Home-based pulmonary rehabilitation program: Effect on exercise tolerance and quality of life in chronic obstructive pulmonary disease patients

Maha Ghanem, Enace Abd ELaal¹, Mogedda Mehany², Kawthar Tolba³

Abstract:
BACKGROUND: A key component in the management of chronic obstructive pulmonary disease (COPD) patients is pulmonary rehabilitation (PR), the cornerstone of which is exercise training.
AIM: This study aims to evaluate the effect of a two-months, home-based PR program with outpatient supervision every two weeks, on exercise tolerance and health-related quality of life (HRQL) using Arabic-translated standardized generic and specific questionnaires in COPD patients recently recovered from acute exacerbations.
DESIGN: Randomized clinical trial.
SETTING AND SUBJECTS: A total of 39 COPD patients who recovered from acute exacerbation were randomly allocated either a two-month home-based PR program in addition to standard medical therapy or standard medical therapy alone in the period between July 2008 and March 2009.
METHODS: Pulmonary function tests (PFTs), six-minute walk distance (6-MWD) test, Arabic-translated chronic respiratory disease questionnaire-self administered standardized format (CRQ-SAS) and quality of life scale Short Form (SF-36) were compared between 25 patients with moderate to severe COPD who underwent a two-month PR program (group 1) and 14 COPD patients who did not (group 2).
RESULTS: Group 1 showed significant improvement in the 6-MWD, and HRQL scores at two months compared with the usual care patients in group 2 (P less than 0.05). Improvement in both CRQ-SAS and SF-36 scores were statistically significant and comparable in group 1.
CONCLUSION: The supervised, post discharge, two-month home-based PR program is an effective non-pharmacological intervention in the management of stable patients with COPD. The 6-MWD is a simple, inexpensive and safe test to assess physical and functional capabilities among COPD patients. HRQL can be measured in patients with COPD either by disease-specific tools that have been specifically designed for use in patients with respiratory system disorders or by generic HRQL tools that can be used across populations with a variety of medical conditions. The Arabic-translated CRQ-SAS is a new tool for assessment of Arabic-speaking patients with chronic respiratory diseases.

Key words: Chronic respiratory disease questionnaire - self - administered standardized format, pulmonary rehabilitation, quality of life

Chronic obstructive pulmonary disease (COPD) is characterized by airflow limitation leading to reduced ventilatory capacity and is associated with shortness of breath. Patients with severe airflow limitation and those who experience repeated acute exacerbations usually suffer from impaired quality of life, reduced exercise capacity, and increased risk of readmission. Interventions designed to hasten recovery and improve symptoms after admission to hospital may lead to reduced use of healthcare in future and real improvement in quality of life and functional ability in breathless and vulnerable patients with COPD.¹²

Several publications have reviewed results of PR investigation and concluded that there is substantial evidence that PR improves exercise capacity and shortness of breath.¹³

In patients with COPD, HRQL may be particularly valuable in PR assessment. Few studies have compared the effectiveness of rehabilitation programs with accompanying lectures and different teaching methods for patients with pulmonary disease.¹⁰ In these studies, the effects of PR on HRQL have used disease-specific questionnaires designed for patients with COPD.¹⁵ These tools make it difficult to compare outcomes in studies of patients with COPD to those with other nonpulmonary disorders and some require administration by a trained interviewer. Also, the effects of early PR of outpatients in the acute recovery phase after hospital admission for acute exacerbations of COPD have poorly been studied.
This study was designed to study the feasibility and safety of scheduled early (two months post-discharge from acute exacerbation) home-based PR program with outpatient supervision every two weeks including exercise training and lecture series on exercise capacity and quality of life in patients with COPD. We also investigated the first use and utility of the Arabic-translated Short Form-36 (SF-36), a questionnaire designed to assess generic quality of life\cite{1} in a brief and comprehensive manner, to assess HRQL following PR and to compare that with another specific tool, the Arabic-translated Chronic Respiratory Disease Questionnaire (CRQ).

**Methods**

**Design:** Randomized clinical trial in a group of Arabic-speaking COPD patients.

Local institutional ethics approval was obtained before commencing the study and all enrolled patients gave written informed consent. Between July 2008 and March 2009, we recruited 39 patients admitted to the Chest Department in a tertiary hospital with moderate to severe COPD according to GOLD 2007\cite{2} criteria for diagnosis of COPD.

Inclusion criteria were: Arabic as the first language, age over 40 years, living within local district and ability to complete the CRQ within one session.

Exclusion criteria: Patients unable to read or write, patients with locomotor problems, cognitive impairment, ischemic heart disease, aortic valve disease, cancer or lung diseases other than COPD were excluded.

The first group of patients consisted of 25 patients. In these patients we pilot tested the CRQ formats during the translation and adaptation process after stabilization of their acute illness and before their discharge. During admission period all patients received standard treatment, including nebulized bronchodilators, oxygen, oral or intravenous antibiotics, noninvasive ventilation (if required), and a one to two week course of oral prednisolone (30-40 mg daily). Patients were discharged on optimal medical treatment and received standard follow-up every two week outpatient appointments with a pulmonary specialist.

Before discharge from hospital, patients were randomly allocated to one of the two groups: Group (1) included 25 patients who underwent early pulmonary rehabilitation program as scheduled in addition to medical treatment (rehabilitation group) and group (2) included 14 COPD patients who did not undergo rehabilitation, but were kept on usual medical care for COPD as indicated (control group).

**Pulmonary rehabilitation program**

This study was accomplished in four phases: planning, assessment, implementation and evaluation of COPD patients. The applied post discharge program was based on the assessment phase, review of related literature\cite{3,4,5,6,9,10}, available resources, and patients’ culture and traditions. The objectives of the model were stated. Proper teaching, learning and training aids were developed and methods of evaluation were specified. Detailed contents of the program are summarized as follow:

**Health education and lecture series**

During the hospitalization period, after stabilization of the medical condition of the enrolled COPD patients, and before their discharge, enrolled patients were interviewed four times for about one hour each. The healthy lifestyle lectures included information about normal lung anatomy and physiology, disease pathology, pulmonary medications, oxygen therapy, avoiding environmental irritants, and prevention and management of respiratory infections. Information about the disease, nutrition, proper use of inhalation therapy and general preventive measures were explained. We developed a booklet to present information in a simple way using drawings. The booklet was given to the patients and used as a reminder to support teaching and practicing at home.

**Exercise training**

Before discharge, and after primary assessment measures, patients were taught to perform these exercises and instructed to do them every other day at home over a period of two months. These exercises included:

1. Respiratory muscle training e.g. diaphragmatic breathing and pursed lip breathing.
2. Endurance training (aerobic training e.g. walking and cycling).
3. Strength training and isolated muscle strength training: Upper-extremity training was performed by repetitively raising and lowering a dowel from the height of the waist to the height of the shoulders (using an interval-training regimen with repetitive periods of exercise and rest as tolerated by the patient). Six to 10 upper-body and lower-body strength exercises were used based on demonstrated weakness and fatigue in each individual subject. Stretching of hamstrings, quadriceps, calves, shoulders, neck, and lower back was performed after each exercise session.

**Baseline assessment and measures of outcome**

We made baseline assessments in the 24-hour period before patients were discharged from hospital and assigned to the intervention. These measurements were repeated after two months from patients’ allocation and discharge. We measured exercise capacity by the six minutes walk test. We developed and used the Arabic-version of chronic respiratory disease questionnaire-self-administered standardized format (CRQ-SAS). CRQ is a well validated tool to assess patients with COPD and often used outcome measures in pulmonary rehabilitation studies, to measure disease specific health status. We measured generic health status with the short form, 36 item questionnaire for medical outcomes (SF-36). Baseline PFTs were also measured.

**A six-minute walk test**

During the 6-MWD test, an index of functional capacity, subjects were asked to walk as far as they could in six minutes. As advised in the ATS statement 2002\cite{11} the test was performed on a continuous rectangular hospital corridor. The patient was encouraged during the test with one of three standardized phrases used by specialized nurses every minute. If the patient was receiving oxygen therapy, the nurse carried the oxygen. The test was performed twice to eliminate any potential learning effect. Walks were conducted on the same day, with at least a 30 minutes rest period between tests. The second of the two walk distances walked was measured to the nearest meter and recorded.
Measures for quality of life

The Arabic-translated CRQ-SAS

The CRQ is a self-administered questionnaire developed by Guyatt[12] measuring both physical and emotional aspects of chronic respiratory disease. It is divided into the four domains of fatigue, emotional function, mastery and dyspnea. Patients are to answer each of the 20 questions on a seven-point scale expressing the degree of disability from 1 (maximum impairment) to 7 (no impairment). The questions on the dyspnea domain are individualized, in that, patients identify five important daily activities, and report their degree of dyspnea on those activities. Higher total score and sub scores on categories indicate better health related quality of life. A change in the score (calculated by dividing the overall score by the number of items) of 0.5 on the seven-point scale, reflects a clinical significant small change. A change of 1.0 reflects a moderate change and a difference of 1.5 represents a large change.[13] Use of the CRQ, authored by Drs. Gordon Guyatt and Holger Schünemann was made under license from McMaster University, Hamilton, Canada.

Translation and instrument development

We followed a sequential forward and backward translation approach. Two translators independently translated the English self-administered CRQ (CRQ-SA) into Arabic. On agreement on first version, we then pilot tested this version on five patients to identify difficulties in understanding. In addition, we tested various possible wordings of items, answer choices and instructions if the translation team considered more than one possible version. A translator with experience in biomedical sciences but unaware of the original English CRQ performed a back translation of the Arabic CRQ formats into the source language (English). A team of McMaster University investigators compared the back translation with the English CRQ to check for conceptual discrepancies. The translation team discussed comments from these patients and finally decided on any modifications.

Arabic-translated medical outcomes study - 36-item short form MOS (SF-36) quality of life scale

The SF-36 incorporates 36 items and yields eight separate sub scales.[7] The validated Arabic version of the questionnaire has been used in evaluation of QOL in patients with different chronic diseases,[14-18] but never in the evaluation of Arabic-speaking COPD patients. The questionnaire include questions related to physical functioning (10), social functioning (two), role limitations due to physical problems (four), role limitations relating to emotional problems (three), mental health (five), vitality (energy/fatigue - four), pain (two), general health perceptions (five), and change in health (one). Each sub scale score ranges from 0 to 100, with 100 representing the most desirable score. The SF-36 required about 10 minutes of the patient’s time and was administered during the initial patient evaluation prior to the start of pulmonary rehabilitation and at the end of 3 weeks during the final visit with the patient.

Both questionnaires on quality of life were used twice; at the beginning and end of the study period.

Spirometry

Spirometry was performed using computerized Sensor Medicus Corporation Machine (CAT No. 752609, SER 54065).

A standard method for test performance and interpretation was used as recommended by the American Thoracic Society (ATS).[19] Forced vital capacity (FVC), forced expiratory volume in first second (FEV1), forced expiratory flow (FEF25-75%) and FEV1/FVC were measured. The results were then expressed as percentage of predicated normal values for each subject after adjustment for age, sex and height.

Blinding

Owing to the nature of the intervention, it was not possible to blind patients or assessors. The assessors were either the investigator responsible for assignment or members of the pulmonary rehabilitation team including the pulmonary specialist and the specialized nurses who were involved in the delivery of the intervention.

Statistical analysis

Numerical values are presented as mean plus/minus (SD) unless otherwise stated. Chi square or the Fisher’s exact test, if cell sizes are small, was used in the 2 × 2 data. We compared mean values of mean differences between groups for CRQ, and SF-36 scores using the Student t test. We analyzed data on an intention to treat basis. Paired t tests were used to determine if the SF-36 scores, CRQ, PFTs measures and distance walked in six minutes differed before and after rehabilitation. All tests were two-tailed unless otherwise stated, and P values < 0.05 were required for statistical significance.

All statistical analyses were performed using statistical software (SPSS version 11) and the on line Epi-calc 2000 for test of proportions calculations.

Results

Baseline demographic and clinical data of all participants are presented in Table 1; both groups were comparable as regards age, residence, smoking history, duration and severity of the disease.

Table 2 shows baseline and two months data of SF-36 scales in the pulmonary rehabilitation group (group 1) and usual care control group (group 2). As regard the overall change in health scale; group 1 shows statistically very significant improvement between time of enrolment and after the two months PR program (<0.001), meanwhile in group 2, the mean score of the change in health tended to get lower. Concerning the four scales of the physical component; apart from general health sub scale, three of the physical components sub scales (physical function, role physical and pain) showed statistically very significant improvement in rehabilitation group at the end of the PR program (<0.001) and none of the physical components’ sub scales showed significant improvement by the end of the two months usual care in group 2 (P > 0.05). Mental component has four sub scales. Same Table shows that only the vitality and role of emotions out of the four scales of mental component showed improvement in group 1 following the PR program (P<0.05, P<0.001 consecutively). Despite that emotional well being and social function scores were higher after PR program, this did not reach statistically significant value (P>0.05). In group 2, none of the mean mental sub-scale scores showed improvement and higher values compared to their baseline values.
Table 1: Socio-demographic and clinical data of participated COPD patients

| Item                                | Group 1 rehabilitation group N = 2 (%) | Group 2 usual care control group N = 14 (%) | Total N = 39 (%) | P value |
|-------------------------------------|----------------------------------------|---------------------------------------------|------------------|---------|
| Age (Mean±SD)                       | 56.96 ± 11.59                          | 56.43 ± 9.03                                | 0.88             |
| Residence                           |                                        |                                             |                  |         |
| Urban                               | 11 (44.0)                              | 2 (14.3)                                    | 13 (33.3)        | 0.062   |
| Rural                               | 14 (56.0)                              | 12 (85.7)                                   | 26 (66.7)        |         |
| Smoking                             |                                        |                                             |                  |         |
| Non smoker                          | 1 (4.0)                                | 1 (7.1)                                     | 2 (5.1)          | 0.37    |
| Mild (0-10 pack/year)               | 6 (24.0)                               | 4 (28.6)                                    | 10 (25.6)        | 0.47    |
| Moderate (10-20 pack/year)          | 11 (44.0)                              | 6 (42.9)                                    | 17 (43.6)        | 0.39    |
| Heavy (> 20 pack/year)              | 7 (28.0)                               | 3 (21.4)                                    | 10 (25.6)        | 0.47    |
| Duration of illness (years)         |                                        |                                             |                  |         |
| <10                                 | 10 (40)                                | 8 (57.1)                                    | 18 (46.2)        | 0.24    |
| 10-20                               | 10 (40)                                | 4 (28.6)                                    | 14 (35.9)        | 0.36    |
| 20-25                               | 5 (20)                                 | 2 (14.3)                                    | 7 (17.9)         | 0.50    |
| Severity of disease                 |                                        |                                             |                  |         |
| Moderate                            | 22 (88)                                | 10 (71.4)                                   | 32 (82)          | 0.19    |
| Severe                              | 3 (12)                                 | 4 (28.6)                                    | 7 (18)           | 0.19    |
| Grades of dyspnea at time of enrolment |                                        |                                             |                  |         |
| II                                  | 1 (7.1)                                | 3 (12.0)                                    | 4 (10.3)         | 0.47    |
| III                                 | 11 (78.6)                              | 22 (88.0)                                   | 33 (84.5)        | 0.38    |
| IV                                  | 2 (14.3)                               | 0 (0)                                       | 2 (5.1)          | 0.18    |
| Amount of sputum                    |                                        |                                             |                  |         |
| Small                               | 5 (35.7)                               | 6 (24)                                      | 11 (28.2)        | 0.35    |
| Moderate                            | 5 (35.7)                               | 8 (32)                                      | 13 (33.3)        | 0.45    |
| Large                               | 4 (28.6)                               | 11 (44)                                     | 15 (38.5)        | 0.27    |
| Cor pulmonale                       |                                        |                                             |                  |         |
| No                                  | 17 (68.0)                              | 8 (57.1)                                    | 25 (64.1)        | 0.37    |
| Compensated                         | 7 (28.0)                               | 5 (35.76)                                   | 12 (30.8)        | 0.44    |
| De-compensated                      | 1 (4)                                  | 1 (7.1)                                     | 2 (5.1)          | 0.37    |
| Respiratory failure                 |                                        |                                             |                  |         |
| No                                  | 8 (57.1)                               | 7 (28.0)                                    | 15 (38.5)        | 0.08    |
| Yes                                 | 6 (42.9)                               | 18 (72.0)                                   | 24 (69.2)        |         |
| Maintenance therapy                 |                                        |                                             |                  |         |
| Oral bronchodilators                |                                        |                                             |                  |         |
| No                                  | 3 (12.0)                               | 0 (0)                                       | 3 (7.7)          | 0.23    |
| Yes                                 | 22 (88.0)                              | 14 (100.0)                                  | 36 (92.3)        |         |
| Inhaled bronchodilators             |                                        |                                             |                  |         |
| No                                  | 11 (44.4)                              | 3 (21.4)                                    | 14 (35.9)        | 0.14    |
| Yes                                 | 14 (56.0)                              | 11 (78.6)                                   | 25 (71.8)        |         |
| Oral corticosteroids                |                                        |                                             |                  |         |
| No                                  | 1 (4.0)                                | 0 (0)                                       | 1 (2.6)          | 0.38    |
| Yes                                 | 24 (96.0)                              | 14 (100)                                    | 38 (97.4)        |         |

COPD = Chronic obstructive pulmonary disease

Table 2: Baseline and two months medical outcomes study 36-items’ short form MOS (SF-36) scales

| SF-36 scale                        | Enroll                  | 2 months                | P value | Enroll                  | 2 months                | P value |
|------------------------------------|-------------------------|-------------------------|---------|-------------------------|-------------------------|---------|
| Change in health                   | 46.00 ± 11.81           | 76.00 ± 8.78            | < 0.001 | 35.71 ± 6.16            | 33.53 ± 14.62           | 0.71    |
| Physical component                 |                         |                         |         |                         |                         |         |
| Physical function                  | 30.64 ± 10.45           | 75.08 ± 14.31           | < 0.001 | 25.86 ± 26.44           | 28.58 ± 27.51           | 0.79    |
| Role physical                      | 19.00 ± 29.12           | 64.00 ± 26.10           | < 0.001 | 5.43 ± 14.58            | 7.14 ± 18.16            | 0.79    |
| Pain                               | 37.20 ± 6.14            | 61.20 ± 11.30           | < 0.001 | 25.00 ± 9.41            | 28.01 ± 8.14            | 0.37    |
| General health                     | 46.00 ± 9.90            | 52.00 ± 9.68            | 0.04    | 36.43 ± 7.19            | 34.17 ± 6.12            | 0.38    |
| Mental component                   |                         |                         |         |                         |                         |         |
| Mental health (emotional well-being)| 47.36 ± 5.12           | 48.00 ± 5.66            | 0.68    | 39.14 ± 0.07            | 36.15 ± 4.17            | 0.31    |
| Social function                    | 50.72 ± 15.90           | 54.76 ± 13.12           | 0.33    | 44.93 ± 10.44           | 40.39 ± 4.34            | 0.15    |
| Role emotional                     | 3.96 ± 10.94            | 96.00 ± 20.00           | < 0.001 | 14.29 ± 36.31           | 13.27 ± 33.37           | 0.94    |
| Energy/fatigue (vitality)          | 50.80 ± 9.65            | 79.60 ± 10.89           | < 0.05  | 46.79 ± 8.23            | 44.78 ± 7.33            | 0.50    |

Table 3 shows baseline and two months outcome data of the two studied groups; the pulmonary rehabilitation group (group 1) and usual care control group (group 2). By the end of the study, COPD patients who underwent two months of PR program in group 1 had statistically significant increase in their achieved six minutes walk distance compared to their baseline measures (P < 0.05) meanwhile the mean distance achieved by patients in the usual care group 2 was even less than their baseline values, however this decrease did not reach statistically significant value. Notably, there was also
**Table 3: Baseline and two months six minutes walk distance of the two studied groups of COPD patients**

| Outcome measure | Group 1 (Rehabilitation group) N = 25 | Group 2 (Usual care control group) N = 14 | Mean differences between groups (95% CI) | P value |
|-----------------|-------------------------------------|------------------------------------------|------------------------------------------|---------|
| Six minutes walk distance in meters | Enroll | 2 months | Enroll | 2 months | | |
| Mean ± SD | 88.79 ± 19.14 | 141.71 ± 23.11 | 83.79 ± 15.9 | 86.56 ± 32.11 | 58.15 ± 11.23 | < 0.001^* |
| Chronic respiratory disease questionnaire^f | | | | | | |
| Dyspnea (range 5-35) | 11.8 ± 5.0 | 19.6 ± 5.2^* | 12.4 ± 4.4 | 13.5 ± 4.3 | 5.5 (3.9-9.0) | 0.003^* |
| Fatigue (range 4-28) | 9.8 ± 2.8 | 17.4 ± 5.4^* | 11.6 ± 6.1 | 13.2 ± 5.1 | 5.3 (1.9-9.8) | 0.004^* |
| Emotion (range 7-49) | 22.1 ± 5.8 | 33.5 ± 7.2^* | 27.0 ± 12.6 | 29.7 ± 11.4 | 8.7 (2.5-15.0) | 0.008^* |
| Short form 36 (range 0-100)^g | | | | | | |
| Physical component | 30.6 ± 14.2 | 56.3 ± 24.0^* | 40.6 ± 21.9 | 47.2 ± 24.2 | 20.1 (3.3-36.8) | 0.02^f |
| Mental component | 26.3 ± 14.6 | 39.0 ± 20.0^* | 30.4 ± 19.9 | 32.4 ± 22.2 | 10.6 (-0.3-21.6) | 0.047^f |
| Pulmonary function tests (spirometry) | | | | | | |
| FVC (L/min) | 1.37 ± 0.50 | 1.42 ± 0.59 | 1.09 ± 0.41 | 0.98 ± 0.20 | 0.44 (0.11-0.77) | 0.01^f |
| FVC (% pred) | 36.24 ± 14.17 | 40.4 ± 16.16 | 29.0 ± 10.91 | 26.57 ± 7.13 | 13.83 (2.5-14.9) | 0.00^f |
| FEV1 (L/min) | 0.80 ± 0.35 | 0.83 ± 0.52 | 0.62 ± 0.18 | 0.64 ± 0.20 | 0.19 (-0.1-0.48) | 0.21^f |
| FEV1 (% pred) | 29.44 ± 13.14 | 29.92 ± 20.21 | 23.21 ± 7.70 | 23.14 ± 7.56 | 6.78 (-5.01-18.57) | 0.25^f |

^*Data expressed as mean score (SD); ^fincreased score denotes improvement; P < 0.05 between baseline and two months in rehabilitation group using paired t test; ^gP < 0.01 between group 1 and group 2 after two months of enrolment using unpaired t tests; ^§P < 0.01 between group 1 and 2 after two months of enrolment using unpaired t tests; ^§§P < 0.05 enroll vs 2 months in group two using paired t tests; ^†P < 0.05 between group 1 and 2 after two months of enrolment using unpaired t tests; ^§§P > 0.05 between group 1 and 2 after two months of enrolment using unpaired t tests, COPD = Chronic obstructive pulmonary disease

**Discussion**

Hospital admission for acute exacerbation of COPD is an enormous financial burden to health service. The current evidence shows that PR provides significant benefits to patients.[1-6,9,21]

The baseline measurements of age and disease severity of this sample of COPD patients included in this study were similar to those of other studies assessing PR. The baseline scores for the CRQ and the SF-36 were also similar to those measured in individuals with COPD in previous studies.[1,2,4,9,10,20]

This study proves that early PR in the recovery period after hospital discharge following an admission for an acute exacerbation of COPD leads to significant improvement in functional capacity and QOL in those patients. It adds that either the commonly used specific (CRQ) or generic (SF-36) quality of life tools could be used as an outcome measure for quality of life; hence, broadening of the comparison between patients with various chronic diseases would be feasible.

**Comparison with other studies**

Excellent evidence supports the benefits of PR in stable patients with COPD.[1,3,4,20,22] Nevertheless, it is not yet widely utilized in many developing countries.[23] This study examines the effects of this intervention in patients during the early recovery period after a hospital admission for an acute exacerbation. Despite optimal medical treatment during hospital admission, patients at discharge take considerable time to recover to baseline levels of physical functioning and health status. Previous studies have shown that up to 25% of patients after acute exacerbations do not fully recover to baseline peak flow at three months[24] and that the recovery period in health status is long even in patients who do not have further exacerbations.[25] Our data indicates that patients can safely participate in a supervised, home-based PR program shortly after an exacerbation and that such a program speeds up recovery from the debilitating effects of a hospital admission. Furthermore, the magnitude of the effects of early PR on exercise capacity and health status are considerably great.
A few studies investigated exercise training after an acute exacerbation of COPD. Man et al. studied the effects of three-month PR program on an outpatient basis and the likelihood of financial benefit to the health service. Early PR, compared with usual care, led to significant improvement in median incremental shuttle walk distance, St. George’s Respiratory Questionnaire, CRQ the mental component of the SF-36 score. Also, Behnke et al. looked at the effects of an initial, 10-day, inpatient training program, followed by six months of supervised home training, compared with usual care, in patients admitted for an acute exacerbation of COPD. They showed improvement in six-minute walking distance and sum scores on the questionnaire on chronic respiratory disease at three months and six months after training compared with control. However, such a program would not be viable in terms of manpower or finance. In contrast, especially in a low income country, two months scheduled home-based PR program with outpatient supervision every two weeks is a more realistic option to save healthcare resources. Previous data support the cost effectiveness of home-based PR program and the likelihood of improvement in the functional status and quality of life that would in turn have positive impact on health service.

**Six-minute walk test**

In patients with chronic lung disease, the minimal clinically important improvement in 6MWD has been reported to be 54 m. A meta-analysis of PR participants has shown a similar minimal clinically relevant increase in 6MWD distance 55.7 m.

We found a statistically significant improvement in 6-MWD after rehabilitation, which has also been demonstrated in previous studies, signifying improvement in patients’ functional status. By the end of two months from enrolment, the rehabilitation group showed statistically significant improvement in 6-MWD compared with their baseline value (52.62 ± 11.2). The mean difference in walk distance between the rehabilitation group compared to usual care control group was (58.15 ± 11.23).

Several factors may influence the 6MWD in healthy individuals and in COPD patients. Patient’s height, spirometric parameters and diffusion capacity correlates with the achieved 6-min walk distance. Also, body weight, age, mental health, and comorbidities can affect the test results in elderly individuals. The sensation of breathlessness (dyspnea) and poor nutritional state are manifestations of COPD that can also reduce 6MWD. Muscle strength in the lower limbs has been previously shown to be an important factor in determining the 6MWD. In addition, when the primary respiratory muscles are dysfunctional or cannot meet the ventilatory demand, muscles whose principal function is to maintain posture may assume an accessory muscle function. The trapezius, latissimus dorsi, pectoralis major, and serratus anterior can all function as inspiratory muscles.

There was minor clinically significant improvement in the six- minute walk distance following PR, yet, the average walk distance of the cohort is still considered very short. This apparently short distance might be attributed to the facts mentioned above and the facts that enrolled patients were at advanced stage of their illness, many of them were in grade III or IV, and they were just coming out of an acute exacerbation of their chronic illness. Also, at time of enrolment, 69.2% had respiratory failure and 35.9% had decompensated cor pulmonale which might be additional factors contributing to the short distance achieved by patients with chronic illness. Also, the end point of assessment of the patients was by the end of two months from enrolment, and possibly this outcome might has been differed if we applied the program for longer period or if the patients were assessed at multiple/longer terms. Moreover, as we mentioned above, we had no control over the level of intensity of the exercise practiced at home, where some of the patients practiced lower intensity exercise regimens that might have an effect on the overall mean six-minute walk distance of others who practiced in higher intensity. However, similar minimal clinically relevant increase in 6MW distance has been demonstrated by other investigators.

**Health related quality of life**

By the end of the study, the differences between group 1 that underwent the two-month PR program and group 2 were statistically and clinically significant for all CRQ domains, SF 36 physical and mental components.

**CRQ**

It is necessary that change after an intervention be clinically important as well as statistically significant. Jaeschke et al. defined the minimally clinically important difference as “the smallest difference in score in the domain of interest which patients perceive as beneficial.” This is the first study to use the Arabic-translated CRQ-SA. The CRQ demonstrated changes that were calculated to be clinically important in both the physical function and emotional function components. The improvement noted in QOL, as measured by the physical function categories of the CRQ, was consistent with the changes found in previous studies of pulmonary rehabilitation using the CRQ. In addition to improvement in physical function, the CRQrecorded changes in emotional function that were also consistent with those from previous studies.

The original CRQ does not address the ability of an individual to perform activities that are routinely performed in daily life, such as walking, climbing stairs, dressing or bending. This may be a limitation of the earlier questionnaire. However, the CRQ-SA questionnaire uses standardized dyspnea domains. The standardized dyspnea domains produce higher cross-sectional correlations than the individualized dyspnea domains. This finding is important because it indicates that the standardized CRQ dyspnea domain allows for better discrimination between different degrees of COPD severity. Also, the SF-36 addressed physical ability. Thus, we believe that the use of both questionnaires in our study broadened the content validity of the quantitative aspect of the QOL assessment. This concept actually is in agreement with other authors conclusions from previous studies.

**SF-36**

Patients in group 1 showed both statistically and clinically significant improvements in SF-36 physical and mental components summary scores from PR entry to two months of PR participation.

Three of the physical component sub scales (physical function,
role physical on limitation of activities and pain) showed statistically significant improvement in rehabilitation group; meanwhile, only the vitality and role of emotions out of the four scales of mental component showed improvement in the mental function component. The overall change in health was significantly improved in rehabilitation group ($P < 0.001$).

Some investigators noted that PR participants perceive greater impairment in the physical aspects of their health rather than in the mental aspects, and that they show greater physical improvements rather than psychosocial improvements following both short-term and long-term PR. Our findings are similar to those of Benzo et al. - SF-36 physical and mental component summary scores to improve in 22 patients with COPD following six weeks of supervised outpatient PR. Our patients had baseline mental component summary scores nearly similar to those of Benzo et al. with mean scores in the 30s. Nevertheless, we observed mental improvement to a smaller extent after two months of participation in PR program. These small improvements may have been because psychosocial improvements may take longer to be appreciated than physical improvements in PR participants. Also, on comparing the two questionnaires, the key difference between them was that the CRQ asked the individual to measure fear, panic and anxiety when short of breath, as well as the individual’s sense of control and confidence over COPD. In contrast, the SF-36 had no questions that related to dyspnea, panic or gaining control. It is likely that the questionnaire could not detect these changes, which may account for the relative lack of responsiveness of the mental health summary component of the SF-36.

**Spirometry**

Despite that $\text{FEV}_1$, $\text{FEV}_1\%$ of predicted, FVC and FVC% of predicted improved slightly in group 1 following the two-month rehabilitation program, this improvement was significant for FVC and FVC% predicted but not statistically significant for $\text{FEV}_1\%$ of predicted. This agrees in part with the previous study of Safwat et al. who reported that there was significant change in FVC, FVC%, $\text{FEV}_1$ and $\text{FEV}_1\%$ after the rehabilitation program related to that the anabolic steroid which was added to exercise rehabilitation program.

**Limitations**

First, this study was confined to the immediate benefits of PR program applied for COPD patients following recent acute exacerbation. It did not measure the effect of this program on frequency of exacerbations, rate of re admissions to the hospital or the long term effect.

Also, we had no control over the level of intensity of the exercise practiced at home. While some patients could have incorporated higher intensity, others may have employed lower intensity exercise regimens. However, studies have shown that both low-intensity and high-intensity exercise training improves QOL and physical performance parameters in patients in PR programs. Thus, looking at the variation in exercise intensity practiced by the patients may not have played a significant role in this respect.

Lastly, the cohort of this study was small because only patients literate enough to complete the questionnaires by themselves were included. Despite that this is the first study to use the Arabic translation version of CRQ-SA and SF-36 in COPD patients, and because of the limited number of patients included in this study, it would be worthwhile if those two Arabic assessment tools be validated in another study with higher number of patient, and to add other interviewer- administered tools like CRQ-IA to be able to assess any patients with chronic respiratory diseases, regardless their levels of educations in any future Arabic studies.

**Conclusions**

Despite medical optimization during hospital admission for acute exacerbations of COPD, early PR after discharge from hospital leads to additional notable improvements in exercise capacity and health status at two months compared with usual care. The 6MWD is a simple, inexpensive, reliable and safe test to assess physical and functional capabilities among COPD patients. HRQL can be measured in patients with COPD either by disease-specific tools that have been specifically designed for use in patients with respiratory system disorders or by generic HRQL tools that can be used across populations with a variety of medical conditions allowing comparison of the results of pulmonary rehabilitation to therapeutic interventions in patients with other medical disorders.

Larger randomized studies are required to determine translation of benefits of early pulmonary rehabilitation into improved health economics. Other unanswered questions include long term effects of early PR, and the optimal structure, location, and duration of PR program in low income countries.

**Abbreviations**

Chronic Obstructive Pulmonary Disease = COPD; Pulmonary Rehabilitation = PR; 6 MWD = six-minute walk distance; CRQ = Chronic Respiratory Disease Questionnaire; CRQ-SAS = chronic respiratory disease questionnaire-self-administered standardized format; QOL = quality of life; HRQL = health-related quality of life; SF-36 = Short form-36 = MOS (SF-36) = Medical Outcomes Study 36-item short form; PFTs = pulmonary function tests; ABGs = arterial blood gases

**Acknowledgment**

Use of the CRQ-SAS, authored by Drs. Gordon Guyatt and Holger Schüemann was made under license from McMaster University, Hamilton, Canada. We would like to thank Peggy Austin (McMaster University) for her advice and help through out forwards and backwards Arabic translation process of CRQ-SAS.

**References**

1. Boueri FM, Bucher-Bartelson BL, Glenn KA, Make BJ. Quality of life measured with a generic instrument (Short-Form-36) improves following pulmonary rehabilitation in patients with COPD. Chest 2001;119:77-84.
2. Man WD, Polkey MI, Donaldson N, Gray BJ, Moxham J. Community pulmonary rehabilitation after hospitalisation for acute exacerbations of chronic obstructive pulmonary disease: Randomised controlled study. BMJ 2004;329:1209.
3. Ries AL, Bauldoff GS, Carlin BW, Casaburi R, Emery CF, Mahler DA, et al. Pulmonary Rehabilitation; Joint ACCP/AACVPR Evidence-Based Clinical Practice Guidelines. Chest 2007;131:48-42S.
4. Norweg AM, Whiteson J, Malgady R, Mola A, Rey M. The effectiveness of different combinations of pulmonary rehabilitation program components: a randomized controlled trial. Chest 2005;128:663-72.
5. Wijkstra PJ, van Altena R, Kraan J, Otten V, Postma DS, Koëter GH. Quality of life in patients with chronic obstructive pulmonary disease improves after rehabilitation at home. Eur Respir J 1994;7:269-73.

6. Wedzicha JA, Bestall JC, Garrod R, Garnham R, Paul EA, Jones PW. Randomized controlled trial of pulmonary rehabilitation in severe chronic obstructive pulmonary disease patients, stratified with the MRC dyspnoea scale. Eur Respir J 1998;12:363-9.

7. Ware JE Jr, Sherbourne CD. The MOS 36-Item Short-Form Health Survey (SF-36). Med Care 1992;30:473-82.

8. Rabe KF, Hurd S, Anzueto A, Barnes PJ, Buist SA, Calverley P, et al. Global strategy for the diagnosis, management, and prevention of chronic obstructive pulmonary disease: GOLD Executive Summary. Am J Respir Crit Care Med 2007;176:532-55.

9. Vogtlatzis I, Andrew FW, Joanne M, Ian KT. Physiological response to moderate exercise work loads in a pulmonary rehabilitation program in patients with varying degrees of airflow obstruction. Chest 1999;116:1200-7.

10. Safwat T, Abd ELSabour M, Fargaly A, Mansour M, Moustafa Y, Aly M. Cardiac-pulmonary exercise test in assessment of COPD patients undergoing rehabilitation programme. Egyptian J of Chest Dis and Tuber 2004;53:64-74.

11. ATS Statement: Guidelines for the Six-Minute Walk Test. Am J Respir Crit Care Med 2002;166:111-7.

12. Guyatt GH, Berman LB, Townsend M, Pugsley SO, Chambers LW. A measure of quality of life for clinical trials in chronic lung disease. Thorax 1987;42:773-8.

13. Redelmeier DA, Guyatt GH, Goldstein RS. Assessing the minimal important difference in symptoms: A comparison of two techniques. J Clin Epidemiol 1996;49:1215-9.

14. Hoopman R, Terwee C, Muller A, Aaronson NK. Translation and validation of the SF-36 health survey for use among Turkish and Moroccan ethnic minority cancer patients in The Netherlands. Eur J Cancer 2006;42:2982-90.

15. Mrabet H, Mrabet A, Zouari B, Ghacem R. Health-related quality of life of people with epilepsy compared with a general reference population: A Tunisian study. Epelepsia 2004;45:838-43.

16. Sabbah AI, Drougy N, Sabbah S, Retel-Rude N, Mercier M. Quality of life in rural and urban populations in Lebanon using SF-36 health survey. Health Qual Life Outcomes 2003;1:30.

17. Ibrahima S, El Salamony O. Depression, quality of life and malnutrition-inflammation scores in hemodialysis patients. Am J Nephrol 2008;31:473-82.

18. Schwarzinger M, Debrunner M, Bittner V, Tracy RP, McNamara R, Arnold A, et al. The 6-min walk test: A quick measure of functional status in elderly adults. Chest 2003;123:387-98.

19. Wegner RE, Joares RA, Kirsten DK, Magnussen H. Factor analysis of exercise capacity, dyspnoea ratings and lung function in patients with severe COPD. Eur Respir J 1994;7:725-9.

20. Oga T, Nishimura K, Tsukino M, Hajiroyo T, Ikeda A, Mishima M. Relationship between different indices of exercise capacity and clinical measures in patients with chronic obstructive pulmonary disease. Heart Lung 2002;31:374-8.

21. Palange P, Forte S, Felli A, Galassetti P, Serra P, Carlone S. Nutritional state and exercise tolerance in patients with COPD. Chest 1995;107:1206-12.

22. Gosselink R, Troosters T, Decramer M. Peripheral muscle weakness contributes to exercise limitation in COPD. Am J Respir Crit Care Med 1996;153:976-80.

23. American Thoracic Society-European Respiratory Society. Skeletal muscle dysfunction in chronic obstructive pulmonary disease. Am J Respir Crit Care Med 1999;159:1-28.

24. American Thoracic Society-European Respiratory Society. Respiratory muscle testing. Am J Respir Crit Care Med 2002;166:518-624.

25. Epstein SK. An overview of respiratory muscle function. Clin Chest Med 1994;15:619-39.

26. Jaeschke R, Singer J, Guyatt GH. Measurement of health status: Ascertaining the minimal clinically important difference. Control Clin Trials 1989;10:407-15.

27. Camp PG, Appleton J, Reid DW. Quality of life after pulmonary rehabilitation: Assessing change using quantitative and qualitative methods. Phys Ther 2000;80:986-95.

28. Puhan MA, Behnke M, Frey M, Grueter T, Brandli O, Lichtenschofl A, et al. Self-administration and interviewer-administration of the German Chronic Respiratory Questionnaire: Instrument development and assessment of validity and reliability in two randomised studies. Health Qual Life Outcomes 2004;2:1.

29. Benzo R, Flume P, Turner D, Tempest M. Effect of pulmonary rehabilitation on quality of life in patients with COPD: The use of SF-36 summary scores as outcomes measures. J Cardiopulm Rehabil 2002;20:231-4.

30. Normandin EA, McCusker C, Connors M, Vale F, Gerardi D, ZuWallack RL. An evaluation of two approaches to exercise conditioning in pulmonary rehabilitation. Chest 2002;121:1085-91.

Source of Support: Nil, Conflict of Interest: None declared.