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Impact of Pulmonary Rehabilitation Program on Health Outcomes of Patients with Chronic Obstructive Pulmonary Disease

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Abstract
Chronic obstructive pulmonary disease (COPD) is one of the most common causes of morbidity and mortality worldwide. Patients with COPD experience a succession of distressing physical, psychological and social changes. Currently, there is no cure for COPD or its debilitating effects on pulmonary function. As a result, health care professionals have shifted their focus from reversing the disease process to reducing disability and improving QOL. The study was to assess the impact of pulmonary rehabilitation program on health outcomes of patients with COPD. The study was conducted in the chest diseases department of Mansoura University Hospital. A total of 27 COPD patients were enrolled in the study. They received the two- month home-based pulmonary rehabilitation program in addition to usual hospital care. The health outcomes were measured by five tools; Saint's George Respiratory Questionnaire (SGRQ), six minutes walk test, Modified Borg Dyspnea Scale and pulmonary function test. The study revealed that, only activity dimension of SGRQ improved significantly in patients with both moderate and severe disease stages while patients with very severe stage showed significant improvement in all dimensions of SGRQ except symptoms dimention. There was no significant improvement in pulmonary function tests of patients in three disease stages. Functional capacity and perceived exertional dyspnea were significantly improved for patients in the moderate and severe stages, while very severe stage patients showed significant improvement only in perceived dyspnea. The supervised two- month home-based pulmonary rehabilitation program is an effective non pharmacological intervention in the management of moderate, severe and very severe stable COPD patients.
Keywords: Pulmonary rehabilitation; Quality of Life; health outcomes; COPD stages.

Introduction

Chronic obstructive pulmonary disease (COPD) is a preventable and treatable disease with some significant extrapulmonary effects that may contribute to the severity in individual patients. Its pulmonary component is characterized by airflow limitation that is not fully reversible. The airflow limitation is usually both progressive and associated with an abnormal inflammatory response of the lung to noxious particles or gases (GOLD, 2010). COPD is composed primarily of two related diseases; chronic bronchitis and emphysema. Most COPD patients have one predominant disease entity, but often with manifestation of both (Hogg, 2004).

COPD is one of the leading causes of mortality and disability both in developed and developing countries (Anto et al., 2001). It is ranked the fourth cause of death worldwide. Furthermore, it is currently the twelfth leading cause of disability worldwide (Ait-Khaled et al., 2001). The World Health Organization (WHO) estimated that by the year 2020 COPD will be the third leading cause of death and the fifth cause of disability worldwide (Barnes, 2002).

Patients with COPD experience a succession of distressing physical and psychosocial changes that affect significantly QOL (Peruzza et al., 2003). Physically, dyspnea, cough, fatigue and sleep disturbance are the most common problems associated with COPD and contributor to disability and poor QOL through the limitations they impose on motivation, concentration and everyday activities including household chores and social and leisure pastimes. Psychosocially, feeling of depression and anxiety are frequently reported by patients with COPD. Also COPD is associated with several social problems as loss of social role and a tendency to avoid social interaction and recreational activities. These problems influence physical functioning, independency, perceived wellbeing, health outcomes and overall QOL in subtle and complex ways (McCann & Moreau, 2003; Yohannes, 2005; Barnet, 2008). Since medications do not eliminate all of the symptoms of COPD and a cure of the illness is not possible, pulmonary rehabilitation has been employed to improve exercise tolerance, functional capacity and QOL (Weaver et al., 1997).

Pulmonary rehabilitation is a multidimensional continuum of services directed to persons with pulmonary diseases with the goal of achieving and maintaining the individual's maximum level of independence and functioning in the community. Pulmonary rehabilitation can change outcomes that predict survival and can improve the systemic component of COPD and its comorbidities with a potential effect on survival (Hunter &

King, 2001). The appropriate selection of patients plays a key role in the success of pulmonary rehabilitation (Bourbeau et al., 2003). Appropriate patients for pulmonary rehabilitation programs are those who recognize that their symptoms depend upon their lung disease and are motivated to be active participants in their own care to improve their health status. The only absolute contraindications are a long history of lack of compliance and unwillingness to participate. Excellent evidence supports the benefits of pulmonary rehabilitation in stable patients (Norweg et al., 2005; Ries et al., 2007; Maltais et al., 2008). Nevertheless, it is not yet widely utilized in many developing countries (Al Moamary, 2008). GOLD (2010) recommended pulmonary rehabilitation for COPD patients from stage II (FEV1 < 80%) and physician referrals to this intervention generally include late stages of the disease (Ambrosino & Simonds, 2007; Romagnoli et al., 2006).Therefore, the aim of this study was to assess the impact of pulmonary rehabilitation program on health outcomes of patients with moderate and severe COPD.

Materials and method

Design: Quasi-experimental research design was used in this study.

Settings:

This study was carried out at the chest diseases department of Mansoura University Hospital, Egypt.

Subjects*:*

The study subjects comprised all COPD patients of both sexes admitted to the above mentioned setting during a period of three months and fulfilling the following criteria: clinically stable with no exacerbation in the last month, Had COPD diagnosed according to the criteria of Gold (2010) [(1)], had COPD staged according to GOLD 2010[(1)]; Stage 2: moderate COPD (50% ≤ FEV1 < 80% predicted) and stage 3: sever COPD (30% ≤ FEV1 < 50% predicted), and free from any other respiratory or associated disorders as heart failure, coronary artery diseases and asthma. Their number amounted to 27 COPD patients.

Study Tools:

Five tools were utilized for the purpose of data collection.

Tool I: Structured Interview Schedule:

It was developed by the researchers and concerned with biosocio-demographic characteristics of the study sample, medical history and patient exposure to risk factors as smoking, environmental and occupational exposures.

Tool II: Saint's George Respiratory Questionnaire (SGRQ) *(Jones et al., 1992)*:

The SGRQ was developed by Jones, 1992 to measure health related quality of life in patients with COPD. It provides an overall measure for the quality of life with subscale scores in three dimensions: symptoms, activities and impact of disease on daily life. **The symptoms subscale** is concerned with the effect, frequency and severity of respiratory symptoms as regard cough, sputum, dyspnea and wheeze. **Activity subscale** focuses on physical activities that either cause or are limited by breathlessness. **Impacts subscale** covers a range of aspects concerned with social functioning and psychological disturbances resulting from airways disease. Each subscale of the questionnaire is scored between 0% (no impairment) and 100% (maximal impairment). A cumulative score for the whole questionnaire also ranges between 0% (no impairment) and 100% (maximal impairment).

Tool III: Pulmonary Function Test:

It was used to evaluate the obstructive ventilatory defect. Three parameters were measured: Forced Expiratory Volume in 1 second (FEV_1), Forced vital capacity (FVC) and the ratio between Forced Expiratory Volume in 1 second and Forced Vital Capacity (FEV_1/FVC). These parameters were measured by the spirometer (spirolab II, Rome, Italy). The results were then expressed as percentage of predicated normal values for each subject after adjustment for age, sex and height [(20)].

Tool IV: Six minutes walk test (6 MWT) *(ATS, 2002)*:

It is a global objective indicator of functional capacity. It is used by measuring the distance (by miters) that the patient covered in 6 minutes. The patients were instructed to cover as much distance as possible in the 6 minutes and verbal encouragement every minute was given. The test was completed in a 50-miters flat corridor inside the department. Patients' walked distance pre and post program were compared.

Tool V: Modified Borg Dyspnea Scale *(Borg, 1982)*:

Modified Borg Scale is a numerical scale for rating perceived dyspnea immediately after a 6 minutes walk test. Patient was instructed to indicate the level of his dyspnea on a 10-point horizontal line after 6minutes of walking. Higher score indicates severe dyspnea. Ratings pre and post program were compared.

Method

1. Permission to carry out the study was obtained from the responsible authorities at the chest diseases department of Mansoura University Hospital after explanation of the aim of the study.

2. Tool II (Saint's George Respiratory Questionnaire) and tool IV (Modified Borg Scale) were translated into Arabic by two researchers and back-translated into English by the other two researchers. The required corrections and modifications were carried out accordingly.
3. Tool II and IV were tested for their reliability. Test-retest measurement was used. Tools were applied on 10 COPD patients selected from chest diseases department. Tools were repeated again for these patients after two weeks. The reliability was assured by means of Cronbach's coefficient alpha. It indicated that the tools have a reliability of 0.86 and 0.88 respectively.
4. Verbal consent from the patients to participate in the study was obtained after explanation of the study purpose and its potential benefits.
5. Privacy of the study sample and confidentiality of the collected data were assured throughout the study.
6. A pilot study was conducted on 5 COPD patients from chest diseases department of Mansoura University Hospital in order to evaluate the clarity and applicability of the tools. These patients were not included in the study sample. Following this pilot study, the final form of tools were reconstructed and made ready for use.
7. For proper conduction of the study, Three phases were utilized:

Assessment Phase:

- Chest radiograph report, chest computed tomography report and electrocardiogram (ECG) for each patient were revised by the researcher to confirm the diagnosis and exclude any coexisting lung pathology or complications.
- Each patient was interviewed individually at chest diseases department on their admission to collect the baseline patient's data using all study tools (I, II, III, IV and V).

Intervention phase:

Pulmonary rehabilitation program

The program was developed by the researcher based on review of current literature [23-30] and the rehabilitative needs of each patients identified from assessment phase of the study. A booklet containing the components of the program was designed and written in a simple Arabic language and supplemented by photos and illustrations and was given to each patients and used as a reminder to support teaching and practicing at home. Simple audio-visual materials were designed by the researcher to facilitate transmission of ideas and keep interest of the study group during sessions. During the hospitalization period, the developed pulmonary rehabilitation program was conducted in 8 sessions over 2 weeks. Each session took about 30 minutes. The developed pulmonary rehabilitation program was conducted in small groups (3-5 patients/session). Each patient was subjected to two types of sessions: theoretical and practical sessions.

1. Theoretical sessions: were carried out in 4 sessions. They included information about the following:
    - Respiratory system and COPD nature.
    - COPD medications.
    - Behavior and lifestyle modification related to proper nutrition, energy conversation techniques, healthy sleep, dyspnea management, measures to reduce risk of infection and airway irritants, smoking cessation, periodic medical follow up and exercises.
2. Practical sessions: they carried out in 4 sessions. Patients were taught to perform these exercises and instructed to do them at home after discharge from the hospital for 2 months. Practical sessions included the following:
    - Inspiratory muscle training by using incentive spirometery
    - Breathing retraining (pursed lip breathing and diaphragmatic breathing)
    - Stretching and strengthening exercise for upper and lower extremities with using dumbbells (1 and 2 Kgs).
    - Airway clearance techniques (deep breathing and coughing exercise and chest percussion and vibration).

- Telephone visits were provided twice a week during 2 months post discharge by the researcher for patients to check with them their consistency with program. Problems and concerns in performing the program were discussed.

Evaluation phase:

- 2 and 6 months post discharge from the hospital, each patient was evaluated to determine the effect of program on QOL, pulmonary function, functional capacity, and perceived dyspnea using the study tools: II, III, and VI.

Statistical analysis:

- Data was analyzed using computer with statistical package for social science (SPSS) version 15. The 0.05 level was used as the cut off value for statistical significance and the following statistical measures were used: descriptive statistics, analytical statistics and graphical presentation.

Results

Table 1. Socio-demographic characteristics of the moderate, severe and very severe COPD stages:

Items	Moderate stage		Severe stage		Very severe stage		Pearson Chi-Square χ^2 test (P)
	N= (8)	%	N= (16)	%	N= (8)	%	
Age (in years)							
40-	2	25.0	6	37. 5	1	33.3	1.964 (0.742)
55-	2	25.0	8	50.0	1	33.3	
70+	4	50.0	2	12.5	1	33.3	
Sex							
Male	7	87.5	14	87.5	2	66.7	0.917 (0.632)
female	1	12.5	2	12.5	1	33.3	
Marital status							
Married	6	75.0	14	87.5	2	66.7	2.928 (0.570)
Single	2	25.0	1	6.3	1	33.3	
Divorced	0	0.0	1	6.3	0	0.0	
Educational level							
Read and write	1	12.5	2	12.5	2	66.7	
Primary	1	12.5	1	6.25	0	0.0	12.150 (0.275)
Secondary	4	50.0	3	18.75	0	0.0	
University	2	25.0	10	62.5	1	33.3	

Table (1) revealed that, 50.0 % of the moderate stage were 70 years old and more and 50.0 % of the severe stage were 55 to less than 70 years. Males were more prevalent in the moderate, severe, and very severe stage. 87.5% of the patients were male and at the moderate stage of the disease. The majority of the patients in the moderate, severe and very severe stages were married (75.0%, 87.5 % and 66.7% respectively). There were no statistical significant differences were detected regarding socio-demographic characteristic of the patients.

Table 2. Stages of COPD as presented by patients at 3 different intervals (pre, 2 and 6 months post pulmonary rehabilitation program):

Items	Moderate COPD (50%≤ FEV_1< 80% predicted)		Severe COPD (30%≤FEV_1<50% predicted)		Very severe COPD (FEV_1< 30% predicted)	
	NO	%	NO	%	NO	%
Pre-rehab.	8	29.6	16	59.3	3	11.1
2 months Post rehab. (post 1)	9	33.3	15	55.6	3	11.1
6 months Post rehab. (post 2)	10	37.0	14	51.9	3	11.1
Z Test (P)[1]	1.000 (0.317)					
Z Test (P)[2]	1.414 (0.157)					

Wilcoxon Signed Ranks Z Test (P)[1]: comparing pre-rehab and 2 months post-rehabilitation (post 1).
Wilcoxon Signed Ranks Z Test (P)[2]: comparing pre-rehab and 6 months post-rehabilitation (post 2).
*Significant, at P≤ 0.05.

Table (2) describes stages of COPD pre, 2 months and 6 months post pulmonary rehabilitation. The results revealed that there were no statistical significant differences were detected among patients in the 3 stages of severity.

Table 3. Effect of pulmonary rehabilitation program on quality of life of patients at 3 levels of disease severity (Moderate, severe and very severe):

Quality of life (SGRQ)#	Moderate COPD			Severe COPD			Very severe COPD			F (P)a	F (P)b	F (P)c
	Pre-rehab. N=8	2 months Post rehab. (post 1) N=9	6 months Post rehab. (post 2) N=10	Pre-rehab. N=16	2 months Post rehab. (post 1) N=15	6 months Post rehab. (post 2) N=14	Pre-rehab. N=3	2 months Post rehab. (post 1) N=3	6 months Post rehab. (post 2) N=3			
	Mean±SD	Mean±SD	Mean±SD	Mean±SD	Mean±SD	Mean±SD	Mean±SD	Mean±SD	Mean±SD			
Symptoms	40.68 ±5.55	36.00± 5.43	36.01± 5.25	63.56±12.45	59.31±14.92	61.98±14.41	85.00**±11.00**	79.73**±13.15**	79.73**±13.15**	21.753 (0.000)*	17.273 (0.000)*	22.278 (0.000)*
t-test (P)1	1.753 (0.100)			0.864 (0.394)			2.623 (0.120)					
t-test (P)2	1.826 (0.087)			0.323 (0.749)			2.623 (0.120)					
Activities	41.83 ±5.06	32.04± 9.95	36.03± 12.36	58.80±12.48	47.74±11.43	50.96±14.52	74.36**±10.61**	61.75**±4.16**	64.25**±6.92**	11.989 (0.000)*	11.046 (0.002)*	6.598 (0.005)*
t-test (P)1	2.505 (0.024)*			2.569 (0.016)*			2.021 (0.181)					
t-test (P)2	1.348 (0.202)			1.590 (0.123)			4.638 (0.043)*					
impact	45.36±11.67	34.48±13.09	33.23± 14.31	59.51±10.50	52.63± 9.80	52.22±11.26	71.84**±3.59**	63.65**±2.02**	62.53**±3.03**	8.403 (0.002)*	11.903 (0.001)*	10.219 (0.001)*
t-test (P)1	1.799 (0.092)			1.885 (0.070)			4.704 (0.042)*					
t-test (P)2	1.934 (0.071)			1.834 (0.077)			5.260 (0.034)*					
Total	43.47±8.47	34.01± 9.98	34.54 ±11.01	59.97±10.67	52.29±10.27	53.51±12.05	74.90**±5.64**	65.86**±4.12**	66.01**±5.70**	13.545 (0.000)*	15.567 (0.000)*	12.663 (0.000)*
t-test (P)1	2.094 (0.054)			2.038 (0.051)			9.629 (0.011)*					
t-test (P)2	1.888 (0.077)			1.557 (0.131)			9.612 (0.011)*					

Paired –sample t-test (P)[1]: comparing pre-rehab and 2 months post-rehabilitation (post 1) in each stage.
Paired –sample t-test (P)[2]: comparing pre-rehab and 6 months post-rehabilitation (post 2) in each stage.
Anova test (P)[a]: comparing between stages pre-rehab.
Anova test (P)[b]: comparing between stages 2 months post-rehab. (post 1).
Anova test (P)[c]: comparing between stages 6 months post-rehab. (post 2).
Saint's George Respiratory Questionnaire **(**decreased scores denote improvement).
*Significant, at P≤ 0.05

Table (3) showed that the total score for all QOL dimensions such as symptoms, activities, and impact decreased (improved) in moderate, severe and very severe stages of disease at 2 and 6 months post rehabilitation program. The improvement was statistically significant for activities dimension (for the three stages), for impact dimension and total score (only for very severe stage).

Table 4. Effect of pulmonary rehabilitation program on functional capacity and perceived dyspnea of patients at 3 levels of disease severity (moderate, severe and very severe):

Items	Moderate COPD			Severe COPD			Very severe COPD			F (P)a	F (P)b	F (P)c
	Pre-rehab. N=8	2 months Post rehab. (post 1) N=9	6 months Post rehab. (post 2) N=10	Pre-rehab. N=16	2 months Post rehab. (post 1) N=15	6 months Post rehab. (post 2) N=14	Pre-rehab. N=3	2 months Post rehab. (post 1) N=3	6 months Post rehab. (post 2) N=3			
	Mean ± SD	Mean ± SD	Mean ± SD	Mean ± SD	Mean ± SD	Mean ± SD	Mean±SD	Mean±SD	Mean±SD			
functional capacity 6MWT (miter)	351.63 ± 21.02	400.11 ± 26.68	390.40 ± 27.25	262.31 ± 39.96	310.33 ± 47.35	293.21 ± 45.34	217.67 ± 2.52	258.67 ± 22.81	253.33 ± 28.43	25.413 (0.000)*	20.382 (0.000)*	24.780 (0.000)*
t-test (P)1	4.122 (0.001)*			3.059 (0.005)*			2.827 (0.106)					
t-test (P)2	3.307 (0.004)*			1.985 (0.057)			2.030 (0.180)					
perceived dyspnea (Borg Scale)#	2.00 ± 0.93	1.00 ± 0.00	1.60 ± 0.70	6.00 ± 2.00	3.80 ± 2.08	4.93 ± 1.69	9.00 ± 0.00	5.33 ± 1.15	6.67 ± 0.58	24.620 (0.000)*	11.777 (0.000)*	25.909 (0.000)*
t-test (P)1	3.055 (0.018)*			3.004 (0.005)*			5.500 (0.032)*					
t-test (P)2	1.046 (0.311)			1.574 (0.127)			7.000 (0.020)*					

Paired –sample t-test (P)[1]: comparing pre-rehab and 2 months post-rehabilitation (post 1) in each stage.
Paired –sample t-test (P)[2]: comparing pre-rehab and 6 months post-rehabilitation (post 2) in each stage.
Anova test (P)[a]: comparing between stages pre-rehab.
Anova test (P)[b]: comparing between stages 2 months post-rehab. (post 1).
Anova test (P)[c]: comparing between stages 6 months post-rehab. (post 2).
decreased scores denote improvement.
*Significant, at P≤ 0.05

Table (4) shows the functional capacity and perceived dyspnea of patients at 3 levels of disease severity (moderate, severe and very severe) pre and at 2 and 6 months post pulmonary rehabilitation program. Both moderate and severe disease stages showed improvement in functional capacity and perceived exertional dyspnea at 2 and 6 months post rehabilitation program and the improvement reached a statistically significant level at both stages of severity, while very severe stage showed significant improvement only in perceived dyspnea.

Table 5. Effect of pulmonary rehabilitation program on pulmonary function tests of patients at 3 levels of disease severity (moderate, severe and very severe):

Pulmonary function tests	Moderate COPD			Severe COPD			Very severe COPD			*F* $(P)^a$	*F* $(P)^b$	*F* $(P)^c$
	Pre-rehab. N=8	2 months Post rehab. (post 1) N=9	6 months Post rehab. (post 2) N=10	Pre-rehab. N=16	2 months Post rehab. (post 1) N=15	6 months Post rehab. (post 2) N=14	Pre-rehab. N=3	2 months Post rehab. (post 1) N=3	6 months Post rehab. (post 2) N=3			
	Mean±SD	Mean±SD	Mean±SD	Mean±SD	Mean±SD	Mean±SD	Mean±SD	Mean±SD	Mean±SD			
FVC (% Pred.)	81.80±7.89	84.38± 7.19	83.95± 6.89	66.78±8.70	68.16±10.13	66.36 ±9.32	56.87±**9.38**	56.23±**6.43**	56.00±**6.25**	12.333 (0.000)*	14.560 (0.000)*	19.362 (0.000)*
t-test $(P)^1$	0.705 (0.492)			0.407 (0.687)			0.293 (0.707)					
t-test $(P)^2$	0.617 (0.546)			0.127 (0.900)			0.313 (0.784)					
FEV_1 (% Pred.)	63.20±8.25	62.87± 9.13	61.06±9.25	38.80±6.53	38.84 ±6.95	37.82±6.65	27.17±**3.09**	26.80±**1.71**	26.53±**0.50**	44.592 (0.000)*	39.381 (0.000)*	38.568 (0.000)*
t-test $(P)^1$	0.079 (0.938)			0.017 (0.987)			0.382 (0.739)					
t-test $(P)^2$	0.511 (0.616)			0.406 (0.688)			0.417 (0.717)					
FVC/FEV_1 (%Pred.)	63.14±4.07	64.37±4.98	64.06±5.14	55.64 ±2.12	56.80± 2.99	55.66± 2.39	47.57±**3.44**	47.60±**1.87**	47.33±**2.36**	34.723 (0.000)*	25.717 (0.000)*	29.115 (0.000)*
t-test $(P)^1$	0.553 (0.589)			1.249 (0.222)			0.034 (0.976)					
t-test $(P)^2$	0.414 (0.685)			0.016 (0.987)			0.157 (0.890)					

Paired –sample t-test $(P)^1$: comparing pre-rehab and 2 months post-rehabilitation (post 1) in each stage.
Paired –sample t-test $(P)^2$: comparing pre-rehab and 6 months post-rehabilitation (post 2) in each stage.
Anova test $(P)^a$: comparing between stages pre-rehab.
Anova test $(P)^b$: comparing between stages 2 months post-rehab. (post 1).
Anova test $(P)^c$: comparing between stages 6 months post-rehab. (post 2).
*Significant, at $P \leq 0.05$

Table (5) shows pulmonary function tests of patients at 3 levels of disease severity (moderate, severe and very severe) pre and at 2 and 6 months post pulmonary rehabilitation program. Post pulmonary rehabilitation, both FVC and FVC/FEV1 had slightly improved in both moderate and severe disease stage while FEV1 improved only in the severe disease stage but these improvements did not reach a statistically significant level. Very severe stage had lower pulmonary function values both at 2 and 6 months post rehabilitation.

Discussion

Chronic obstructive pulmonary disease is a disease that is not confined to airways and the lungs, but also produces systemic consequences so a multidisciplinary approach must be taken into account. Although there are a variety of drugs that reduce the symptoms of COPD, there is still no treatment that can restore pulmonary functions to a normal, predisease level (GOLD, 2010). Pulmonary rehabilitation is recognized as a cornerstone of COPD treatment: it ameliorates symptoms and exercise capacity, improving health-related quality of life. In the present study the comparison between the outcomes of pulmonary rehabilitation in moderate, severe and very severe stage of COPD was done.

The results of the current study revealed that, there was marked improvement in QOL but this improvement was still out of significance except for activity dimension for moderate and severe stage, while very severe stage showed significant improvement in all dimensions of SGRQ except for symptoms. Clearly, mechanisms that explain improved QOL after pulmonary rehabilitation program go beyond exercise physiology and include improved mood state and increased self-efficacy and confidence. The same results were confirmed in a study conducted in Turkey by Ergün et al (2011), they found that comprehensive pulmonary rehabilitation program in an outpatient setting showed significant improvement in QOL and the improvement reached a statistically significant level and patients had benefited from a program regardless of disease severity. On the other hand, Wedzicha et al (1998) in UK, however, did not find that QOL improved in COPD patients who followed a home –based pulmonary rehabilitation program, even though the patients were supervised by a physical therapist and attributed the lack of benefit to the short duration of the program, the severity of disease and the low intensity of exercise. This is in congruence with a study done in The Netherlands by Hesselink et al (2004) they reported that rehabilitation program, provided by a general practice assistant for patients with asthma and COPD resulted in an improved inhalation technique however it did not show any change in disease symptoms or QOL. They interpreted the result that the participants had mild to moderate symptoms and generally good QOL scores at baseline.

Additionally, the present study showed that, both FVC (% Pred.) and FVC/FEV1 (% Pred.) improved in both moderate and severe stage disease while FEV1 improved only in the severe disease stage but the improvement not reach statistically significant level. This is in accordance with Niederman et al (1991) in USA, Vogiatzis et al (1991) in UK and Karapolat et al (2007) in Turkey who demonstrated that the training benefits of rehabilitation are independent of underlying airflow limitation and rationalized that COPD is a chronic and progressive disease that results in no improvement in pulmonary function and arterial oxygenation with rehabilitation program.

As regard functional capacity, the present study revealed that, walking distance during six minutes time increased significantly after program implementation for both moderate and severe COPD stages denoting functional capacity improvement. This improvement may be attributed to several factors. The first is related to improvement in lung function parameters. The second mechanism, as demonstrated by various authors, points to

an effect of muscle training on neuromuscular coordination (Resqueti et al., 2007). Improvement in this respect would increase an individual's ability to carry out activities of daily living, particularly for the most sedentary patients. The third mechanism to which improved functional capacity in COPD patients is attributed to desensitization of dyspnea during exercise and development of tolerance which may enable patients to perform higher level of work with reduced symptoms (Celli, 2000). Finally the fact that patients in the current study participated in a pulmonary rehabilitation program that included the training of different muscle groups may be additional factor that explains the good response observed. Very severe stage showed improvement in their achieved distance but the improvement did not reach statistically significant level. This may attributed to the limited number of patients with very severe COPD.

Concerning the perception of exertional dyspnea, the results of present study revealed that patients in three stages showed significant decrease (improvement) in their ratings of perceived dyspnea. The possible mechanisms for reduced severity of breathlessness are: increased in lactate threshold, improved skeletal muscle oxidative activity, corresponding fall in ventilatory demands during exercise as a result of enhanced mechanical efficiency and improved respiratory muscle function (Casaburi et al.,1997; Lotters et al., 2002).This is in agreement with the previous studies in this field (Nield et al., 2007; person et al., 2000).

The severe disease stage gained greater improvement in activity dimension of QOL and perceived dyspnea while very severe stage showed significant improvement in impact and total score of SGRQ. Moderate stage gained greater improvement in functional capacity. This could be due to the larger room for improvement that these patients (severe and very severe COPD stage) may have from a pulmonary rehabilitation program: they are often more home bound, have greater limitation to exercise, and suffer from greater dyspnea. These results are in accordance with a study done in France by Beaumont et al (2011) who concluded that all participants benefited from rehabilitation and the most severe benefited the most.

On the other hand, Takigawa et al (2007) in Japan found that late stage COPD (severe and very severe COPD) showed marked improvement in pulmonary functions, functional capacity and arterial blood gases than early stage (mild and moderate COPD). In the same line, Altenburg et al (2011) in The Netherlands concluded that, COPD patients with worse disease status, i.e. lower FEV1, more signs of hyperinflation, lower exercise capacity and worse quadriceps force improved more in endurance exercise capacity after pulmonary rehabilitation and should not be excluded for treatment with pulmonary rehabilitation. Bratås et al (2010) in Norway found that patients with moderate disease were more likely to achieve an improved QOL than patients with severe disease. Wedzicha et al (1998) in UK found that patients with a high degree of dyspnea obtained less benefit from rehabilitation than patients with mild or moderate dyspnea. The authors speculated that it is possible that patients with more severe dyspnea may require longer or more intense training. These results are consistent with the meta-analysis of Salman et al (2003) in USA who concluded that mild and moderate COPD (FEV1 > 35%) patients obtain benefits from short and long rehabilitation programs while severe COPD (FEV1 ≤ 35%) patients need at least 6 month of rehabilitation. Ergün et al (2011) added that FVC improved significantly only in earlier stages of COPD and attributed that to the high degree of hyperinflation in the late disease stages.

Conclusions and recommendations

The results of the current study revealed that, patients with COPD whether in the moderate, severe or very severe COPD stages benefited from pulmonary rehabilitation program. Those patients in severe disease stage gained greater improvement in activity dimension of QOL and perceived dyspnea while very severe stage patients showed significant improvement in impact and total score of SGRQ. Moderate stage patients also gained greater improvement in functional capacity. Further studies with a large number of patients are needed to confirm these findings and that such studied should include other outcome measures, such as the number of exacerbations, the medication used and the cost benefit of home-based pulmonary rehabilitation program. Also, more studies needed to evaluate effectiveness of long-term follow up of pulmonary rehabilitation programs.

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