

Pulmonary rehabilitation: A regional perspective evidenced-based review

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Abstract:

Pulmonary rehabilitation (PR) is an integral component of the comprehensive management plan of patients with chronic lung diseases by addressing their functional and psychological deficits. PR is generally recommended to symptomatic patients with chronic lung diseases who develop shortness of breath on their own pace at level ground while receiving optimum therapy. From a regional perspective, this review covers the description of a PR program, its establishment and outcome assessment.

Key words:

Chronic lung diseases, chronic obstructive pulmonary disease, pulmonary rehabilitation, quality of life

Pulmonary rehabilitation (PR) is an essential component of the comprehensive management plan of patients with chronic lung diseases by addressing their functional and psychological deficits.^[1] It is defined as “an evidence-based, multi-disciplinary and comprehensive intervention for patients with chronic respiratory diseases who are symptomatic and often have decreased daily life activities, integrated into the individualized treatment of the patient; PR is designed to reduce symptoms, optimize functional status, increase participation and reduce health care costs through stabilizing or reversing systemic manifestations of the disease.”^[2] There is an ample evidence to support that PR will lead to improvement in respiratory symptoms, quality of life and exercise endurance that may be extended for 18 months from completing a program.^[3-5] The following criteria are used to categorize evidence:

- Evidence category A: Randomized controlled trials with rich body of data
- Evidence category B: Randomized controlled trials with limited body of data
- Evidence category C: Non-randomized trials and observational studies
- Evidence category D: Consensus judgment of the authors when there was clinical literature addressing the subject was insufficient to justify placement in one of the other categories.

Indication for PR

PR is generally recommended to symptomatic patients with chronic lung diseases who develop shortness of breath on their own pace at level ground while on optimum therapy. Based on available evidence, PR is recommended for

chronic obstructive pulmonary disease (COPD) patients with a forced expiratory volume in one second (FEV₁) of at least 50% of predicted. It is further extended to symptomatic patients with moderate disease who have an FEV₁ between 50% and 80% of predicted (Evidence B).^[6,7] With the introduction of the global initiative for COPD, PR is recommended for those with a COPD assessment test (CAT) score of more than 10. As part of the comprehensive management plan of patients with chronic lung diseases, it is recommended that co-morbid conditions, nutritional status and peripheral muscle weakness are assessed as well. These factors would influence a satisfactory response from the program. Evidence has also shown that participation in a PR program reduces the utilization of health care resources for patients with COPD (Evidence B).^[8,9]

PR is recommended to be offered on an out-patient base as it has potential advantages of being cost-effective and conducted by trained staff in a safe clinical environment. In-patient rehabilitation may be utilized to commence the program after a disease exacerbation or for advanced cases with severe deconditioning.^[10] Patients with orthopedic or neurologic problems are normally excluded from the PR program as it may affect their mobility and cooperation with exercises. Poorly controlled coexisting medical conditions may limit participation of some patients.

Description of PR Program

PR is recommended to be tailored to meet the needs of the individual patients, addressing age-specific and cultural variables and contain patient-determined goals, as well as goals

established by the individual team discipline. Both patients and families participate in this training administered by a multi-disciplinary team including PR therapists. These services are to be overseen by a Medical Director to assure appropriate performance of service delivery. The role of professionals working in PR programs and their competencies should be well-described.^[11]

The main components of a PR program include:

Exercise training

Exercise training is the cornerstone of PR program as it leads to improvement of muscle function (Evidence A).^[12] Patient treatment should be maximized prior to PR as patient performance is affected by airway obstruction, ventilatory limitations, gas exchange abnormalities and skeletal or respiratory muscle dysfunction. Exercise leads to better motivation for the psychological status, symptoms and cardiovascular function.^[13,14] It is recommended that the exercise prescription should take in consideration patient safety, co-morbid conditions (e.g., musculoskeletal and neurological disorders), individual patient needs, and goals of rehabilitation (Evidence B). To maximize benefits from exercise, pre-exercise bronchodilator and gradual warm-up are recommended.^[15] Oxygen supplementation during exercise is beneficial especially for those with hypoxemia (Evidence A).^[16]

An adequate duration of the program has not been determined. However, a typical PR protocol is recommended to be at least three supervised visits/week over 8-12 weeks for approximately 20 visits (Evidence B).^[17-19] In general, low intensity endurance exercises are recommended. Selected patients with adequate ventilatory tolerance who can tolerate low intensity exercises may be offered careful resistance exercises.^[20] For practical purposes, the recommended exercise targets are a Borg Dyspnea score of 4-6, fatigue, or heart rate at the gas exchange threshold.^[21] The recommended exercises for the lower and upper extremities include combination track or treadmill walking, upright cycling, stair stepping and arm ergometer (Evidence A). Further, aerobic exercises are also recommended which include lower extremities, upper extremities, flexibility and strength. Selected patients may benefit from resistive exercises training like hand weights and elastics bands (Evidence A). The total effective training time is recommended to exceed 30 min. However, interval training is an alternative for those patients who find difficulty in achieving this target of training time or intensity.^[22] Finally, inspiratory muscle training may be used as an adjunct treatment especially in those patients with severe disease (Evidence D).

Self-management education

Education is an integral part of PR program and should aim to promote self-management skills and self-efficacy rather than didactic lectures. This is recommended to involve a combination of teaching, counseling, and behavior modification techniques (Evidence A).^[23] Self-efficacy can be achieved by personal experience and practice, feedback and enforcement and analysis of cause of various failures.^[23] Self-management plan is recommended to include instruction in prevention and early treatment of exacerbation. Early intervention will

speed recovery, reduce mortality and minimize health care utilization.^[24]

Educational topics are available in Arabic language and include the following topics:^[25]

- Breathing strategies
- Normal lung function and pathophysiology of lung disease
- Proper use of medications, including oxygen
- Bronchial hygiene techniques
- Benefits of exercise and maintaining physical activities
- Energy conservation and work simplification techniques
- Eating habits
- Irritant avoidance, including smoking cessation
- Prevention and early treatment of respiratory exacerbations
- Indications for calling the health care provider leisure, travel, and sexuality
- Coping with chronic lung disease
- End-of-life planning
- Anxiety and panic control, including relaxation techniques and stress management.

Behavioral modification

COPD is associated with increased mental health disorders such as anxiety and depression. Therefore, psychosocial support is recommended as it facilitates adjustment process by encouraging adaptive behavior and helping patients to diminish negative emotions (Evidence C).^[26]

Outcome Assessment

Outcome assessment in chronic lung diseases should be patient-centered and range from unstructured clinical assessment to validated tests. Measurement of exercise capacity is recommended to be accomplished by obtaining the 6 min walk distance which is responsive to the PR intervention and simple to perform with little additional equipment.^[27]

The two most widely used disease-specific health related quality of life questionnaires are the chronic respiratory disease questionnaire (CRQ) and the Saint George's respiratory questionnaire.^[28,29] The CRQ is available in Arabic as it can be applied in the local setting without changes that may affect its validity and reliability. The Arabic translation was based on the version of CRQ with standardized dyspnea domain and self-administrated (CRQ-SAS). The CRQ-SAS is a 20-item questionnaire with a seven-item likert's scale that covers dyspnea, fatigue, emotion and mastery domains. The score of each domain is calculated by the average of the related questions where higher numbers indicate better quality of life. For COPD patients, the CAT was recently introduced to measure the impact of the disease [Figures 1 and 2].^[30] The CAT is an eight items test where higher numbers reflect a higher impact of the disease [Table 1]. The CAT is also available in the Arabic language.^[31,32]

Benefits from PR program may continue up to 18 months (Evidence B).^[3] Health related quality of life is maintained for a longer period compared to exercise (Evidence A).^[33] Strategies to maintain the benefits of a PR program include continuing exercises and recall program for rehearsal of exercises and techniques learned during the program (Evidence B).^[34]

Your name: _____ Today's date: _____

How is your COPD? Take the COPD Assessment Test (CAT)

This questionnaire will help you and your healthcare professional measure the impact COPD (Chronic Obstructive Pulmonary Disease) is having on your wellbeing and daily life. Your answers, and test score, can be used by you and your healthcare professional to help improve the management of your COPD and get the greatest benefit from treatment.

For each item below, place a mark (X) in the box that best describes you currently. Be sure to only select one response for each question.

Example: I am very happy (0) (1) (2) (3) (4) (5) I am very sad

Question	0	1	2	3	4	5	SCORE
I never cough	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	
I cough all the time	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	
I have no phlegm (mucus) in my chest at all	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	
My chest is completely full of phlegm (mucus)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	
My chest does not feel tight at all	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	
My chest feels very tight	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	
When I walk up a hill or one flight of stairs I am not breathless	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	
When I walk up a hill or one flight of stairs I am very breathless	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	
I am not limited doing any activities at home	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	
I am very limited doing activities at home	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	
I am confident leaving my home despite my lung condition	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	
I am not at all confident leaving my home because of my lung condition	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	
I sleep soundly	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	
I don't sleep soundly because of my lung condition	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	
I have lots of energy	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	
I have no energy at all	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	
TOTAL SCORE							

Figure 1: The COPD Assessment Test - English version

التاريخ واليوم، الاسم،

ما هي حالة مرض الانسداد الرئوي المزمن لديك؟ قم بإجراء اختبار تقييم مرضك

سيساعدك ذلك هذا الاستبيان على قياس مدى تأثير مرض الانسداد الرئوي المزمن على وضك العام وحياتك اليومية، كما سيساعد طبيبك أيضاً، حيث يمكنه من استخدام أجهزتك ودرجات الاختبار التي حصلت عليها من أجل تحسين معالجة مرضك والحصول على الاستفادة القصوى من العلاج.

ضع علامة (X) على الرقم الذي يصف حالتك حالياً في كل فقرة مع التأكد من اختيار إجابة واحدة فقط.

على سبيل المثال،

أنا سعيد جداً (0) (1) (2) (3) (4) (5) أنا حزين جداً

أنا لا أسعل أبداً	(0) (1) (2) (3) (4) (5) أنا أسعل طوال الوقت	
لا يوجد لدي بلغم (مخاط) في صدري أبداً	(0) (1) (2) (3) (4) (5) صدري ممتلئ كلياً بالبلغم (مخاط)	
لا أشعر أبداً بضيق في صدري	(0) (1) (2) (3) (4) (5) أشعر بضيق شديد في صدري	
لا ألهث عند صعود التل أو الدرج	(0) (1) (2) (3) (4) (5) ألهث جداً عند صعود التل أو الدرج لدور واحد	
أنا غير مقيد بالنسبة للأنشطة التي أقوم بها في المنزل	(0) (1) (2) (3) (4) (5) أنا مقيد جداً بالنسبة للأنشطة التي أقوم بها في المنزل	
أستطيع مغادرة المنزل بكل ثقة بغض النظر عن حالة رئتي	(0) (1) (2) (3) (4) (5) لست واثقاً أبداً من مغادرة المنزل بسبب حالة رئتي	
أنام بشكل سليم	(0) (1) (2) (3) (4) (5) لا أنام بشكل سليم بسبب حالة رئتي	
أشعر بوجود طاقة كبيرة لدي	(0) (1) (2) (3) (4) (5) لا أشعر أبداً بوجود أي طاقة لدي	
المجموع الكلي		

Figure 2: COPD Assessment Test - Arabic Version

Table 1: Interpretation of the COPD Assessment Test

CAT Score	Interpretation
>30	Very high
>20	High
10-20	Medium
<10	Low

Establishing a PR Program

There are international guidelines that guide the establishment of a PR program.^[35-37] Furthermore, the American Association of Cardiovascular Rehabilitation has published its guidelines that carry practical recommendations.^[38]

Other Components of PR

Nutrition

Malnutrition is seen in 26-47% of patients with chronic lung diseases and is frequently associated with anemia, underweight and muscle wasting.^[39,40] Malnutrition aggravates any existing musculoskeletal dysfunction, dyspnea and may lead to limitation in exercise capacity.^[41] It has been associated with an increased susceptibility to infection due to impaired immunity and increased colonization and adherence of bacteria in the upper and lower airways.^[42] The body mass index (BMI) is a simple tool to assess nutritional status and patient's

morbidity and mortality. However, it does not reflect body mass composition as patient may lose fat free mass (organ, muscle and bone) while maintaining normal BMI. Nevertheless, for practical purposes, the BMI is recommended to classify patients as follows: Underweight (<21 Kg/m²), normal weight (21-25 Kg/m²), overweight (26-30 Kg/m²), and obese (>30 Kg/m²). Recent weight loss of >10% over 6 months carries a negative prognostic effect. Further, mortality is associated with underweight status independent of the degree of airflow limitation.^[43]

Measures to improve nutrition are recommended especially in underweight patients. Management strategies that improve energy balance and adequate protein intake are designed to help patients to gain weight, improve protein synthesis and restore fat free mass.^[44] The combination of nutritional supplementation and supervised exercise program has been shown to increase body weight and fat free mass.^[45]

Oxygen therapy

There is unequivocal evidence that long-term oxygen therapy (LTOT) improves survival and quality of life in patients with COPD. The LTOT is recommended when the PaO₂ <55 mm Hg (<7.3 kPa) or SaO₂ <88%, whereas the patient is breathing room air and is free of acute exacerbation for at least 2 months while receiving maximum therapy. LTOT is also recommended if the PaO₂ is 55-60 mm Hg (7.4-8 Pka) in a patient with COPD that is

associated with cor pulmonale, peripheral edema, or hematocrit $\geq 55\%$ (Evidence A). Despite the lack of solid evidence, LTOT recommendation may be extended to patients with COPD with $\text{PaO}_2 > 60$ mm Hg (> 8 kPa or $\text{SaO}_2 > 88\%$) with nocturnal hypoxemia or during exercise. The available evidence is based on COPD literature; however, the evidence was extrapolated and extended to other chronic lung diseases. Once LTOT is commenced, re-evaluation of the patients at 3 months and 1 year to optimize oxygen prescription is recommended.^[46,47] The oxygen should be titrated to achieve a resting PaO_2 of 60-65 mm Hg or SaO_2 between 88% and 94%. The usual dose is 1-2.5 L/min, typically given by nasal cannula, for a minimum of 18 h/day to derive its survival benefit. Long extension tubes may be needed to ensure continuous use of oxygen during a normal day activity and exercise. A practical way of supplying oxygen at home is the using an oxygen concentrator. Lightweight portable delivery systems are now available for use outside the home.

Air travel

COPD patients are liable to develop potentially serious oxygen desaturation during commercial flights. Commercial airplanes' cabin is pressurized to a level of 6000-8000 m that it is equivalent to inspired oxygen of 15% at sea level.^[48] Therefore, it is recommended that patients with COPD to keep PaO_2 above 50 mm Hg (6.7 kPa) during flight. Supplemental oxygen by nasal cannula usually compensates for the hypoxemia of air travel.^[49] However, oxygen pressure should be maintained during flight at the same level at which the patient is clinically stable at sea level. Patients with COPD should also ask their physicians to fill the oxygen supplement form provided by airlines. Attention also should be paid to co-existing conditions which could preclude air travel such as unstable angina, severe anemia, uncontrolled heart failure, large emphysematous bullae, or pneumothorax.

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