Impact of Pulmonary Rehabilitation on Psychosocial Morbidity in Patients With Severe COPD*

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Study objective: To assess the effect of pulmonary rehabilitation (PR) on psychosocial morbidity, functional exercise capacity, and health-related quality of life (HRQL) in patients with severe COPD.

Design: A prospective, randomized, controlled trial with blinding of outcome assessment and data analysis.

Setting: A tertiary-care respiratory service.

Patients: Forty patients (mean age, 65 ± 8 years [± SD]) with severe chronic flow limitation (FEV1, 35 ± 13%) without respiratory failure (PaO2, 72 ± 9 mm Hg; PaCO2, 42 ± 5 mm Hg) were randomized either to a control group or to a PR group (PRG).

Interventions: Sixteen weeks of PR that included breathing retraining and exercise.

Measurements: At baseline and 16 weeks, we evaluated psychosocial morbidity using two questionnaires (the Millon Behavior Health Inventory [MBHI] and the Revised Symptom Checklist [SCL-90-R]) and measured 6-min walk distance (6WMD) and HRQL using the Chronic Respiratory Questionnaire (CRQ).

Results: We found differences in favor of the PRG in the following MBHI domains: introversive, forceful, and sensitive personality styles (all p ≤ 0.05) and chronic tension (p ≤ 0.01). Results of the depression, hostility, global severity, positive symptom distress index (all p ≤ 0.01), somatization, anxiety, psychoticism, and positive symptom (all p ≤ 0.05) domains of the SCL-90-R favored the PRG. We also found statistically and clinically significant differences between groups in 6MWD (85 m; p < 0.01) and in two domains of the CRQ: dyspnea (1.0; p < 0.01) and mastery (0.6; p < 0.05). The other two domains of CRQ showed strong trends in favor of PRG: 0.7 for both fatigue and emotional function (minimal important difference, 0.5).

Conclusions: PR may decrease psychosocial morbidity in COPD patients even when no specific psychological intervention is performed. Findings from this study also confirm the positive impact of PR on functional exercise capacity and HRQL.

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Key words: COPD; effort capacity; health-related quality of life; psychological tests; pulmonary rehabilitation

Abbreviations: CG = control group; CRQ = chronic respiratory questionnaire; GSI = global severity index; HRQL = health-related quality of life; MBHI = Millon Behaviour Health Inventory; 6MWD = 6-min walk distance; PR = pulmonary rehabilitation; PRG = pulmonary rehabilitation group; PSDI = positive symptom distress index; PST = positive symptom total; SCL-90-R = Revised Symptom Checklist

COPD leads to a persistent decrease in functional capacity and quality of life. The reduction in physical capacity is frequently associated with psychological impairment and morbidity, including anxiety and depression. Many randomized trials have shown that pulmonary rehabilitation (PR), although it cannot improve pulmonary function, results in important benefits in health-related quality of life (HRQL) and dyspnea during daily activities. These benefits suggest that PR might also reduce psychological morbidity resulting from the illness.

Several studies have evaluated psychosocial interventions in COPD patients, but few have analyzed the impact of PR on psychosocial issues when no specific psychosocial interventions are performed. The studies that have examined psychological issues have focused on the effects of PR on depression and anxiety. The results of these studies are
controversial. Some\textsuperscript{10,15} have suggested that PR programs reduce anxiety and depression, while others\textsuperscript{11} did not show differences. No studies have yet addressed the impact of PR without specific psychological intervention on psychosocial morbidity other than depression and anxiety.

Results of a previous randomized trial\textsuperscript{16} conducted in our center demonstrated that a COPD PR program improves exercise capacity and HRQL. Because we cannot accommodate a large number of patients eligible for rehabilitation, we built on these results with a randomized trial designed to evaluate the effect of PR without any specific psychological intervention on psychosocial morbidity, as well as on effort capacity and HRQL in patients with severe COPD.

**Materials and Methods**

**Patients**

We enrolled consecutive eligible patients with COPD\textsuperscript{1} at our outpatient clinic. Inclusion criteria were as follows: age $\leq 75$ years; FEV$_1$ $< 70\%$ of reference values; FEV$_1$/FVC ratio $< 65\%$, Pa$_{O_2}$ $> 55$ mm Hg at rest, no indications for home oxygen therapy, and no exacerbation or hospitalization in the previous 2 months. Exclusion criteria were psychiatric disturbances, heart disease, or relevant bone or joint disease. The hospital ethics committee approved the study, and all patients provided written informed consent.

**Study Design**

In this prospective, randomized trial, patients were allocated either to a control group (CG) or to a PR group (PRG). Randomization was not concealed, but the likelihood of bias introduced by uncontrolled randomization was reduced by recruitment of consecutive patients. Medical treatment for patients in both groups, including salbutamol, ipratropium bromide, and inhaled budesonide, was established before the first visit and remained unchanged throughout the study. In response to an exacerbation, we added antibiotics ($\beta$-lactam or macrolide agents) if a respiratory infection was the cause, and oral steroids (prednisone) if dyspnea had increased. After an exacerbation, patients returned to their previous treatment.

In addition to the drug regimen, the PRG participated in a 4-month intensive rehabilitation program. The same physician (R.G.) saw the patients at each visit, and patients in both groups received instructions to contact her at any time if a medical problem arose. Neither patients nor clinicians were blinded to allocation.

**PR Program**

During the first 2 months of PR, PRG patients participated in two 30-min sessions each week. Each session included relaxation techniques, breathing retraining with diaphragmatic breathing control, pursed lips breathing, and self-conscious breathing control during daily life activities (walking and stairs climbing), and chest wall and abdominal muscle wall work.\textsuperscript{17,18} Patients in whom secretions were a problem received training in effective cough and postural drainage strategies. PRG patients also attended four 45- to 60-min educational sessions on the anatomy and basic physiology of the respiratory system, as well as on the nature of their disease, training in inhalator management, and disease management strategies.

In the second 2-month period, PRG patients engaged in an exercise training program of five 30-min sessions weekly on a stationary cycle ergometer, without supplemental oxygen. Exercise started with a workload equivalent to 50\% of the maximal load achieved during a baseline progressive exercise test. The load increased in increments of 10 W, provided the patient’s heart rate, oxygen saturation by pulse oximetry, and BP were stable, and patients tolerated the exercise well.

**Outcome Measures**

Patients in both groups completed outcome measures at baseline and at the end of a 4-month period. The technicians who collected data were blinded to patient allocation to the PRG or the CG, as were the data analysts until the analysis was deemed complete.

**Psychological Assessment**

One psychologist blinded to allocation administered two psychological tests to all patients at baseline and after 4 months follow-up. Both tests had been translated into Spanish and were validated in the Spanish language.

The Millon Behavioral Health Inventory (MBHI) questionnaire\textsuperscript{19} assesses personality styles, attitudes, and ability to cope with the chronic disease. The MBHI questionnaire includes 150 items that patients can complete in approximately 30 min. Some items contribute to more than one domain. The domains and the associated number of items are as follows: eight domains addressing personality styles: introversive (32 items), inhibited (43 items), cooperative (33 items), sociable (40 items), confident (33 items), forceful (33 items), respectful (42 items), and sensitive (48 items); 6 items domains related to attitudes: chronic tension, recent stress, premorbid pessimism, future despair, social alienation, and somatic anxiety; and 3 items that generate a prognosis index: pain treatment responsiveness, life threat reactivity, and emotional vulnerability. The higher the score, the worse the psychological status. A score $< 74$ is considered normal status, scores of 74 to 84 suggest the presence of a personality style or attitude tending to lead to psychosomatic illness, and scores $> 84$ signify the definite presence of a personality style or attitude associated with psychosomatic illness.

The Revised Symptom Checklist (SCL-90-R) is a self-report questionnaire widely used in both normal and distressed populations.\textsuperscript{20} Ninety items are classified into 10 domains: somatization (12 items), obsessive-compulsive (10 items), interpersonal...
sensitivity (9 items), depression (13 items), anxiety (10 items), hostility (6 items), phobic anxiety (7 items), paranoid ideation (6 items), psychoticism (10 items), and 7 additional items. The questionnaire also provides three global indexes of associated distress: global severity index (GSI), positive symptom distress index (PSDI), and positive symptom total (PST). Each item is rated on a 5-point distress scale (scores of 0 to 4): 0 to 0.99 is considered normal, 1 to 1.99 indicates slight psychopathology, 2 to 2.99 indicates moderate psychopathology, 3 to 3.99 indicates considerable psychopathology, and 4 indicates extreme psychopathology. To complete the questionnaire takes approximately 20 min.

**Effort Capacity**

All the patients performed the 6-min walking test along a flat hospital corridor (30 m). Each patient received instruction and standardized encouragement to walk up and down the corridor as many times as possible during the allotted time. At baseline, the patients performed the test three times to avoid learning effects, with 30 min of rest between each test. We used data from the best of three tests, and considered a difference of ≥ 54 m as important.

**HRQL**

A trained interviewer administered the Chronic Respiratory Questionnaire (CRQ), translated and validated by demonstrating anticipated correlations with other questionnaires and functional measures, to assess HRQL. This questionnaire includes 20 items in four domains: dyspnea (5 items), fatique (4 items), emotional function (7 items), and mastery (4 items), each item being graded on a 7-point scale. The minimal important difference is 0.5 on a 7-point scale, in which higher numbers represent better HRQL.

**Data Analysis**

We assessed the impact of treatment on psychosocial morbidity measures, 6-min walk test, and HRQL using an unpaired t test with adjustment for baseline score. The level of significance used for all the tests was 5% (p ≤ 0.05), and the approach was two sided.

**RESULTS**

We randomized 40 male patients aged 65 ± 8 years (mean ± SD). All patients had severe chronic airflow limitation with FEV1 of 35 ± 13% of the reference value and without respiratory failure (Pao2, 72 ± 9 mm Hg; Paco2, 42 ± 5 mm Hg). Five patients withdrew from the study, the two patients in the PRG and one patient in the CG as the result of exacerbation during the first month; and two patients from the CG decided to abandon the study during the first weeks. The PRG was therefore made up of 18 patients, and the CG group included 17 patients. In those who completed the study, baseline anthropometric and pulmonary function variables in the two groups proved similar (Table 1).

**Psychosocial Morbidity Tests**

**MBHI Questionnaire:** In reference to personality styles, combining baseline scores from patients in both groups showed high scores in the inhibited (71 ± 5.1), respectful (67 ± 3.2), sensitive (67 ± 5.8), and introverted (50 ± 3.6) domains. The score in future despair in the attitude scales was also high, as were life threat reactivity (81 ± 5) and pain treatment responsiveness (75 ± 5.1).

At baseline, using data only from those who completed the study, the PRG showed a lower introversion score, and higher forceful and hypersensitive personality style domains than the CG. The PRG also showed a higher chronic tension than the CG. Scores in the other domains proved similar (Table 2). After the 4-month period, the PRG showed statistically significant improvements relative to the control group in introversion (p ≤ 0.05), forceful (p ≤ 0.05), and sensitive (p ≤ 0.05) scales of personality styles and in the chronic tension scale (p ≤ 0.01) [Fig 1]. The other scales of personality styles—including inhibited, cooperative, sociable, confident, and respectful—failed to show statistically significant differences between groups. Neither were there significant differences in the other attitude items (recent stress, premorbid pessimism, future despair, social alienation, and somatic anxiety) nor in the prognosis index (pain treatment responsiveness, life threat reactivity, and emotional vulnerability).

**Table 1—Anthropometric and Functional Variables**

<table>
<thead>
<tr>
<th>Variables</th>
<th>CG</th>
<th>PRG</th>
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<tbody>
<tr>
<td>Patients</td>
<td>17</td>
<td>18</td>
</tr>
<tr>
<td>Male/female gender</td>
<td>17/0</td>
<td>16/2</td>
</tr>
<tr>
<td>Age, yr</td>
<td>66 ± 8</td>
<td>68 ± 8</td>
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<tr>
<td>Weight, kg</td>
<td>73 (16)</td>
<td>70 ± 15</td>
</tr>
<tr>
<td>Height, cm</td>
<td>168 ± 7</td>
<td>166 ± 11</td>
</tr>
<tr>
<td>FVC, % predicted</td>
<td>64 ± 13</td>
<td>67 ± 15</td>
</tr>
<tr>
<td>FEV1, % predicted</td>
<td>38 ± 15</td>
<td>32 ± 11</td>
</tr>
<tr>
<td>FEV1/FVC, %</td>
<td>41 ± 12</td>
<td>36 ± 9</td>
</tr>
<tr>
<td>Residual volume, %</td>
<td>155 ± 53</td>
<td>187 ± 63</td>
</tr>
<tr>
<td>PaO2, mm Hg</td>
<td>71 ± 11</td>
<td>73 ± 9</td>
</tr>
<tr>
<td>PaCO2, mm Hg</td>
<td>43 ± 4</td>
<td>42 ± 5</td>
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</tbody>
</table>

*Data are presented as No. or mean ± SD. Differences between groups were not significant.

**Table 2—MBHI**

<table>
<thead>
<tr>
<th>Variables</th>
<th>CG</th>
<th>PRG</th>
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</thead>
<tbody>
<tr>
<td>Introversive</td>
<td>50 ± 20</td>
<td>65 ± 21</td>
</tr>
<tr>
<td>Forceful</td>
<td>54 ± 24</td>
<td>61 ± 26</td>
</tr>
<tr>
<td>Sensitive</td>
<td>67 ± 20</td>
<td>68 ± 19</td>
</tr>
<tr>
<td>Chronic tension</td>
<td>40 ± 22</td>
<td>57 ± 20</td>
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</table>

*Data are presented as mean ± SD.

†p ≤ 0.05, comparison of change in PR with change in the CG.

‡p ≤ 0.01, comparison of change in PR with change in the CG.
On the domains that did not significantly favor the intervention group, nine domains showed trends in favor of the PRG, and five domains showed trends in favor of the CG.

**SCL-90-R Questionnaire:** Restricting the analysis to patients who completed the study, patients in the PRG group showed mild psychopathology with greater depression, anxiety, hostility, and phobic anxiety at baseline than patients in the CG (Table 3).

Following the PR program, the PRG showed a significant improvement in a number of domains translating (Table 3; Fig 1), while the control group tended to show deterioration. We observed statistical differences in change from baseline between groups in somatization (p ≤ 0.05), depression (p ≤ 0.01), anxiety (p ≤ 0.05), hostility (p ≤ 0.01), psychoticism (p ≤ 0.05), total score (p ≤ 0.01), GSI (p ≤ 0.01), PSDI (p ≤ 0.01), and PST (p ≤ 0.05). Obsessive-compulsive, interpersonal sensitivity, or paranoid ideation failed to demonstrate statistically significant differences between the groups (Table 3; Fig 1). All but one of these domains showed trends in favor of the PRG.

**Effects in Functional Exercise Capacity**

After the 4-month follow-up period, the PRG showed an important (63 m) improvement in 6-min walk distance (6MWD), while the CG deteriorated by 22 m; differences between the change in the PRG and CG provided statistically significant (p ≤ 0.01) [Table 4].

**Effects in HRQL**

Statistically significant results favored the PRG in two domains of the CRQ: dyspnea (p ≤ 0.01) and mastery (p ≤ 0.05). The other two domains showed trends in favor of PR (Table 4). The difference in favor of the PRG was large and important in all four domains: 1.0 for dyspnea, 0.7 for fatigue, 0.7 for emotional function, and 0.6 for mastery (Table 4).

**Discussion**

This study suggests that PR without a specific psychological intervention program can impact positively on psychosocial morbidity in patients with COPD. We found substantial differences between groups in favor of the PRG on some, but not all, domains of two questionnaires that address issues of psychosocial morbidity. In the questionnaire domains that failed to show significant differences, most favored the intervention group.

COPD is a progressive irreversible disease that, in its advanced stages, severely reduces the ability to

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**Table 3—SCL-90-R**

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<th>Variables</th>
<th>CG</th>
<th>PRG</th>
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<tbody>
<tr>
<td></td>
<td>Baseline</td>
<td>4 mo</td>
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<tr>
<td>Somatization</td>
<td>0.8 ± 0.4</td>
<td>1 ± 0.5</td>
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<tr>
<td>Depression</td>
<td>0.6 ± 0.6</td>
<td>0.9 ± 0.6</td>
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<tr>
<td>Anxiety</td>
<td>0.6 ± 0.7</td>
<td>0.8 ± 0.6</td>
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<tr>
<td>Hostility</td>
<td>0.5 ± 0.8</td>
<td>1.3 ± 0.8</td>
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<tr>
<td>Psychoticism</td>
<td>0.16 ± 0.17</td>
<td>0.22 ± 0.21</td>
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<tr>
<td>GSI</td>
<td>0.5 ± 0.48</td>
<td>0.7 ± 0.30</td>
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<tr>
<td>PSDI</td>
<td>1.9 ± 0.6</td>
<td>2.5 ± 0.3</td>
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<tr>
<td>PST</td>
<td>24 ± 12</td>
<td>24 ± 10</td>
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* Data are presented as mean ± SD.
† p ≤ 0.05.
‡ p ≤ 0.01.
perform daily activities and to interact with families and friends. Some studies have suggested that the incidence of depression and anxiety is higher in patients with COPD than in patients with other chronic diseases, varying from 21% to 96% for anxiety and from 27% to 79% for depression. Seung et al found that anxiety and depression are significantly associated with the functional status of COPD patients and suggest that these symptoms may be both underdiagnosed and undertreated.

As well as depression and anxiety, there are other psychological characteristics in COPD patients that can compromise their ability to cope with the disease: irritability, hostility, anger, fear, loneliness, hypochondriasis, hysteria, psychopathic deviance, dissatisfaction, and negative self-concept. MBHI questionnaire results in our study suggested that the style of coping with the disease at baseline was inhibited (tendency to feel doubtful, insecure, and uncomfortable), respectful (predominance of responsibility, scrupulosity, and collaboration with the physician), sensitive (easily irritable, unsatisfied, and presenting variations in mood), and introverted (not very communicative, and reserved). In relation to MBHI attitudes, the patients showed high scores in future despair (respiratory troubles are highly menacing, and patients cannot see the future with hope), life threat reactivity (they live the disease as a progressive vital menace), and pain treatment responsiveness (feeling the treatment is not satisfactory). In the SCL-90-R scores at baseline, the PRG showed mild psychopathology in anxiety, depression, and hostility.

Psychological testing revealed an improvement in personality styles, attitudes, and ability to cope with the disease, together with reductions in depression and anxiety, following the PR program, with appreciable and significant differences from the CG. After 4 months of the PR program, patients felt stronger and were less introverted and less sensitive to facing disability. Disease somatization also decreased, and patients felt less depressive and psychotic, with lower anxiety, hostility, and enhanced positive symptom distress.

Several studies have evaluated specific psychosocial interventions in patients with COPD, but only a few randomized studies have analyzed the impact of PR programs on psychosocial issues without specific psychological intervention, and these focused only on depression and anxiety and showed variable results. Dekhuijzen et al evaluated the effect of different programs on anxiety and depression, comparing PR alone, inspiratory muscle training, and a combination of both treatments. Their results showed that PR and PR plus inspiratory muscle training was associated with a significant reduction in anxiety and depression after a 10-week training period, and the benefits were still apparent after 1 year. Ries et al found that a comprehensive PR program did not affect depression. Gayle et al conducted a randomized trial that found that an exercise program had a small but significant impact on anxiety but not on depression.

The mechanism of psychological improvement with PR is not well established. Even though correlations between anxiety and depression and physiologic measures, effort capacity, and psychological status are not strong, the variables may influence one another. Some authors have therefore suggested that the improvement obtained with PR programs in exercise capacity or perception of dyspnea can improve psychological function.

The new contribution of our study lies in the fact that PR improves not only depression and anxiety but also impacts on other psychosocial morbidity including styles of personality such as introversion, sensitivity, forceful, somatization, and hostility. To our knowledge, our study is the first to evaluate the effects of PR from this wider point of view, taking into account coping styles and attitudes in COPD patients, without including a specific psychological intervention.

Furthermore, in agreement with previous reports, we found that the PR program resulted in important benefits in functional exercise capacity and HRQL. These results reaffirm the utility of breathing retraining and exercise training in obtaining statistical and patient-important improvements in 6MWD, and mastery and dyspnea domains of HRQL. These results are very similar to our previous study with a similar rehabilitation program.

The limitations of our study include the significant difference found between the two groups in baseline scores of the MBHI and the SCL-90-R questionnaires. Using the baseline score as a covariate in the analysis deals, to a large extent, with this problem.

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<td>Baseline</td>
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<tr>
<td>6MWD, m</td>
<td>330 ± 59</td>
<td>308 ± 72</td>
<td>347 ± 72</td>
<td>410 ± 92</td>
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<td>CRQ dyspnea</td>
<td>3.6 ± 1.1</td>
<td>3.4 ± 1.2</td>
<td>2.9 ± 1.1</td>
<td>3.7 ± 1.2</td>
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<tr>
<td>CRQ fatigue</td>
<td>5.4 ± 1.2</td>
<td>4.9 ± 1.3</td>
<td>5.0 ± 1.1</td>
<td>5.2 ± 1.1</td>
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<tr>
<td>CRQ emotional function</td>
<td>5.3 ± 1.0</td>
<td>4.9 ± 1.2</td>
<td>5.1 ± 1.1</td>
<td>5.4 ± 1.0</td>
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<tr>
<td>CRQ mastery</td>
<td>5.6 ± 1.2</td>
<td>5.6 ± 1.1</td>
<td>5.1 ± 1.6</td>
<td>5.7 ± 1.1</td>
<td>§</td>
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*Data are presented as mean ± SD. †p ≤ 0.05, change in PR vs change in control. ‡p ≤ 0.01, change in PR vs change in control. §Clinically significant.
Other limitations include the possibility of differential management in the two groups as a result of unblinded caregivers, the small but differential loss to follow-up in the two groups, and the large number of outcome measures we used, which leaves us open to the play of chance. While we did not adjust our p value threshold for multiple outcomes, many of the measures are highly correlated, the differences between groups were often substantial, all significant results favored the intervention, and most nonsignificant trends favored the PRG. In conclusion, while confirming that PR programs produce patient-important improvements in HRQL and effort capacity, this study suggests that PR without a specific psychosocial intervention can improve aspects of psychosocial morbidity in patients with COPD.

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