Effectiveness of Pulmonary Rehabilitation with Exercise Training in Improving Health Outcomes for Patients with Chronic Obstructive Pulmonary Disease

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Abstract

Background: Even though pulmonary rehabilitation is supposed to be crucial to managing patients with chronic obstructive pulmonary disease, health outcomes are still not at their best. **Aim:** To evaluate the effectiveness of pulmonary rehabilitation with exercise training in improving health outcomes for patients with chronic obstructive pulmonary disease. **Methods:** A quasi-experimental research design (one-group pre/post-test) was consumed. **Setting:** this study was applied in the Chest department at the Specialized Medical Building and outpatient clinic: Mansoura University Hospital, which provides services for chest disease patients including chronic obstructive pulmonary disease patients. **Tools**: Six tools were utilized **1)** A structured interview questionnaire; **2)** a six-minute walk scale; **3)** a Borg scale; **4)** Exercise self-efficacy; **5)** a London chest activity of daily living scale; and **6)** a chronic obstructive pulmonary disease assessment test scale. **Results:** There was a highly significant improvement in pulmonary function (0.0001), a six- minute walk scale (m) (0.0001) and an increase in daily step count. The severity of dyspnea significantly decreased (0.0001) with significant improvement in Exercise self-efficacy (0.004) and chronic obstructive pulmonary disease Assessment Test (0.05). Furthermore, there is a significant correlation between Activity of Daily Living with Level of Dyspnea (0.001) and functional status (0.01). **Conclusions:** The current study highlighted sufficient evidence that pulmonary rehabilitation with exercise training was effective in optimizing management and general health outcomes among chronic obstructive pulmonary disease patients. **It is recommended** to use Pulmonary Rehabilitation with Exercise Training as a routine part of care for patients with Chronic Obstructive Pulmonary Disease as a routine part of care.

Keywords: Chronic Obstructive Pulmonary Disease, Exercise Training, Health Outcomes, Pulmonary Rehabilitation,

Introduction:

A widespread lung condition around the world is chronic obstructive pulmonary disease (COPD) characterized by a gradually persistent restriction in airflow **(WHO 2022).** COPD has a significant and growing social and economic cost. By 2030, COPD will rank as the fourth most common cause of death and the seventh most common cause of disability. COPD patients' daily symptoms restrict their activities and ultimately make it impossible for them to work or take care of themselves **(Zeng, Jiang, Chen, Chen & Cai., 2018).**

The significance of appropriate COPD care is underscored by the correlation between recurrent exacerbations and poorer health outcomes, death rates, and a drop in forced expiratory volume in one second (FEV1). Delaying the onset of an exacerbation may slow the disease's evolution and improve their overall health. Outlining the best evidence-based treatment of COPD in primary care, guidelines have been developed and distributed. One such set of guidelines is the Global Initiative for Obstructive Lung Disease (GOLD) **(GOLD., 2022).**

Despite robust global recommendations, primary care practitioners are not fully aware of these standards. Evidence proposes suboptimal application of most of these recommendations. According to guidelines, pulmonary

rehabilitation (PR), which consists of a planned program of supervised exercise training, education, and behaviour modification, should be considered the cornerstone of non-pharmacological care in COPD. Guidelines recommend that patients with COPD, regardless of their severity, benefit greatly from rehabilitation with PR even those who are limited by dyspnea during exercise **(Milner et al., 2018).**

Intensifying alertness of the magnitude of the challenge posed by low levels of physical activity in people with COPD highlights the need for interventions to increase engagement in physical activity (**Burge, Cox, Abramson & Holland., 2020).**

Significance of the study

Patients with COPD appear to be more likely to be physically inactive, and this behaviour is a reliable indicator of poor outcomes. PR did not necessarily include a rise in everyday physical activity. Physical activity levels may rise significantly as a result of exercise training. To increase physical activity levels and improve COPD symptoms, more individualized behavioural lifestyles and physical activity interventions, together with exercise training, may be required (**Coultas et al., 2018).**

Aim of the study:

To evaluate the effectiveness of pulmonary rehabilitation with exercise training in improving health outcomes for patients with chronic obstructive pulmonary disease.

Research hypotheses:

H0: Pulmonary rehabilitation with exercise training does not affect general health outcomes in COPD patients.

H1: Pulmonary rehabilitation with exercise training would optimize general health outcomes in COPD patients.

Operational definition

Physical activity (PA) is operationally defined as "the behavior that involves human movement, resulting in physiological attributes including increased energy expenditure and improved physical fitness"

Subjects and methods:

Research Design: The study will track a quasi- experimental design, which concerns manipulating the independent variable to detect the effect on the dependent variable. The pre-post-test results help establish the effectiveness intervention's measures proposed in the existing research **(Ngusie, et al., 2023)**.

Research Setting: This proposal was achieved in the Chest department at the Specialized Medical Building and outpatient clinic of Mansoura University Hospital, Egypt.

Subjects: A purposive sample of 45 patients will be utilized in the current study. The sample size was estimated centered on **Dorje and colleagues (2018)** formulation which is calculated as (N=nx30/100) in which: N= Sample size

n= Overall number of patients with COPD admitted to Mansoura University Hospital during 2023.

The calculated sample size comes out to be 38.2 patients. To account for expected drop-outs, an additional patient was added, so the sample size was 45 patients.

Participants' inclusion criteria:

Conscious, adult COPD patients, age 20-60 years from both genders, symptomatic patients (dyspnea and reduction in exercise tolerance), clinically stable and had been receiving optimal medical therapy (dual bronchodilator therapy) for at least 8 wk., communicate verbally, willingness to partake in the study.

Participants exclusion criteria:

patients suffering from joint disease, heart disease, or absence of motivation to the exercise package

Tools of data collection

Six tools were used for data collection:

Tool I: A structured interview questionnaire

The researchers designed it following a thorough examination of the literature **(Debouche, et al, 2016).** It split into three sections:

Section 1: The socio-demographic data

of the patients, including patients' age, gender, level of education, and level of physical activity.

Section 2: Medical data including weight, height, body mass index (kg/m2), current smoking status, and daily steps.

Section 3: Contained Lung Function, Chest wall expansion (CWE), the average amount of expectorated sputum, O2 saturation, Breathholding time (BHT), C-Reactive protein level, lung function test, Chest wall expansion (CWE) measurements, and Breath-holding time (BHT)

Tool II: six-minute walk scale (6MWT)

This scale has been recognized as easier to administer, tolerate, and accurately reflect daily living activity to judge patients' exercise capacity. Distance covered in six minutes is found by multiplying total laps by 12 meters and adding the distance of the partial lap at the test end **(Balke (1963)**.

Tool III: Borg Scale

The following scale by **(Chen, Fan & Moe., 2002),** was utilized to assess the patients' dyspnea level after the 6MWT. Patients were asked to mark their dyspnea level on a 10-point horizontal line. Scores ranging from 0 to 10 (0 = no dyspnea, 3 = mild, 5 = severe, 8 = very severe, and 10 = most severe dyspnea). Higher scores indicated more severe dyspnea.

Tool IV: Exercise self-efficacy.

The scale is a nine-item self-report measure adopted from **(Lee et al., 2009)**, which allows patients to indicate whether they can stick to an exercise plan even when faced with challenges. Patients use a scale from 0 (No confidence) to 10 (very confident) to rate their current expectation of their ability to carry out exercise programs. Total scores range from 0 to 90, where higher scores indicate higher exercise self-efficacy.

Tool V: London Chest Activity of Daily Living Scale (LCADL)

Adopted from **Garrod, Bestall & Paul (2000),** The scale is a dependable way to measure functional limitations in COPD patients caused by dyspnea, and it also effectively reflects changes in pulmonary rehabilitation programs. It consists of four domains with 15 items in total, each scored from 0 to 5. Higher total scores indicate greater functional limitation.

Tool VI: Chronic Obstructive Pulmonary Disease Assessment Test scale

This tool was developed by **Gupta, Pinto, Morogan & Bourbeau (2014),** which is a valid disease-specific questionnaire for measuring the quality of life of patients with chronic obstructive pulmonary disease and consists of eight questions. The total score was calculated, and higher scores indicate worse outcomes.

Validity and reliability

A team of five experts with specialized knowledge in medical-surgical nursing, critical care nursing, and medical biostatistics reviewed the content for validity. The experts made adjustments to the tools to improve their clarity, relevance, thoroughness, simplicity, and practicality. Each tool was evaluated independently, and any disagreements were discussed until a consensus was reached. All suggested changes were made to enhance the questionnaire's validity until the final format used in the study was achieved. Cronbach's alpha was used to assess the validity of the suggested study tools (tool II: 0.86; tool III: 0.78; tool IV: 0.73; tool V: 0.95; and tool VI: 0.82).

Pilot study

A pilot study was conducted involving a sample of 10% of the target population. However, these patients were later excluded from the study. The purpose of this preliminary investigation was to assess the clarity, feasibility, and applicability of the research tools, as well as to estimate the time required for completing and submitting them.

Ethical Considerations and Human Rights:

The research Ethical Committee of Faculty of Nursing at Mansoura University, Egypt, granted ethical permission **(IRB 0584)**. The participants were told that their involvement in the study was voluntary and that they could choose to withdraw at any time without facing any negative consequences. Each participant was required to provide verbal consent after being fully informed about the study's purpose, benefits, risks, and procedures. The confidentiality and anonymity of the data were

ensured, and it was used only for the purposes of the study.

Fieldwork and Data Collection:

Fieldwork consists of four sequential phases to achieve its aims.

Preparatory phase

In this phase, the researchers create research instruments by carefully reviewing academic literature. After finalizing the English version, it was translated into Arabic and then back translated into English. We also examined the content validity and reliability of the tool mentioned earlier. We obtained written permission from the relevant authorities at the beginning of the study.

Planning Phase

Based on a review of current literature, the researchers developed the instructional content, intended outcome, and instructional video in simple Arabic **(Lear, 2018; Moulson et al., 2020).**

Implementation Phase

The researchers joined the previously mentioned setting from the beginning of April 2024 until the end of July 2024 and all participants who satisfied the specified parameters were incorporated into the study.

The researchers conducted physical baseline outcome assessments, which included weight, height, body mass index (kg/m2), current smoking status, level of physical activity, and daily steps.

The pulmonary rehabilitation program included whole-body exercise training consisted of 2 educational sessions and 1 practical session.

Educational session: patients were enlightened on various aspects of COPD and exercise routines using diverse instructional strategies and illustrated media, it takes approximately 20 to 30 minutes.

Practical session: Advice and counsel on physical activity provided to participants utilising the Australian Physical Activity and Sedentary Behaviour Guidelines' five-point strategy (Ask, Advise, Assess, Assist, and Arrange follow-up) and the researchers make sure the patient's phone number is registered and that he or she has internet access **(Australia's Physical Activity and Sedentary Behaviour Guidelines, 2019)**.

The pulmonary rehabilitation program included 30 minutes of respiratory training in the morning, chest wall stretching, learning controlled breathing techniques, inhalation, expectoration, psychological support, and a session of further personalized training for each patient.

Exercise training included 2-3 times for 10 - 20m/ day and increased to 30m/ day (as tolerated) including walking, range of motion, and isometric exercise for 4 weeks.

Chest wall expansion (CWE) measurements were used to evaluate the effect of PR with exercise training by measuring the difference between thoracic girth after maximal inspiration and at the end of maximal expiration using measuring tape at 2 levels of the rib cage, upper level at the 3rd intercostal space and lower level at spinous process of the 5th thoracic vertebrae in standing position with arms along the body (**Moll and Wright., 1972)**.

Breath-holding time (BHT) After a maximal inhalation, the subjects were asked to hold their breath as long as possible with a closed nose and mouth without inhalation (**Mirsky, Lipman & Grinker 1946).**

The amount of sputum was measured daily and summed at the end of every week

The **6MWT** was conducted on a flat, straight, enclosed corridor with a hard surface that was seldom traveled in the thoracic unit and was based on the Guidelines for the Six-Minute Walk Test of the American Thoracic Society **(Balke (1963)**. Lung Function, 6MWD, (CWE), the average amount of sputum, O2 saturation, and Breathholding time (BHT) were measured at baseline and in Wk. 4

The quality of life and dyspnea were evaluated by the COPD assessment test (CAT) and Borg Scale at baseline and in Wk. 4 **(Ueki et al., 2018).**

Changes from baseline dyspnea are considered a primary outcome. Secondary outcomes were changes in exercise capacity, HRQOL, activity of daily life (ADL), physical activity (PA), and adverse events **(Alison et al.,**

2017).

Contact participants on a regular basis through WhatsApp and telephone call to detect any changes in physical behaviour and prevent reverting to a sedentary lifestyle.

Advise patients when they are active, the importance of fluid intake and a healthy diet, not to exercise if they feel nauseated, have chest pain, are out of oxygen, have increased shortness of breath or worsening of other COPD-related symptoms, feel dizzy, weak, or unsteady. If patients exercise outside, avoid exercising on days with extreme temperatures or weather conditions.

Participants initiate contact with the researchers for advice and support by joining a chat room.

Follow-up was done with each patient individually in the outpatient clinic to follow patients' progress and carry out a post-test.

Evaluation Phase:

The effect of PR program with exercise training on O2 saturation, pulmonary function, Chest wall expansion (CWE), average amount of expectorated sputum, Breath holding time, functional exercise capacity, level of dyspnea, exercise self-efficacy, functional limitation was assessed through comparisons between the pre and post-tests after 4 Wk using study tools (tool 1 section 3, tool II, tool III, tool IV, tool V and tool VI).

Statistical design:

Version 22 of the Statistical Package for the Social Sciences (SPSS) was used to analyze the data that had been gathered. The researcher examined, categorized, and then coded each tool's content. Numbers and percentages were used to define categorical variables, and paired nominal data described by the McNemar test—a nonparametric test. A significance less than 0.05 (P value) was deemed statistically significant, while values below 0.001 were considered highly significant.

Results

Table (1) shows the participants' % distribution of the demographic variables. In this study, fifty patients were enrolled, of whom more than half (57.8) were male, more than one-third (42.2) were in their fourth decade of life, and slightly less than half (46.6) had a bachelor's degree. Most (88.8) of the patients were married and not physically active (68.9).

Figure (1) examines the participants' levels of C- reactive protein before and after the intervention and finds that, when compared to baseline, the C- reactive protein level significantly decreased after week four (0.03).

Table (2) showed a statistically significant rise in the daily step count with a highly significant improvement in pulmonary function (0.0001) and 6MWT (m) (0.0001). A considerable

improvement in exercise self-efficacy (0.004) and the COPD Assessment Test (0.05), and the severity of dyspnea dramatically decreased (0.0001).

Figure (2) illustrates that at Wk. 4 follow-up participants had significant improvement in O2 saturation (0.003), breath holding time (0.01), the average amount of expectorated sputum (0.003), and chest wall movement (0.0001)

Table (3) compares mean changes in functional limitation and clarifies that participants had a decrease in functional limitation from 38.5(13.2) to 30.4(12.5) after 4th Wk. of intervention (-5.9(9.23 to -2.60)

Table (4) revealed a significant correlation between LCADL total and Level of dyspnea (0.001) and functional status (0.01)

Table (1) Demographic data among participants (N=45)

Characteristic	N	%
Sex		
• Male	26	57.8
• Female	19	42.2
Age group (years)		
• 20 < 30	11	24.4
• 30 < 40	10	22.2
• 40 < 50	19	42.2
• 50 - 6*	5	11.2
Education level		
• Illiterate	5	11.2
• Intermediate Education	19	42.2
• University education	21	46.6
Marital status		
• Single	5	11.2
• Married	40	88.8
Physical activity		
• Active	14	31.1
• Inactive	31	68.9
Residence		
■ Rural	25	55.6
■ Urban	20	44.4

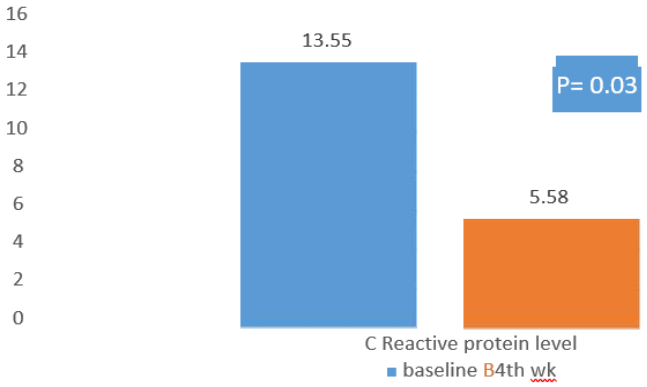

Figure 1: C - reactive protein level of participants pre- and post-intervention

Table 2: Comparison of the pulmonary function, physical ability, level of dyspnea, exercise self-efficacy, and functional limitation of participants pre- and post-intervention (N = 45)

Variables	Baseline	Wk. 4	P- value
Pulmonary function test			
= FVC	45.33 ±14.60	57.04 ±16.99	0.0001
= FEV1	46.15 ±14.33	54.45 ±16.82	0.0001
6MWT (m)	392.2 ± 80.2	453.2 ± 82.4	0.0001
Borg scale	5.0 (1.0)	2.0 (2.0)	0.0001
Exercise self-efficacy	76.8 ± 14.6	80.0 ± 13.5	0.004
COPD Assessment Test scale	5.96 ± 2.58	7.95 ± 2.48	0.05

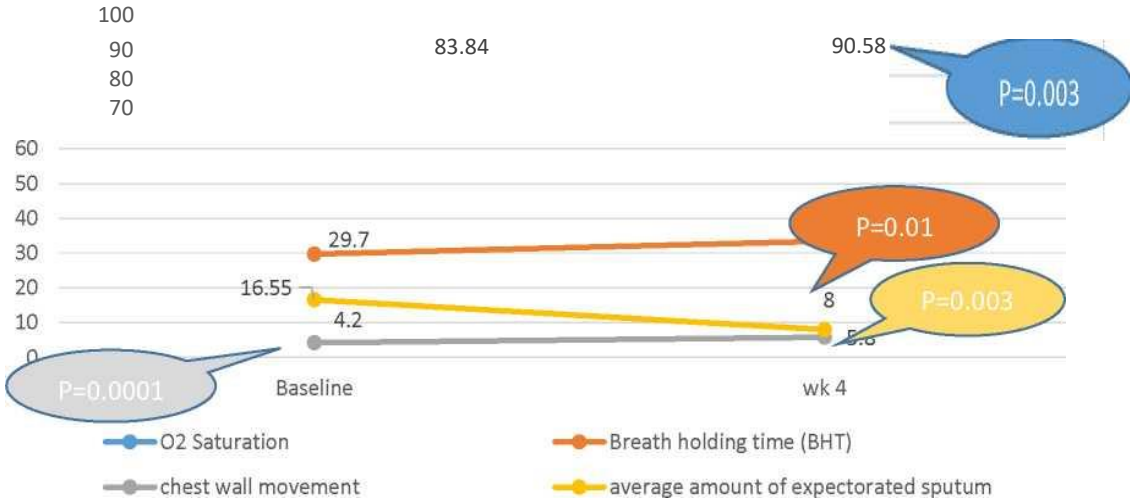

Figure 2: O2 saturation level, breath holding time, average amount of expectorated sputum, and chest wall movement pre- and post-intervention

Table (3) Functional limitation level in patients with COPD due to dyspnea pre- and post-intervention using The London Chest Activity of Daily Living scale (LCADL)

LCADL	Baseline mean (SD)	Wk. 4 mean (SD)	Difference (95% CI)
Self-care	8.95 (3.2)	7.5(3.1)	-1.6 (-2.73 to -0.64)
Domestic	16.24(10.3)	15.4(8.4)	-2.4(-5.83 to -0.06)
Physical	5.6(1.5)	3.8(1.8)	-0.9(-1.23 to -0.36)
Leisure	6.5 (2.4)	4.4(2.1)	-0.24(-2.093 to -0.77)
LCADL total	38.5(13.2)	30.4(12.5)	-5.9(-9.23 to -2.60)

Table (4) Correlations between LCADL total and level of dyspnea and functional status, physical activities in daily life, and mortality index.

Variables	LCADL	
	r	**P- Value**
6MWT (m)	- 0.31	0.01
Borg scale	0.49	<0.001

Discussion

Globally, one of the main causes of illness and death is chronic obstructive pulmonary disease (COPD) **(GOLD 2020).** Longer durations of symptoms have been linked to worse health outcomes and noticeably shorter times between exacerbations. Acute Exacerbation of Chronic Obstructive Pulmonary Disease (AECOPD) patients who have more severe symptoms are also more likely to be housebound. Actions to improve symptoms as soon as feasible after an AECOPD are necessary due to the extended influence of AECOPD on symptom severity and the impact of symptoms on quality of life **(Wageck, Cox & Holland., 2019).**

Patients with COPD frequently have worsening quality of life (QOL), growing disability, and higher medical expenses, including

hospitalization. One of the best therapeutic approaches for enhancing exercise tolerance, overall health, and breathlessness in COPD patients is comprehensive pulmonary rehabilitation (PR) in conjunction with exercise training **(Higashimoto., 2020).**

The study at hand pertains to evaluating the usefulness and relevance of pulmonary rehabilitation with exercise training in optimizing management and general health outcomes in chronic obstructive pulmonary disease patients.

The current study ascertained that the fourth decade of life accounted for the bulk of study participants. This discovery's reasoning stems from the fact that COPD is a chronic illness that often manifests in people over 40 and progressively worsens as a result of pathophysiological alterations that disrupt airway function, which was confirmed by studies by **Lutter et al., (2020) and Bahremand et al., (2021).** In this study, more than half of the participants were men. This finding might be explained by the fact that tobacco smoke is the most common cause of COPD and that the illness has long been associated with smoking in men **(Ntritsos et al., 2018).**

Lung injury in patients with COPD is exacerbated by reduced lung function, increased sputum production, and severe inflammation. Elevated levels of C-reactive protein (CRP), a significant inflammatory mediator, signify a more severe inflammatory response **(Li, Feng, Meng, and Li., 2022)**.

When compared to baseline, the current study found a significant drop in C-reactive protein (CRP) levels at week four. This could be explained by the patient's increased expectorated sputum volume, which helps to reduce the inflammatory process. These findings are consistent with a study carried out by **Wageck, Cox & Holland 2019)** clarified, the inflammatory response is linked to worse functional performance, muscle weakness, and decreased exercise tolerance. A potential COPD relapse and recurrent exacerbations are significantly predicted by a higher CRP that persists over time. The current study's findings demonstrated that those who received PR in addition to exercise instruction saw notable improvements in their daily step count, dyspnea, and pulmonary function. From the researcher perspective, the changes can be attributed to the program's high level of utility and acceptability. The present findings serve as compelling evidence to support the efficacy of PR with exercise training.

In agreement is the trial of **Marti, Williams & Gimeno-Santos (2020)** summarized that the rehabilitation process slows down the COPD long-term effects by enhancing QoL, exercise tolerance, and respiratory function in addition to pharmacological therapy**. Zhang, Hu, Xu, Wu & Lou (2022)** showed that aerobic exercise with diaphragmatic breathing significantly improves respiratory function, 6

MWD, QoL, blood gas levels, and capacity for self-care.

In the present study, pulmonary function and PaO2 levels were significantly improved at the end of the Wk. 4 compared to baseline. The present findings corroborate the findings of **Lu & Zhang (2022)** who emphasized respiratory rehabilitation combined with aerobic exercise is more beneficial for COPD patients which increases respiratory function, and arterial blood gas status, QoL, and self-care skills.

Concurrently, the research conducted by **Neunhauserer et al., (2021) and Liu, et al., (2021)** clarifies that exercise has been demonstrated to significantly enhance patients' health-related quality of life and exercise tolerance in COPD patients. Combining aerobic exercise with PR can enhance some pulmonary function measurements, lessen dyspnea, and produce greater therapeutic benefits. Previous studies by **Allwood et al., (2021)** have shown that, after exercise, the working ability of the diaphragm (the main respiratory muscle) is improved, resulting in decreased severity of dyspnea and better gas exchange in the lungs which improves gas status in COPD patients.

When considering the effectiveness of PR with exercise training, in the current study, there was a significant increase in breath holding time, average amount of expectorated sputum, and chest wall movement.

The observations made by **Beaumont, Forget, Couturaud & Reychler (2018)** suggest that the diaphragm plays a main role in maintaining normal ventilation and lung function as a main inspiratory muscle and can be strengthened by exercises, as other muscles. So, PR with muscle training is considered an important part of COPD patient's treatment.

This outcome is congruent with the findings of **Wageck, Cox & Holland (2019)** who outlined that, Breathing frequently gets shallow and rapid when the respiratory muscle is tired or the respiratory load is high, aggravates the uneven gas distribution in the lungs, making the ventilation/blood flow imbalance more serious and worsening the arterial blood gas status.

In a similar vein, **Terry & Dhand (2020)** illuminate that, Weakness in the respiratory muscles makes breathing more difficult and affects gas exchange. Respiratory training is thought to be a useful strategy for helping COPD patients breathe better since it can lower oxygen use and frequency of breathing.

Concurrently, the research conducted by **D^browska-Bien et al., (2018), Hansen et al., (2020), and Na et al., (2021)** confirmed that in patients with COPD, PR with exercise training has been shown to increase functional exercise capacity, reducing dyspnea, increasing exercise tolerance, and QoL. **Paolucci et al., (2022)** revealed that restoring lung function and correcting inadequate oxygenation and hypercapnia are the main objectives of treatment for COPD. To protecting central respiratory function, PR combined with an exercise training program helps reduce hypoxemia and hypercapnia.

Our results show significant improvement in Exercise self-efficacy and a decrease in limitations that interfere with functional status and physical activities which subsequently improve health-related quality of life after 4 weeks of intervention

In the same direction, a study carried out by **Wageck, Cox & Holland (2019) and Rebordosa et al., (2019) found** that People with COPD can benefit from PR programs that incorporate exercise training which reduce dyspnea and enhance physical ability, degree of physical activity, and health-related quality of life with an adequate intervention period (4e12 weeks)

According to most guidelines, patients should participate in a supervised exercise program for at least four weeks, which should include lower limb endurance exercises, which are essential to PR **(GOLD 2020).** The Australian and New Zealand guidelines, as well as a statement by the Japanese Society of Respiratory Physical Therapy, mentioned that lower limb endurance training is a core component of exercise training to increase exercise capacity **(Ueki et al., 2018).**

This study finding clarifies that there was also a significant correlation between functional status and Level of dyspnea this may be attributed to PR being recommended in international guidelines as an effective treatment

for patients with COPD in all the disease stages which improves exercise capacity and HRQOL **(Higashimoto., (2020).**

Likewise, similar findings were reported in a study conducted by **Rutkowski et al., 2020)** confirmed that PR including walking and range of motion exercise has been documented as a significant standard treatment for patients with COPD by reducing symptoms and increasing walking capacity and improve QoL**.**

Going with this context, the results of the study by **Paolucci et al., (2022)** proved that, for patients with COPD a 4-week supervised, intensive pulmonary rehabilitation consisting of endurance and strength training sessions resulted in improved dyspnea and diaphragm-excursion and QoL.

In agreement is the trial of **Yang et al., (2022)** documented that, Physical inactivity in COPD is a significant problem with reductions in physical activity (PA) commencing early in the disease trajectory. It has been linked to impaired lung function and increased risk of hospitalizations and mortality. Consequently, PA interventions constitute an important component of COPD management with guidelines emphasizing that people with COPD should be encouraged to be regularly physically active and to reduce sedentary behaviour time.

Conclusion

The results confirm our hypothesis that pulmonary rehabilitation with planned exercise training optimizes management and general health outcomes in chronic obstructive pulmonary disease patients.

Recommendations

A huge, practical trial is required to look at the viability and cost-effectiveness of this intervention. The current study should be done once more with a bigger sample size and in a diverse healing center for generalization of the results.

Reference

Yang IA, George J, McDonald CF, McDonald V, O'Brien M, Craig S, Smith B, McNamara R, Zwar N, Dabscheck E. (2022). The COPD-X Plan: Australian and New Zealand Guidelines for the Management of Chronic Obstructive Pulmonary Disease 2025. Version 2.66, April 2022.

T Paolucci, L Pezzi, RG Bellomo, et al. (2022). Tailored patient self-management and supervised, home-based, pulmonary rehabilitation for mild and moderate chronic obstructive pulmonary disease J Phys Ther Sci, 34 (2022), pp. 49-59

H Zhang, D Hu, Y Xu, L Wu, L. Lou. (2022). Effect of pulmonary rehabilitation in patients with chronic obstructive pulmonary disease: a systematic review and meta-analysis of randomized controlled trials Ann Med, 54 (2022), pp. 262-273

RM Engel, J Wearing, P Gonski, S. (2017). Vemulpad The effect of combining manual therapy with exercise for mild chronic obstructive pulmonary disease: study protocol for a randomized controlled trial Trials, 18 (2017), p. 282

S Rutkowski, A Rutkowska, P Kiper, et al. (2020). Virtual reality rehabilitation in patients with chronic obstructive pulmonary disease: a randomized controlled trial Int J Chron Obstruct Pulmonary Disease, 15 (2020), pp. 117-124

World Health Organization. 2022). Global health estimates: Life expectancy and leading causes of death and disability. [Internet]. Geneva, Switzerland, 2022 [cited 2022 Dec 10]. Available from: https:// www. who. int/ data/ gho/data/ themes/ morta lity- and- global- health estim ates. Accessed 10 Jun 2022.

Global Initiative for Chronic Obstructive Lung Disease. (2022). Global strategy for the diagnosis, management and prevention of chronic obstructive pulmonary disease: 2022 report. [Internet]. Available from: https:// goldcopd. org/ 2022/. Accessed 15 Jan 2022.

Milner SC, Boruff JT, Beaurepaire C, Ahmed S, Janaudis-Ferreira T. (2018). Rate of, and barriers and enablers to, pulmonary rehabilitation referral in COPD: A systematic scoping review. Respir Med. 2018; 137:103-14.

Burge AT, Cox NS, Abramson MJ, Holland AE. (2020). Interventions for promoting physical activity in people with chronic obstructive pulmonary disease (COPD). Cochrane Database Syst Rev. 2020 Apr 16;4(4):CD012626. doi: 10.1002/14651858.CD012626.pub2. PMID: 32297320; PMCID: PMC7160071.

Zeng Y, Jiang F, Chen Y, Chen P, Cai S. (2018). Exercise assessments and trainings of pulmonary rehabilitation in COPD: a literature review. Int J Chron Obstruct Pulmonary Disease. 2018 Jun 26; 13:20132023. doi: 10.2147/COP26; 13:201333

PMID: 29983556; PMCID: PMC6027710.

Debouche P, Pitance L, Robert A, Liistro G and Reychler G. (2016). Reliability and Reproducibility of Chest Wall Expansion

Measurement in Young Healthy Adults. Volume 39(6), P.P. 443-449. https://doi.org/10.1016/j.jmpt.2016.05.004

U.S. Department of Health and Human Services. (2018). Physical activity guidelinesfor Americans, 2nd edition. Washington, DC 2018

Caspersen CJ, Powell KE, Christenson GM. (1985). Physical activity, exercise, and physical fitness: definitions and distinctions for health-related research. Public Health Reports 1985;100(2):126-31.

Pettee Gabriel, K. K., Morrow, J. R., Jr., & Woolsey, A. L. (2012). Framework for physical activity as a complex and multidimensional behavior. Journal of Physical Activity & Health, 9(Suppl. 1), S11-18

Ngusie, H. S., Ahmed, M. H., Mengiste, S. A., Kebede, M. M., Shemsu, S., Kanfie, S. G., ... & Gullslett, M. K. (2023). The effect of capacity building evidence-based medicine training on its implementation among healthcare professionals in Southwest Ethiopia: a controlled quasi- experimental outcome evaluation. BMC Medical Informatics and Decision Making, 23(1), 172.

Dorje, T., Zhao, G., Scheer, A., Tsokey, L., Wang, J., Chen, Y., . . . Maiorana, A. (2018). Smartphone and social media-based cardiac rehabilitation and secondary prevention (SMART-CR/SP) for patients with coronary heart disease in China: A randomized controlled trial protocol. BMJ Open, 8(6). doi:10.1136/bmjopen-2018-021908

Balke B. A (1963). simple field test for the assessment of physical fitness. Rep 63-6. Rep CivAeromed Res Inst US 1963:1-8

Moll J. M., Wright V. (1972). An objective clinical study of chest expansion. Annals of the Rheumatic Diseases. 31(1):1-8. doi: 10.1136/ard.31.1.1.

Mirsky IA, Lipman E, Grinker RR. (1946). Breath holding time in anxiety states. Fed Proc 1946;5:74

Gupta N, Pinto L, Morogan A, Bourbeau J. (2014). The COPD assessment test: a systematic review. European Respiratory Journal 2014 44: 873-884; DOI: 10.1183/09031936.00025214

Garrod R., Bestall J.C., Paul E.A. (2000). Development and validation of a standardized measure of activity of daily living in patients with severe COPD: the London Chest Activity of Daily Living scale (LCADL) Respir Med. 2000;94(6):589-596

Lee LL, Perng SJ, Ho CC, Hsu HM, Lau SC, Arthur A. (2009). A preliminary reliability and validity study of the Chinese version of the self-efficacy for exercise scale for older adults. Int J Nurs Stud. 2009 Feb;46(2):230-8. doi: 10.1016/j.ijnurstu.2008.09.003. Epub 2008 Oct 23. PMID: 18950769.

The Department of Health and Aged Care (2019): Australia's Physical Activity and Sedentary Behaviour Guidelines and the Australian 24-Hour Movement Guidelines: The Australian Government, Department of Health. [Internet] Australia: The Department of Health and Aged Care, 2019 [updated 2019 April 12]. Available from: https:// www. health. gov. au/inter net/ main/ publi shing. nsf/ Conte nt/ health- pubhl th-strat eg- physact-guide lines. Accessed 8 May 2022.

Ueki J, Kozu R, Ohdaira T, Katsura H, Kurosawa H, Ando M, et al. (2018). Pulmonary rehabilitation in Japan: a position statement from the Japan society for respirator y care and rehabilitation, the Japanese society of respiratory physical therapy, and the Japanese respiratory society. The Journal of the Japan Society for Respiratory Care and Rehabilitation 2018;27:95e114.

Alison JA, McKeough ZJ, Johnston K, McNamara RJ, Spencer LM, Jenkins SC, et al. (2017). Australian and New Zealand pulmonary rehabilitation guidelines. Respirology 2017;22:800e19.

Higashimoto Y, Ando M, Sano A, Saeki S, Nishikawa Y, Fukuda K, Tohda Y. (2020). Effect of pulmonary rehabilitation programs including lower limb endurance training on dyspnea in stable COPD: A systematic review and meta-analysis. Respir Investig. 2020 Sep;58(5):355-366. doi: 10.1016/j.resinv.2020.05.010. Epub 2020 Jul 11. PMID: 32660900.

Global Initiative for Chronic Obstructive Lung Disease (GOLD) (2020). Global strategy for the diagnosis, management and prevention of chronic obstructive pulmonary disease. GOLD Report 2020. Available from: https://goldcopd.org/goldreports/.

Ntritsos G, Franek J, Belbasis L, Christou MA, Markozannes G, Altman P, Fogel R, Sayre T, Ntzani EE, Evangelou E. (2018). Gender-specific estimates of COPD prevalence: a systematic review and meta-analysis. Int J Chron Obstruct Pulmon Dis. 2018 May 10;13:1507-1514. doi: 10.2147/COPD.S146390. PMID: 29785100; PMCID: PMC5953270.

Lutter JI, Lukas M, Schwarzkopf L, Jorres RA, Studnicka M, Kahnert K, Karrasch S, Bewig B, Vogelmeier CF, Holle R; COSYCONET Study Group. (2020). Utilization and determinants of use of non-pharmacological interventions in COPD: Results of the

COSYCONET cohort. Respir Med. 2020 Sep;171:106087. doi: 10.1016/j.rmed.2020.106087. Epub 2020 Jul 12. PMID: 32917358.

Bahremand T, Etminan M, Roshan- Moniri N, De Vera MA, Tavakoli H, Sadatsafavi M. (2021). Are COPD Prescription Patterns Aligned with Guidelines? Evidence from a Canadian Population-Based Study. Int J Chron Obstruct Pulmon Dis. 2021 Mar 25;16:751- 759. doi:10.2147/COPD.S290805. PMID: 33790551; PMCID: PMC8006812.

Wageck B, Cox NS, Holland AE. (2019).
Recovery Following Acute Exacerbations of Chronic Obstructive Pulmonary Disease - A Review. COPD. 2019 Feb;16(1):93- 103.doi: 10.1080/15412555.2019.1598965.Epub 2019 May 2. PMID: 31044644.

Li L, Feng Q, Meng Q, Li F. (2022). Efficacy and Safety Analysis of Piperacillin Tazobactam in Combination with High Frequency Chest Wall Oscillation in Patients With COPD Coupled With Pneumonia. Altern Ther Health Med. 2022 Jan;29(1):124-129. PMID: 35986739.

D Neunhauserer, B Reich, B Mayr, et al. (2021). Impact of exercise training and supplemental oxygen on submaximal exercise performance in patients with COPD Scand J Med Sci Sports, 31 (2021), pp. 710-719

Lu S, Zhang Q. (2022). Pilot testing the
impact of an aerobic exercise plus rehabilitation training on respiratory function in older adults with COPD. Geriatr Nurs. 2023 May-Jun;51:238-244. doi:
10.1016/j.gerinurse.2022.03.011. Epub 2022 Apr 4. PMID: 37023683.

K Liu, X Yu, X Cui, et al. (2021). Effects
of proprioceptive neuromuscular facilitation stretching combined with aerobic training on pulmonary function in COPD patients: a randomized controlled trial Int J Chron Obstruct Pulmon Dis, 16 (2021), pp. 969-977

JD Marti, D McWilliams, E. Gimeno- Santos. (2020). Physical therapy and rehabilitation in chronic obstructive pulmonary disease patients admitted to the intensive care unit Semin Respir Crit Care Med, 41 (2020), pp. 886-898

H Hansen, T Bieler, N Beyer, et al.
(2020). Supervised pulmonary telerehabilitation versus pulmonary rehabilitation in severe COPD: a randomised multicentre trial Thorax, 75 (2020), pp. 413-421

M Beaumont, P Forget, F Couturaud, G. Reychler. (2018). Effects of inspiratory muscle training in COPD patients: a systematic review and meta-analysis Clin Respir J, 12 (2018), pp. 2178-2188

PD Terry, R. Dhand. (2020). Inhalation therapy for stable COPD: 20 years of GOLD reports Adv Ther, 37 (2020), pp. 1812-1828

BW Allwood, M Stolbrink, N Baines, et
al. (2021). Persistent chronic respiratory symptoms despite TB cure is poorly correlated with lung function Int J Tuberc Lung Dis, 25 (2021), pp. 262-270

Kofod LM, Dossing M, Steentoft J, et al. (2017). Resistance training with ankle weight cuffs is feasible in patients with acute exacerbation of COPD. J Cardiopulm Rehabil Prev. 2017;37(1):49-56. doi: 10.1097/HCR.0000000000000230

Rebordosa C, Plana E, Aguado J, et al.
(2019). GOLD assessment of COPD severity in the Clinical Practice Research Datalink (CPRD). Pharmacoepidemiol DrugSaf2019;28(2):126-133. doi:10.1002/pds.4448.

Coultas DB, Jackson BE, Russo R, Peoples J, Singh KP, Sloan J, et al. (2018). Home-based physical activity coaching, physical activity, and health care utilization in chronic obstructive pulmonary disease. Chronic obstructive pulmonary disease self-management activation research trial secondary outcomes. Annals of the American Thoracic Society 2018;15:470e8.

Alison JA, McKeough ZJ, Johnston K, McNamara RJ, Spencer LM, Jenkins SC, et al. (2017). Australian and New Zealand pulmonary rehabilitation guidelines. Respirology 2017;22:800e19.

Global Initiative for Chronic Obstructive Lung Disease (GOLD). (2020) Global strategy for the diagnosis, management and prevention of chronic obstructive pulmonary disease. GOLD Report 2020. Availablefrom: https://goldcopd.org/goldreports/. Tistad M, Lundell S, Wiklund M, Nyberg A, Holmner A, Wadell K. (2018).

Usefulness and Relevance of an eHealth Tool in Supporting the Self-Management of Chronic Obstructive Pulmonary Disease: Explorative Qualitative Study of a Cocreative Process. JMIR Hum Factors. 2018 Oct 26;5(4):e10801. doi: 10.2196/10801. PMID: 30368440; PMCID: PMC6229513.

Ueki J, Kozu R, Ohdaira T, Katsura H, Kurosawa H, Ando M, et al. (2018). Pulmonary rehabilitation in Japan: a position statement from the Japan society for respirator y care and rehabilitation, the Japanese society of respiratory physical therapy, and the Japanese respiratory society. The Journal of the Japan Society for Respiratory Care and Rehabilitation 2018;27:95e114.

Chen MJ, Fan X, Moe ST. (2002). Criterion-related validity of the Borg ratings of perceived exertion scale in healthy individuals: a meta-analysis. J Sports Sci. 2002;20(11):873-899.