capacity parameters 6 MWT distance. Mean drop out rate post-intervention (10.9% (IG), 16.7 % (CG))

6 MWD: 6 minute walking test distance, CAT : COPD assessment test, CCQ : Clinical COPD Questionnaire, CG : control group, COPD : chronic obstructive pulmonary disease, CRQ-D : chronic respiratory disease questionnaire-dyspnoea, ESWT : endurance shuttle walk test, FEV1 % predicted : force expiratory volume in 1 second % predicted, PR : pulmonary rehabilitation, PTR : pulmonary tele-rehabilitation, SGRQ : St George's Respiratory Questionnaire (SGRQ).



patients had to be stopped considering the risk of spreading COVID-19 during the pandemic (Elbeddini & Tayefehchamani, 2021). Barriers to access to pulmonary rehabilitation in hospitals due to poor mobility accompanied by transportation and economic barriers in COPD patients raise the need for pulmonary telerehabilitation (Tsai et al., 2017).

DISCUSSIONS

PTR home-based exercise and education programs required two-way interaction between patients and therapists which is beneficial in increasing service accessibility and reducing treatment costs (Bryant et al., 2019). Pulmonary telerehabilitation is safe to apply in the stable condition of COPD patients (Taito et al., 2021). The clinical requirements for patients to be able to participate in the pulmonary telerehabilitation program are medically stable COPD patients with FEV1 > 60% and did not have cognitive impairment (Blondeel et al., 2018).

The use of information technology based on videoconferencing applications with the support of monitoring training programs and educational materials available on the website has been used in this study. PTR home-based exercise and education program or PR hospital-based exercise and education program in stable COPD patients has been carried out for 6-10 weeks in 5 articles (83 %) of the 6 articles reviewed, while 1 articles (17 %) have been done for 12 months with the pulmonary rehabilitation method with the aim of maintaining physical capacity after recovered care in the hospital.

Dosage of pulmonary rehabilitation exercises in COPD patients at least twice a week for 6 months with exercise supervision and education by a physiotherapist in a hospital (Chaplin et al., 2017). Transportation barriers, the severity of exacerbation symptoms and economic ability to attend rehabilitation cause the average dropout rate to be high. (Hansen et al., 2020) Pulmonary telerehabilitation in COPD patients is an effective and efficient strategy for patients who live in remote areas and do not have access to exercise programs in hospitals (Zanaboni et al., 2016).

Pulmonary rehabilitation used a comprehensive individual approach based on the

identification of the patient's individual condition assessment data (Wouters et al., 2018). The implementation of pulmonary rehabilitation implements the restoration of exercise capacity and endurance exercises such as walking endurance exercises, sitting to standing exercises, exercises with ergometer monitoring, chest physiotherapy, and arm strengthening exercises with burbles (Wilson et al., 2015). Pulmonary rehabilitation programs in hospitals are effective in forcing patients to move to the therapy site, while pulmonary telerehabilitation will only make patients less likely to move out of the house (Blondeel et al., 2018).

Implementation recommendations of pulmonary telerehabilitation program for the therapy group recommended in aerobic exercise, activity endurance training, and breathing exercises were carried out with half the number of participants in the therapy group at the hospital through physiotherapy monitoring (Stickland et al., 2011). The approach method for pulmonary telerehabilitation included to a pulmonary rehabilitation program in stable COPD patients takes into account the complexity of the clinical status and the personal uniqueness of each patient (Wouters et al., 2018).

PTR Home-based exercise programs on patients with a history of repeated exacerbations of COPD are not effective to improve the patient's quality of life, so increased clinical services is absolutely necessary (Pinnock et al., 2013). Improved clinical services can be achieved in an individualized approach to pulmonary telerehabilitation with patient involvement in the creation and development of the web site facilities used (Chaplin et al., 2017). Patient preparation is related to the use of interactive communication media based on a website and an assessment of the patient's physical condition is absolutely carried out at the beginning of the activity (Stickland et al., 2011).

However, neither PTR nor conventional PR was associating with continuous improvement in physical capacity after the program was completed (Godtfredsen et al., 2020). The pulmonary rehabilitation exercise program monitored by a physiotherapist must be immediately abolished and replaced with a patient self-care pulmonary rehabilitation program



without remote monitoring by a physiotherapist (Moy et al., 2015). The need for monitoring daily activities is carried out to the evaluated quality of life of COPD patients from the impact of exercise on respiratory symptoms and barriers to daily activities due to shortness of breath (Stamenova et al., 2020). So that the measurement of the activity tolerance of COPD patients is measured by walking endurance exercises (Galdiz et al., 2021).

The key to the success of pulmonary telerehabilitation is the patient's active role in full compliance with the PTR home-based exercise program for reduced the risk of acute COPD exacerbations, reducing emergency room visits, and outpatient visits (Vasilopoulou et al., 2017). PTR home-based exercise program was comparable to the results of the PR hospital-based exercise program on evaluation exercise capacity and quality of life. However, the cost-efficiency of the treatment can be obtained from a PTR home-based exercise program compared to pulmonary rehabilitation hospital-based exercise programs (Stickland et al., 2011).

CONCLUSION

The effect of telerehabilitation with videoconference and pulmonary telerehabilitation module materials available on the website with the patient's active role in full adherence to the PTR home-based exercise program is comparable to the results of a PR hospital-based exercise program on the evaluation of exercise capacity and quality of life with treatment cost efficiency.

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