

# **Modern approaches of rehabilitation in COPD patients**

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## **Abstract**

**Chronic Obstructive Pulmonary Disease (COPD) presents a significant challenge to public health, impairing the quality of life for affected individuals. Traditionally, the management of COPD primarily involved pharmacological interventions and symptom management, but a shift towards comprehensive rehabilitation programs has been observed in recent times. This study focuses on exploring these modern approaches to COPD rehabilitation, including exercise training, education, psychosocial support, and self-management strategies. By emphasizing patient-centered and multidisciplinary methodologies, modern rehabilitation approaches aim to address the individual needs of COPD patients. Previous studies affirm the positive impacts of these comprehensive programs, including improved exercise capacity, reduced symptoms, and enhanced overall well-being. This current investigation aims to further analyze the effects of various pulmonary rehabilitation methods on COPD management within a modern medical context. By critically evaluating literature and research databases like SCOPUS, PubMed, SciELO, Google Scholar, and Cochrane Library, this study seeks to provide unique insights into the efficacy and benefits of pulmonary rehabilitation for COPD patients. The implications of this research could contribute significantly to evidence-based practices, assisting healthcare professionals in optimizing the selection and implementation of pulmonary rehabilitation interventions for improved patient outcomes.**

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**List of Abbreviations**

COPD: Chronic obstructive pulmonary disease

WHO: world health organization

RCTs: randomized controlled trial

PR : pulmonary rehabilitation

HRQoL : Health-related quality of life

mMRC : modified Medical Research Council

## **Introduction**

Chronic Obstructive Pulmonary Disease (COPD) is a progressive respiratory condition that significantly impacts the quality of life for affected individuals. Traditional approaches to COPD management have primarily focused on pharmacological interventions and symptom relief. However, in recent years, there has been increasing recognition of the importance of comprehensive rehabilitation programs in optimizing the functional capacity and overall well-being of COPD patients.

This abstract explores modern approaches to rehabilitation in COPD patients. These approaches encompass multidimensional interventions targeting various aspects of the disease, including exercise training, education, psychosocial support, and self-management strategies.

Exercise training plays a central role in COPD rehabilitation, aiming to improve exercise tolerance, muscle strength, and respiratory function. Various exercise modalities, such as aerobic training, strength training, and pulmonary rehabilitation programs, are tailored to individual patient needs and capacities. Additionally, patient education programs provide information on COPD management, self-care techniques, and strategies for symptom control. Psychosocial support, including counseling and behavioral interventions, helps address psychological and emotional challenges commonly associated with COPD.

Modern approaches to COPD rehabilitation emphasize a patient-centered and multidisciplinary approach, involving healthcare professionals from various disciplines, including physiotherapists, respiratory therapists, psychologists, and nutritionists. These collaborative efforts ensure that the rehabilitation program addresses the individualized needs of each patient, considering their physical, psychological, and social factors.

The benefits of modern rehabilitation approaches in COPD patients are well-documented. Studies have shown that comprehensive rehabilitation programs improve exercise capacity, reduce symptoms, enhance health-related quality of life, and decrease healthcare utilization. These programs empower patients with self-management skills, leading to improved adherence to treatment plans and better long-term outcomes.

## **Aim**

This study aims to investigate the effects of various pulmonary rehabilitation methods in the management of chronic obstructive pulmonary disease (COPD) within the modern medical context. By analyzing the research database in pulmonary rehabilitation, we seek to evaluate the different types of interventions and their impact on COPD patients.

### **Materials and methods**

To accomplish this, a comprehensive examination of the available literature and research database will be conducted. The focus will be on identifying and analyzing studies that have explored the effects of pulmonary rehabilitation methods in individuals with COPD. Through a critical evaluation of the research findings, this study aims to provide unique insights into the efficacy and benefits of pulmonary rehabilitation for COPD patients.

The material and methods used in this research are comparing information from research database such as SCOPUS, PubMed, SciELO, Google Scholar, Cochrane Library, and analysis of information from different textbooks of COPD and topics related to rehabilitation of COPD patients.

### **Practical significance**

The Pulmonary rehabilitation is beneficial for patients with chronic obstructive pulmonary disease. It has been shown to reduce symptoms of breathlessness, improve physical function and enhance overall quality of life.

This study adopts a comprehensive approach to analyze the various types of pulmonary rehabilitation methods within the realm of modern medicine and their effects on individuals with COPD. By investigating the research database, this study aims to provide valuable insights into the role of pulmonary rehabilitation in COPD management. The findings will contribute to evidence-based practice, guiding healthcare professionals in the selection and implementation of effective pulmonary rehabilitation interventions.

## **Chapter 1**

### **Introduction of pulmonary rehabilitation in COPD patients**

Pulmonary rehabilitation is a personalized and comprehensive program that incorporates exercise training, education, and behavior change to benefit individuals with chronic respiratory diseases. It has been shown to enhance the physical and psychological well-being of patients, while also promoting the long-term adoption of health-enhancing behaviors [1].

Numerous studies have demonstrated the physiological, symptom-reducing, psychosocial, and

health-economic advantages of pulmonary rehabilitation across various outcome areas for individuals with COPD [2].

The program has been particularly effective in improving functional exercise capacity and health-related quality of life, especially in patients with moderate to severe stages of the disease [3].

Apart from the respiratory symptoms of dyspnea, COPD is associated with extra-pulmonary manifestations, including skeletal muscle dysfunction resulting from factors such as physical inactivity, systemic inflammation, hypoxemia, undernutrition, oxidative stress, and systemic corticosteroid use [4].

It is important to note that pulmonary rehabilitation does not directly impact lung mechanics or gas exchange [5].

Instead, it optimizes the functioning of other body systems to minimize the impact of lung dysfunction [6].

By implementing a comprehensive pulmonary rehabilitation program, COPD patients can experience gradual improvements in muscle function and enhanced tolerance for increased workloads [7].

Furthermore, pulmonary rehabilitation has been found to reduce the perception of dyspnea and dynamic hyperinflation, leading to improved overall well-being [8].

## **Chapter 1.1**

### **Clinical impact of pulmonary rehabilitation**

The duration of a pulmonary rehabilitation program can vary between 6 weeks to 12 weeks across different centers. These programs typically incorporate a range of activities such as aerobic exercise, education, and muscle strengthening. Patients usually undergo supervised training sessions 2-3 times a week, with each session lasting between 30 to 60 minutes. The training regimen may include various components like endurance training, interval training, resistance/strength training, walking exercises, flexibility exercises, inspiratory muscle training, and neuromuscular electrical stimulation [9].

The interventions provided during pulmonary rehabilitation are tailored to meet the individual needs of patients, with the goal of maximizing their functional gains. One of the key benefits of pulmonary rehabilitation is the improvement in symptoms such as dyspnea, exercise tolerance, and overall health status, particularly in stable patients [9].

#### **Symptom control**

Pulmonary rehabilitation (PR) has shown significant benefits in reducing symptoms of dyspnea and leg discomfort in patients. Additionally, patients often report improved limb muscle strength and endurance, which contribute to enhanced functional capacity and increased independence in performing

daily activities [10].

A comprehensive Cochrane review, which analyzed 23 randomized controlled trials, further supports the positive effects of PR. The review revealed that PR not only alleviates dyspnea and fatigue but also improves emotional function and the patient's sense of control over their condition. Importantly, these improvements were not only statistically significant but also of considerable magnitude [11].

### **Physical activity and exercise tolerance**

The significance of physical activity has gained considerable attention due to its association with improved survival rates, enhanced quality of life, and reduced healthcare utilization. In contrast, physical inactivity has been linked to negative outcomes [12].

In line with these findings, the Cochrane review mentioned earlier [13] reported improved exercise capacity among patients who underwent pulmonary rehabilitation. Additional studies conducted by Griffiths et al. and Singh et al. have also presented similar findings, further supporting the positive impact of pulmonary rehabilitation on exercise capacity [14].

### **Healthcare burden**

Pulmonary rehabilitation (PR) has demonstrated promising outcomes in reducing unscheduled healthcare visits, COPD exacerbations, and hospitalizations among certain patients [15].

Moreover, there is evidence in the literature supporting the potential for reduced hospitalization rates in individuals participating in PR programs immediately after an acute exacerbation of COPD (AECOPD), particularly when the program is initiated within 1 week of discharge [16].

### **Psychosocial**

Anxiety and depression have a considerable impact on COPD patients, leading to poorer patient-centered outcomes. However, it has been observed that participation in pulmonary rehabilitation (PR) programs can lead to improvements in psychological well-being, regardless of the severity of COPD [17].

This finding was further supported by a meta-analysis of six randomized controlled trials, which revealed that PR was more effective than standard care in reducing anxiety and depression levels [18].

**Chapter 1.2**

**Indications of pulmonary rehabilitation**

Pulmonary rehabilitation (PR) should be considered for patients with chronic lung conditions who experience symptomatic shortness of breath that limits their physical activity, even with optimal medical management [19].

Additionally, PR is not only beneficial for patients with lung-related conditions like chronic obstructive pulmonary disease (COPD), restrictive lung disease, and pulmonary hypertension, but also for those with chronic diseases such as heart failure and musculoskeletal disorders. Providing PR at an earlier stage of the disease can have a significant impact on the disease trajectory, resulting in improved exercise tolerance, increased physical activity, reduced exacerbations, and enhanced self-efficacy and behavior change [20].

Referral to PR is often guided by the modified Medical Research Council Breathlessness score (mMRC), which is a graded scale ranging from 0 to 4, used to assess the level of perceived respiratory disability and its impact on mobility [21].

By using the mMRC scale, patients can indicate the extent to which breathlessness affects their daily functioning [22]."  
(table 1).

<b>Grade</b>	<b>Level of breathlessness with the activities</b>
<b>0</b>	<b>No shortness of breath except on strenuous exercise</b>
<b>1</b>	<b>Short of breath when walking on an incline</b>
<b>2</b>	<b>Walks slower than contemporaries on a level ground because of shortness of breath or has to stop due to breathlessness when walking up at own pace</b>
<b>3</b>	<b>Stops for breath when walking 100 m or after a few minutes on level ground</b>
<b>4</b>	<b>Too short of breath to leave the house, or short of breath when dressing and undressing</b>

Table 1. The modified Medical Research Council Breathlessness score.

The referral for pulmonary rehabilitation (PR) is strongly recommended for patients with a modified Medical Research Council dyspnea score (mMRC) of 2-4, who experience functional limitations due to breathlessness. However, even patients with an mMRC dyspnea score of 1, who are also functionally limited by breathlessness, have been shown to benefit from PR. Notably, patients with COPD who have an mMRC score of 4 achieve similar benefits from PR as those with lower breathlessness scores [23].

Other common indications for referral to PR programs include poor functional status, physical deconditioning, chronic fatigue, reduced health-related quality of life, and difficulties in performing activities of daily living. Moreover, patients who require increased utilization of medical resources due to frequent exacerbations, hospitalizations, and emergency room visits can also benefit from pulmonary rehabilitation [24].

**Chapter 1.3**

**Contraindications of pulmonary rehabilitation**

"The referral to pulmonary rehabilitation (PR) typically has few exclusion criteria, which



include patients with specific conditions [25]:

1. Unstable cardiovascular disease, uncontrolled diabetes, and ongoing orthopedic illness that would hinder the patient from safely engaging in exercise.
2. Inability to exercise safely due to other medical illnesses such as severe arthritis or severe peripheral vascular disease.
3. Untreated psychiatric illness and cognitive impairment that may impede the patient's ability to follow instructions are also reasons for not referring a patient to PR.
4. Lack of motivation is another criterion for exclusion from pulmonary rehabilitation.
5. Congestive heart failure.
6. Unstable diabetes.
7. Severe exercise-induced hypoxemia that cannot be corrected with supplemental oxygen.
8. Active cigarette smoking, although considered a relative contraindication.

These criteria help ensure the safety and effectiveness of PR programs, while also considering the individual needs and circumstances of the patients."

## Chapter 2

### Types of pulmonary rehabilitation in COPD patients

Pulmonary rehabilitation is a specialized program designed for individuals with chronic lung diseases such as COPD, emphysema, and chronic bronchitis. The primary objective of pulmonary rehabilitation is to maximize the functional capacity of these individuals, enabling them to engage in daily activities with greater ease. By targeting respiratory symptoms and complications, pulmonary rehabilitation aims to enhance the overall quality of life for patients (see Figure 1). Through a comprehensive approach, including exercise training, education, and symptom management, pulmonary rehabilitation strives to decrease respiratory symptoms and associated complications."

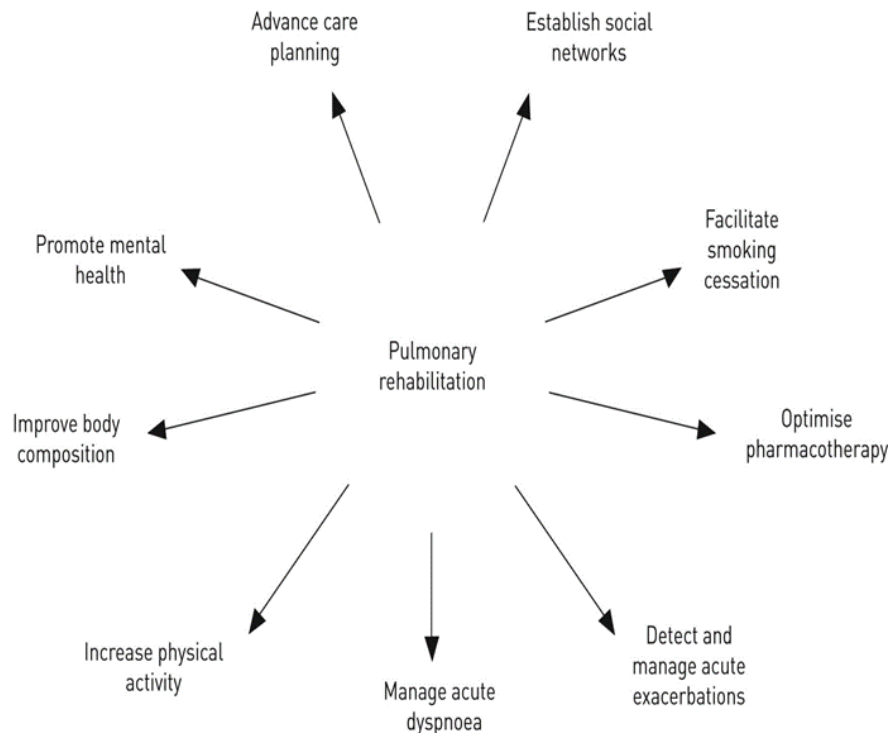


Figure -1 effects of pulmonary rehabilitation.

#### Types of pulmonary rehabilitation in COPD patients in general practice

- (i) Breathing techniques
- (ii) Psychological counseling
- (iii) Education
- (iv) Exercise training
- (v) Nutritional counseling

## Chapter 2.1

### breathing techniques

#### Improvement of inspiratory muscle function

The improvement of inspiratory muscle function is a crucial aspect of pulmonary rehabilitation, particularly in individuals with chronic lung diseases. It is common to observe reduced endurance and strength of the inspiratory muscles in these conditions, which contribute to the sensation of dyspnea [25].

Pulmonary rehabilitation incorporates various breathing techniques and body positions that aim to optimize the length-tension relationship and geometry of the respiratory muscles, especially the diaphragm. By operating at a greater length, the inspiratory muscles can generate a greater output for the same neural input, leading to improved contraction efficacy and enhanced lung volume changes. Contrary to common belief, the displacement and contribution of the diaphragm to tidal volume during resting breathing have not been shown to be different in individuals with COPD [26,27]. However, during more severe stages of COPD and increased ventilation levels, the contribution of the diaphragm is reduced [28].

Specific training targeting the respiratory muscles can enhance their strength and endurance capacity, ultimately improving ventilatory capacity, alleviating symptoms, and enhancing exercise performance (see Figure 2).

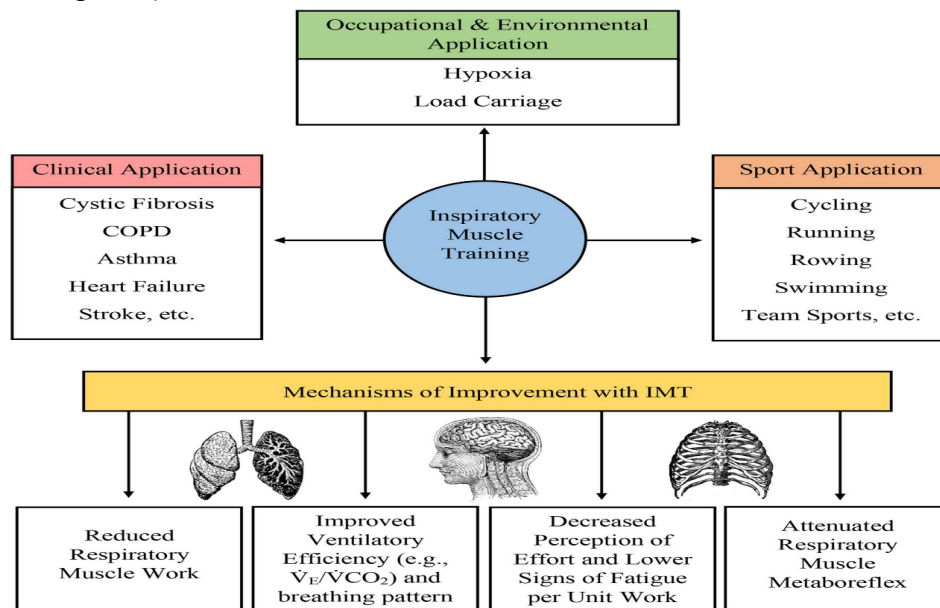


Figure 2 Modern approaches to inspiratory muscle training.

## Chapter 2.2

### Psychological counseling

People with severe COPD often experience a higher risk of depression and anxiety, which can lead to a decreased interest in pleasurable activities, including sexual activity. To address these psychological aspects, certain pulmonary rehabilitation programs offer relaxation training and counseling services [29].

The implementation of a psychological rehabilitation program has shown significant benefits in reducing anxiety and depressive symptoms among individuals with COPD. Particularly, the improvement in anxiety symptoms was particularly noteworthy. In addition to the positive impact on psychological well-being, the program also resulted in significant improvements in health status, exercise tolerance, and intensity of dyspnea in COPD patients. The outpatient-based rehabilitation program was well-received by the patients, and its relatively simple design makes it feasible without the need for expensive equipment (see Figure 3)."

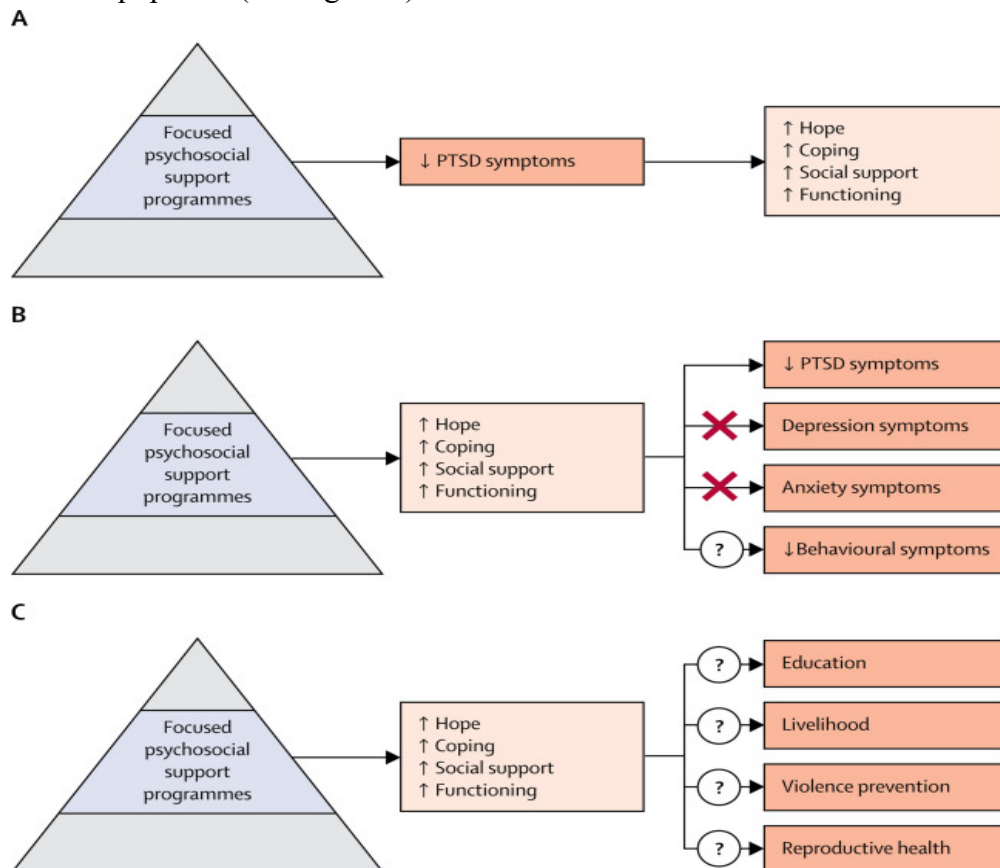


Figure 3 modern approaches in psychological rehabilitation.

**Chapter 2.3**

**Education**

The importance of education within pulmonary rehabilitation is underscored by multiple national and international clinical practice guidelines [30].

In pulmonary rehabilitation, education comprises a significant portion of patient time, with 25-50% dedicated to didactic knowledge-based formal group activities, and additional informal teaching occurring through patient-to-patient and patient-to-healthcare professional interactions [30].

This emphasis on education is evident in the substantial contact time patients have with the multi-professional respiratory team during pulmonary rehabilitation, which far exceeds the amount of time most patients spend with their doctors in a year. Educational activities are prevalent in over 90% of programs across Europe, North America, and Australia [30, 31].

Within pulmonary rehabilitation, educational activities focus on teaching patients how to effectively manage their respiratory condition. This review examines the latest evidence regarding the 'education' component of pulmonary rehabilitation, synthesizing global guidelines and suggesting future directions for this crucial aspect of care. The incorporation of education in pulmonary rehabilitation stems from the belief that providing patients with knowledge about their condition will result in improved health outcomes, with healthcare professionals determining the specific topics patients need to be educated on [30, 32].

For patients with COPD, common educational topics in pulmonary rehabilitation programs include disease education, inhaler technique, and medication management for both stable disease and exacerbations [33].

Additional frequently covered subjects are those that promote adherence to exercise programs, such as understanding the benefits of exercise, symptom management, relaxation techniques, and energy conservation strategies (see Table 2).

<b>Recommendations from the ATS/ERS statement on PR [35]</b>	<b>Research data from patients with COPD and healthcare professionals on PubMed [36]</b>	<b>Recommendations from an Australian survey of patients who had completed PR [37]</b>	<b>Findings from a recent systematic review on content and delivery of education in PR [38]</b>
Normal pulmonary anatomy and physiology		Information on diseases (e.g. what the lungs do)	
Pathophysiology of chronic respiratory disease	Disease education	Information on diseases (e.g. what the lungs do)	
Communicating with healthcare providers	Welfare and benefits system		
Interpretation of medical testing			
Breathing strategies	Management of breathlessness and physical limitations of COPD	Breathing techniques/managing breathlessness	Dyspnea and symptom management
Secretion clearance techniques			

Role and rationale of medications including oxygen therapy	Medication	The role and correct use of medications.	
Effective use of respiratory devices	Medication		Inhaler and nebulizer
Benefits of exercise and physical activity		Physical exercise	
Energy conservation during activities of daily living			
Healthy food intake		Nutrition/healthy eating	Nutrition
Irritant avoidance			
Early recognition and treatment of exacerbations	Management of an exacerbation		Early recognition of signs of infection
Leisure activities			
Coping with chronic lung disease	Psychosocial support	Coping with chronic lung disease and management of depression, anxiety and panic attacks	Anxiety and depression and stress management

Table 2 Recommended education topics within PR.

The impact of health education in pulmonary rehabilitation is expected to extend to five key areas [34]:

- I. Knowledge: Health education aims to increase patients' understanding and knowledge about their condition, its management, and the benefits of certain behaviors or interventions.
- II. Perception of benefit: By providing education on the potential positive outcomes of specific actions or behaviors, health education seeks to influence patients' perception of the benefits associated with adopting health-promoting behaviors.
- III. Health beliefs: Health education aims to shape patients' beliefs and attitudes towards their health and well-being, fostering a sense of empowerment and motivation to engage in self-care and make positive health choices.
- IV. Health behaviors: By imparting knowledge and influencing perceptions, health education aims to facilitate the adoption of health-enhancing behaviors, such as regular exercise, medication adherence, and symptom management.

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- V. Health outcomes: Ultimately, the goal of health education in pulmonary rehabilitation is to improve health outcomes. By enhancing patients' knowledge, beliefs, and behaviors, health education contributes to better disease management, reduced symptoms, improved functional capacity, and overall well-being.

These five areas highlight the multifaceted role of health education in pulmonary rehabilitation, emphasizing its potential to positively impact various aspects of patients' lives and health-related outcomes.

## **chapter 2.4**

### **Exercise training**

Exercise training is a fundamental component of pulmonary rehabilitation programs, which encompass various disciplines and revolve around interventions involving exercise. The primary objective of exercise training is to counteract the overall effects of COPD on the body, specifically addressing the dysfunction of skeletal muscles [39].

Continuous and interval training, along with strength training, are recognized as the key exercise elements within pulmonary rehabilitation [40].

#### **Continuous and interval training**

Endurance training is a widely utilized exercise approach for individuals with COPD, focusing on enhancing aerobic exercise capacity due to its relevance to various daily activities [40].

The implementation of exercise training in pulmonary rehabilitation is guided by three key parameters: intensity, frequency, and duration [41].

Studies have shown that higher exercise intensity in lower extremity training leads to greater physiological benefits compared to lower intensity training in COPD patients [41]. However, both low-intensity and high-intensity exercise training have demonstrated clinical benefits across different stages of COPD, with moderate-to-high intensity exercises effectively addressing muscular functional impairments [41].

While low-intensity training improves symptoms, health-related quality of life, and aspects of daily life performance, long-term adherence appears to be better with low-intensity training. Nevertheless, training programs should strive to achieve maximal physiological effects [42].

Hence, high-intensity training is often recommended in pulmonary rehabilitation centers, with target intensities set at 60% to 80% of the peak work rate achieved during incremental maximal exercise tests [41].

A minimum total effective training time of 30 minutes is ideal [42].

Endurance exercise primarily focuses on leg muscles and commonly includes activities such as walking, stationary cycling, and treadmill exercises. Training load adjustments can be made based on symptom scores, such as dyspnea measured by the Borg scale [43, 44].

Most programs consist of three sessions per week, with a minimum of two supervised sessions, lasting for at least 6-8 weeks [45, 46].

In cases where severely breathless patients are unable to achieve the aforementioned training targets, interval training may be preferable [47, 48].

This approach involves alternating shorter periods of high-intensity exercise with recovery periods of low-to-moderate intensity [48].

It is often more comfortable for patients experiencing severe dynamic hyperinflation, potentially improving treatment adherence. Moreover, lower metabolic and ventilatory stress allows for an increase in total exercise duration for individuals with severe COPD [49].

During training sessions, measurements of oxygen saturation, heart rate, and blood pressure are taken. Supplementary oxygen is provided to maintain oxygen saturation levels above 90% [42].

All recorded parameters are documented in the medical file. As the rehabilitation program progresses, therapists should adjust the training intensity based on individual responses. Retesting may provide physiological evidence of training improvements and aid in intensity adjustment throughout the program [50] (figure 4).



### Types of exercise in COPD

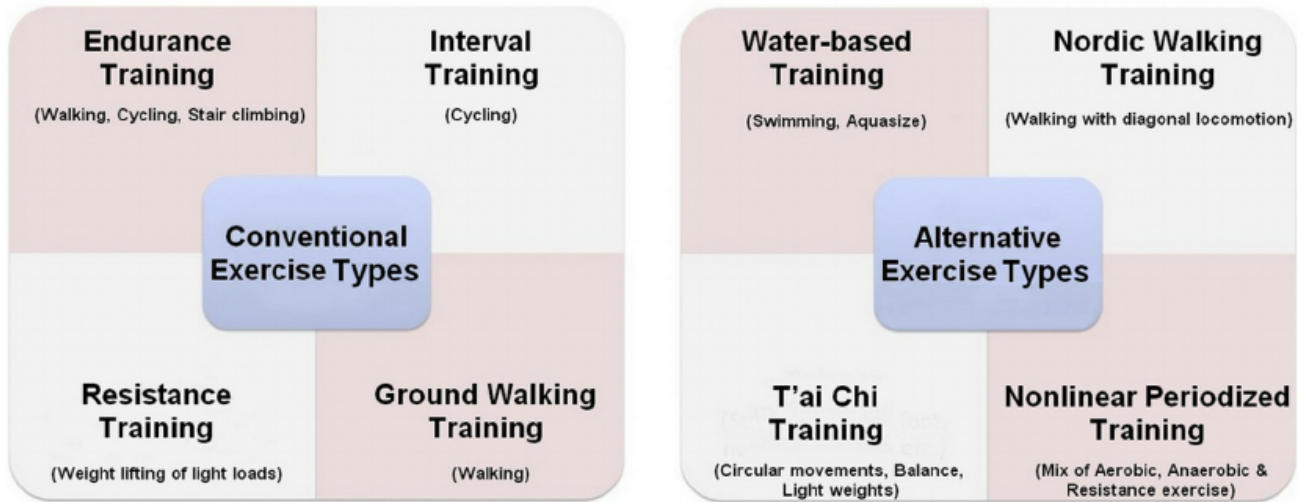


Figure 4 types of exercise training in rehabilitation of COPD.

## **Chapter 2.5**

### **Nutritional counseling**

Nutritional counseling plays a crucial role in pulmonary rehabilitation programs for individuals with chronic obstructive pulmonary disease (COPD). Certified dietitians are responsible for educating patients on how to plan and maintain a healthy diet [51]. COPD patients require significantly more energy to breathe compared to individuals with healthy lungs, up to 10 times more. Therefore, it is essential for COPD patients to consume a diet that provides an adequate amount of the right nutrients. Consuming large meals in a short period of time can lead to increased shortness of breath for COPD patients. To alleviate breathlessness, individuals with COPD are typically advised to eat smaller, more frequent meals throughout the day [51].

This eating pattern can help manage symptoms and reduce the burden on the respiratory system. During the pulmonary rehabilitation program, several tests are conducted to assess various aspects of a COPD patient's nutritional status [52].

These tests help determine if the patient has a healthy body weight, establish a goal weight if necessary, and calculate the appropriate daily calorie intake to maintain a healthy body weight.

Adopting a healthy diet can have a positive impact on COPD symptoms, as it ensures that the body receives adequate nutrients for optimal functioning [53]. This, in turn, can help patients maintain a healthy body weight, increase energy levels, improve muscle strength, reduce breathlessness, and lower the risk of respiratory infections and COPD flare-ups.

As part of nutritional counseling, overweight patients receive guidance on planning a diet to support weight loss, while underweight patients receive advice on foods that can aid in weight gain. In general, individuals with COPD can benefit from incorporating the following types of foods into their diet [54]:

- (i) High-fiber foods
- (ii) High-protein foods
- (iii) Fresh fruits and vegetables
- (iv) Foods rich in vitamins and minerals

These food choices provide essential nutrients, promote overall health, and support the specific needs of individuals with COPD

## **Conclusion**

modern approaches to rehabilitation in COPD patients offer a holistic and patient-centered approach to disease management. By combining exercise training, education, psychosocial support, and self-management strategies, these approaches aim to optimize functional capacity, enhance quality of life, and reduce the burden of COPD. Embracing these modern rehabilitation approaches can greatly improve the outcomes for individuals living with COPD, empowering them to actively participate in their own care and achieve the best possible health outcomes.

Considering that physical activity and smoking cessation are general health recommendations, and medical treatment is typically managed by general practitioners (GPs), it may be more appropriate to allocate resources towards pulmonary rehabilitation for individuals with severe and very severe COPD. GPs can continue to play a role in the care of patients with moderate disease.

Successful pulmonary rehabilitation relies on promoting behavioral changes in patients. This can be achieved through comprehensive programs that involve a multidisciplinary team providing support, counseling, encouragement, and coaching. These programs encompass exercise training, psychosocial support, nutritional intervention, self-management techniques, education, pacing, and energy conservation strategies. They are designed for motivated COPD patients and serve as an important and safe therapeutic option to address the systemic manifestations of COPD. When combined with pharmacological therapy, pulmonary rehabilitation can lead to optimal patient management and a positive impact on the daily lives of individuals with COPD

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figure 1. <https://err.ersjournals.com/content/22/129/405#ref-7>

figure 2. <https://www.frontiersin.org/articles/10.3389/fphys.2021.766346/full#F1>

figure 3. <https://www.verywellmind.com/psychosocial-rehabilitation>

4589796#:~:text=Psychosocial%20rehabilitation%20is%20a%20treatment,communities%20as%20independently%20as%20possible.

Figure 4 [https://www.researchgate.net/figure/Types-of-exercise-in-chronic-obstructive-pulmonary-disease-COPD\\_fig1\\_261565726](https://www.researchgate.net/figure/Types-of-exercise-in-chronic-obstructive-pulmonary-disease-COPD_fig1_261565726)