Experimental Evaluation of Rehabilitation in Chronic Obstructive Pulmonary Disease: Short-Term Effects on Exercise Endurance and Health Status

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Randomly assigned 119 adults with chronic obstructive pulmonary disease to an 8-week comprehensive rehabilitation program or to an 8-week education control program. Comprehensive pulmonary rehabilitation included education, physical and respiratory therapy instruction, psychosocial support, and supervised exercise training; education control included biweekly classroom instruction and discussions on respiratory therapy, medical aspects of lung disease, clinical pharmacology, and diet, but no exercise training. Both groups received extensive physiological and psychosocial evaluation before and after the intervention. Six months after enrollment, patients randomly assigned to the rehabilitation program showed significant increases in exercise endurance, whereas patients randomly assigned to control program showed
nonsignificant increases. Improvement in self-efficacy was correlated with improvements in exercise endurance.

Key words: rehabilitation, chronic obstructive pulmonary disease (COPD), exercise, quality of life

Chronic obstructive pulmonary disease (COPD) includes the diagnostic categories of emphysema, chronic bronchitis, and asthma. COPD is a major public health problem for at least four reasons: It is a major cause of death, it affects a large number of persons, there is an increasing incidence, and it has a major impact on activities of daily living (National Institutes of Health, 1979). Currently, COPD is the fifth leading cause of death in the United States and accounts for approximately 58,800 deaths per year (National Center for Health Statistics, 1981). COPD is second, only to AIDS, as the most rapidly increasing cause of death in the United States.

Comprehensive rehabilitation programs for patients with COPD are well established. In 1981, the American Thoracic Society recommended standards for these multidisciplinary programs, which typically include individual assessment, education, instruction in respiratory and chest physiotherapy, psychosocial support, and supervised exercise training (American Thoracic Society Ad Hoc Committee of the Scientific Assembly on Clinical Problems, 1981). The primary goal of the programs is to restore the individual patient to the highest possible level of independent functioning.

Although several reports have suggested that pulmonary rehabilitation produces significant benefits (Bass, Whitcomb, & Foreman, 1970; Fishman & Petty, 1971; Moser, Bokinsky, Savage, Archibald, & Hansen, 1980), there have been no controlled clinical trials evaluating its efficacy. Previous research has shown that behavioral interventions designed to increase exercise are associated with beneficial outcomes, including improved exercise tolerance, health status, and self-efficacy (Atkins, Kaplan, Timms, Reinsch, & Lofback, 1984; Kaplan, Atkins, & Timms, 1984). The programs employed in these studies, however, are not representative of those used in clinical practice.

The purpose of this study was to evaluate a comprehensive rehabilitation program in a controlled, randomized, clinical trial. Patients were randomly assigned to the comprehensive rehabilitation program or to an education control program. Prior to and following the intervention, detailed evaluations of physiological and health status measures were performed. In this article, some preliminary results of changes in exercise endurance and health status outcomes are presented.
METHOD

Subjects

The subjects were 32 female and 87 male COPD patients who met the following criteria:

1. Clinical diagnosis of COPD, confirmed by history, physical examination, spirometry, and chest roentgenograms. Patients with primarily acute, reversible airway disease (asthma) without chronic airflow obstruction were not accepted.

2. Patients were required to be stable on an acceptable medical regimen. If the treatment was considered inappropriate, or if the patient was unstable, the primary physician was contacted, and the treatment program was reevaluated prior to including the patient in the study.

3. Patients were excluded if they had other significant disabling lung disease, such as pulmonary fibrosis or cancer; serious heart problems, such as recent myocardial infarction or unstable arrhythmias; or other medical conditions that would affect their participation (e.g., orthopedic problems limiting exercise testing and training, psychiatric illness, concurrent evaluation for acute medical problem).

The San Diego Veterans Administration (VA) and U.S. Navy Balboa Hospital were targeted for recruitment because pulmonary rehabilitation programs are not currently available to the patients at these facilities. Enrolled patients included 51 recruited from the San Diego VA Medical Center, 16 from the U.S. Navy Balboa Hospital, 13 from the University of California, San Diego Medical Center, and 39 from the general medical community in San Diego. All patients had their own primary care physician.

Randomization

Over a 1-year period, 350 COPD patients were screened for the study. One hundred twenty-nine patients met entry criteria and signed a consent form describing the randomization process, the two intervention groups, and the assessment procedures. Following agreement and consent, these 129 patients were randomly assigned to either the comprehensive rehabilitation program or to the education control program. The randomization procedure involved a computer-generated list of the words “rehabilitation” and “education” in random order. As each patient entered the study, the recruiter reported the name to an independent person who made assignments according to the random-order lists. The purpose of utilizing a pure
randomization procedure with the possibility of having an unequal number of participants in each group was to minimize the effects of uncontrolled sources of variance, such as age, level of disability, and recruiter bias. Mathematical studies have shown that unconstrained randomization produces less bias than blocked randomization (Blackwell & Hodges, 1957).

Ten patients dropped out prior to treatment, leaving 119 patients who received the intervention. There were no differences between those patients who dropped out prior to the intervention and those who remained. The subjects were 32 female and 87 male COPD patients, of which 57 were randomized into the rehabilitation group and 62 were randomized into the education control group. The rehabilitation group was 26% female and 74% male. The education control group was 27% female and 73% male. The mean age of the subjects was 62.6 years (SD = 7.2 years). The mean forced expiratory volume in 1 sec (FEV$_1$) was 1.23 l (SD = 0.55 l) prebronchodilator (45% of predicted) and 1.41 l (SD = 0.64 l) postbronchodilator (52% of predicted). The predicted values were those of Morris, Koski, and Johnson (1971).

Rehabilitation Group

The rehabilitation program involved 12 sessions in 8 weeks. Each 4-hr session included two classes or group sessions plus supervised exercise training. Patients were enrolled in groups of three to five at approximately 1-month intervals. During the 8-week core program, each patient received individualized instruction, which included education about the disease; instruction in physical and respiratory care techniques; psychosocial support; and exercise training.

Patients were educated in small groups by experienced pulmonary rehabilitation program staff and selected guest speakers. The topics included "How Normal Lungs Work," "What Is COPD?" "Medications in COPD," "Nutrition in COPD," "Oxygen Use and COPD," "Coping With Stress," "Energy-Saving Techniques," "Self-Care Tips," "Travel and COPD," "Pollution and Environmental Hazards," "Smoking Cessation Techniques," and "Breathing Techniques." The general format involved a didactic presentation of the material—handouts followed by a question-and-answer period. Patients were also given instruction and practice with proper respiratory care techniques such as postural drainage, chest physiotherapy, percussion, vibration, pursed lip breathing, and controlled coughing. In addition to learning more about COPD and its management, patients and staff met in weekly group sessions facilitated by a staff psychiatrist. The sessions typically focused on issues commonly faced by COPD patients—depression, anxiety, fear, sexual dysfunction, and family/social problems. Relaxation techniques were introduced to help the patient
better cope with some of the emotional precipitants and concomitants of dyspnea.

The fourth component of the rehabilitation program is the exercise training segment. Because the disease often restricts daily activities, patients are typically sedentary and physically deconditioned. For moderate to severe COPD patients, even the slightest exertion (e.g., brushing teeth) can cause the discomforting and painful symptoms of breathlessness. Exercise training has been shown, however, to have short-term benefits for these patients and may provide important physiological and psychological benefits. Using the baseline exercise testing data, each patient was given an individualized exercise prescription. The primary exercise modality was walking, and the training program emphasized increasing endurance at targets that approached peak exercise tolerance (Ries & Archibald, 1987). Under supervision, patients were initially trained to walk on a treadmill and were then instructed in translating this regimen into free-walking. While walking at their prescribed target speed on the treadmill, patients were taught to count the number of steps taken in 1 min and to observe the length of their stride. The patients then practiced walking on level group outside using the same number of steps in 1 min and the appropriate stride length. They were asked to walk at least twice daily and to keep a training log of their times and distances. In addition to free-walking at home, the patients walked on a treadmill under supervision during each rehabilitation session. The actual amount of time spent walking on the treadmill was determined by the patient, with a maximum allowable time of 34 min. During each training session, the patients were encouraged to walk at least as long, if not longer, than the last time. After the 2-month intervention was completed, patients were encouraged to continue with their exercise regimen, but walking logs were no longer collected.

**Education Control Group**

Patients in the education control group attended four biweekly meetings at which they were given information but not the behavioral components or the individualized instruction of the rehabilitation program. In particular, those in the education control group did not receive supervised exercise training. Patients were enrolled in groups of three to seven at approximately 1-month intervals. The format for each of the education meetings was similar. At the beginning of each 2-hr session, a videotape describing some aspect of COPD management (Pulmonary Self-Care Series, Encyclopaedia Britannica, Vision Multimedia Communications, Inc., Winter Park, FL) was presented. The four-part series included the following videotapes: "Learning to Live With a Breathing Problem," "Clearing Your Airways," "Building Your Strength and Endurance," and "Learning to Breathe Better." In addition, the
patients completed the Social Readjustment Rating Scale (Holmes & Rahe, 1967), the Social Support Questionnaire (Sarason, Levine, Basham, & Sarason, 1983), the Multidimensional Health Locus of Control Scale (Wallston, Wallston, & DeVellis, 1976), and the Sense of Coherence Questionnaire (Rumbaut, Anderson, Kaplan, & Turek, 1981), as well as a semi-structured smoking interview. Following the administration of these measures, the patients participated in a group discussion about either the material covered in the videotape or that covered in the questionnaires. One of the primary reasons for having patients fill out the questionnaires was to generate discussion (e.g., about the importance of social support for the COPD patient, the impact of life events on health status, the degree to which the patients feel they have some control over the disease, the effects of smoking on the etiology and progression of COPD). The final part of the session included a lecture followed by a question-and-answer period. The lectures were presented by experts including a pulmonary physician, a dietician, a clinical pharmacologist, and a respiratory therapist.

There are several important points that need to be addressed with regard to the education control group. First, these patients spent only 8 hr in education, whereas the experimental group spent 48 hr in rehabilitation. The rationale for using an education control group as opposed to a true control group or an attention control group is twofold. First, we believed that it would be unethical to ask fairly sick patients to commit 2 years to the study—during which they were not to seek out or participate in other treatments or programs—without receiving some intervention. It is important to emphasize that our education control program is comparable to many programs offered in the community as rehabilitation. The education control group not only offered information, but also allowed a comparison of the two treatment options available in the community to patients with COPD—an expensive, comprehensive rehabilitation program and an inexpensive education program. It may be that simply educating COPD patients about their disease and medications, and the benefits of exercise, proper diet, and proper breathing techniques, will increase their physiological and psychological functioning. Information and education alone may be insufficient to produce enduring changes in functional capabilities in COPD patients, and patients may need the behavioral training offered in the comprehensive program to achieve these changes. An attention control group, although desirable, was not economically feasible given the required sample size and the number of potential volunteers.

Outcome Measures

In this article, we report outcomes for four measures: exercise endurance, quality of well-being, depression, and self-efficacy. Each patient was
assessed on these measures at baseline prior to treatment, at 2 months immediately following treatment, and at 6-month follow-up.

**Exercise endurance test.** A peak, symptom-limited, graded exercise test was performed on a treadmill in a hospital laboratory to determine peak exercise tolerance levels for each patient. Expired and arterial blood gases were measured during this exercise test. Patients with resting or exercise arterial PO$_2$ values less than 50 mm Hg were tested and subsequently exercised on supplemental oxygen sufficient to maintain arterial PO$_2$ above 50 mm Hg during exercise. Expired gases were not measured in these patients. Based on the treadmill performance in the laboratory, each patient was given an exercise prescription chosen to approximate maximal sustained exercise tolerance. The target rates for the individualized exercise prescriptions ranged from a treadmill speed of 0.6 mph at 0% grade to 3.0 mph at 16% grade. The target work rates for the endurance test were 95% ($SD = 15\%$) of the maximal work level reached on the initial incremental exercise test.

The exercise endurance test was designed to assess each patient's endurance for walking, the type of exercise used in the rehabilitation program. Prior to endurance testing, heart rate, respiratory rate, and blood pressure (BP) were recorded with the patient seated. Those patients requiring supplemental oxygen rested for 10 min with the oxygen prior to being tested. Then, all patients walked at 1 mph for 2 min (0.6 mph for patients with that target speed). For patients whose prescribed target rate was greater than 1 mph, after 2 minutes the tester asked the patient if they felt they could walk faster. If the patient replied "yes" or "maybe," the treadmill speed was increased to a level 0.5 mph (or 2% to 4% grade) less than the target speed/grade; if the patient felt he or she could not walk faster, or if the target rate was less than 1.5 mph, the patient was maintained at the initial speed. After 2 min more, if the target rate had not yet been reached, the patient was once again asked if he or she could walk faster. If so, the treadmill speed was increased to the target rate. Once the individualized target rate was achieved, all patients were instructed to walk as long as possible. If the patient walked for 20 min at the target rate, the treadmill speed was increased another 0.5 mph (or 2% to 4% grade). A maximum endurance walk protocol was achieved if the patient walked 20 min at the target work rate and 10 min at a higher rate. During the entire endurance walk, the patient's BP was monitored every 3 min. The test was stopped when a patient stated that he or she was unable to walk any longer. In addition, the examiner could stop the test for any of the following conditions: chest pain, dizziness, excessive rise in BP ($\geq$ 250 mm Hg systolic BP or $\geq$ 130 mm Hg diastolic BP), and excessive fall in BP ($\leq$ 20 mm Hg in systolic BP). At the end of the test, sitting pulse rate, respiratory
rate, and BP were again measured. Symptoms of perceived breathlessness and general fatigue were rated on a 10-point scale after the first 2 min on the treadmill and at the end of the test (Borg, 1982). The examiner then recorded reasons for stopping the test. In 95% of the cases, the patient reported wanting to terminate the exercise endurance tests due to dyspnea. The other cited reasons for termination included fatigue and pain in the lower body. In only two instances did the examiner decide to stop the endurance walk. The same protocol for the endurance walk was used at each follow-up testing session.

Quality of Well-Being Scale (QWB). The QWB is a comprehensive measure of health-related quality of life that includes several components. First, it obtains observable levels of functioning at a period of time. The levels of functioning are obtained from three separate scales: Mobility, Physical Activity, and Social Activity. Second, symptomatic complaints and disturbances are noted. Each patient is classified according to the symptom or problem that bothered him or her the most. Then, the observed level of function and the subjective symptomatic complaint are weighted by preference, or the desirability of the state, on a scale ranging from dead (0) to optimum function (1.0). The weights are obtained from independent samples of judges who rate the desirability of the observable health status. Using this system, it is possible to place the general health status of any individual on the continuum between death and optimal functioning for any point in time. This system has been used extensively in a variety of medical and health services research studies (see Kaplan & Anderson, 1988). In addition, specific validity and reliability studies using this measure for COPD patients have been published (Kaplan, Atkins, & Timms, 1984). These studies have demonstrated that the QWB is sensitive to relatively minor changes in health status and that it is correlated with a variety of physical and functional measures of health status.

Efficacy expectation. Efficacy expectations for each patient were assessed using a questionnaire developed by Kaplan, Atkins, and Reinsch (1984). The questionnaire consists of seven self-efficacy scales that measure the following behaviors: Lifting, Climbing, Walking, Pushing, General Exertion, Anger Arousal, and Stress Tolerance. Within each of the scales, the patient was presented with a series of brief statements describing progressively more difficult performance requirements for that behavior. For example, the Lifting scale includes the following brief statements; “Lift 10 pounds, lift 20 pounds, lift 30 pounds . . . lift 200 pounds.” Although a range of behaviors was assessed, including self-efficacy for lifting objects and self-efficacy for tolerating anger arousal, this article focuses on efficacy expectations for walking behavior only. The Walking scale included “Walk
1 block within 5 minutes, walk 2 blocks within 10 minutes, walk 3 blocks within 15 minutes . . . walk 3 miles within 90 minutes." For each brief statement, patients were asked to rate the strength of their expectation to perform the activity on a 100-point probability scale ranging in 10-point intervals from complete certainty (100) through moderate certainty (5) to complete uncertainty (0). In sum, to measure self-efficacy expectations for walking, patients were presented with nine brief statements representing increasing gradations, in nonequal intervals, of difficulty for walking. They then indicated the degree of confidence that they could perform the behavior. The score on the self-efficacy measure reflects the highest level for which a person expresses 100% confidence. Higher self-efficacy scores represented full confidence for walking greater distances. Studies have shown that efficacy expectations significantly predict performance in cardiac rehabilitation patients (see Bandura, 1982). In addition, Atkins et al. (1984) demonstrated that efficacy expectations correlate significantly with health status, pulmonary function, and exercise tolerance in a group of COPD patients.

Center for Epidemiologic Studies–Depression Scale (CES-D). The CES-D is a general measure of depression that has been used extensively in epidemiologic studies. For example, the CES-D was administered to 2,867 persons as part of the Health and Nutrition Examination Survey (see National Center for Health Statistics, 1987). The scale was predictive of several depressive outcomes, and CES-D scores were linearly related to depressive disorders. The scale includes 20 items and taps dimensions of Depressed Mood, Hopelessness, Appetite Loss, Sleep Disturbance, and Energy Level. In the present study, the patients were asked to report how often they experienced a particular "symptom" during the past week on a 4-point scale ranging from rarely or none of the time—0 to 1 days (0) to most or all of the time—5 to 7 days (3). Scores on the CES-D can range from 0 to 60, with scores greater than 15 indicative of clinically significant levels of depressive symptomatology in adults. Eaton and Kessler (1981) presented evidence for the reliability and validity of this measure.

RESULTS

Differences between the two groups prior to the intervention were tested using analysis of variance (ANOVA). The results are summarized in Table 1. As the table shows, the groups did not differ significantly on any of the variables examined, suggesting that the two groups were equivalent prior to treatment. For both groups, patients were required to make up any sessions
that they missed. Strict attendance records were kept to ensure that all patients completed their respective programs. Two months after enrollment, 104 patients had complete follow-ups, 4 patients had partial follow-ups (answered questionnaires but were too sick to take the endurance test), and 11 patients were unavailable for testing. Six months after enrollment, 103 patients had complete follow-ups, 3 had partial follow-ups, and 13 patients were unavailable for testing. Thus, there was a 91% follow-up rate at 2 months and an 89% follow-up rate at 6 months. Of the patients unavailable for follow-up, 1 in the rehabilitation group died prior to the 2-month evaluation. Table 2 shows the status of patient participation at baseline, at 2 months, and at 6 months. There do not appear to be differential attrition rates for the two groups.

### Table 1
Group Comparisons on Key Variables at Initial Evaluation

<table>
<thead>
<tr>
<th>Variable</th>
<th>Rehabilitation</th>
<th>Education Control</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>M</td>
<td>SD</td>
</tr>
<tr>
<td>Quality of well-being</td>
<td>.6656</td>
<td>0.096</td>
</tr>
<tr>
<td>Depression</td>
<td>14.02</td>
<td>08.74</td>
</tr>
<tr>
<td>Treadmill endurance</td>
<td>12.53</td>
<td>08.94</td>
</tr>
<tr>
<td>Self-efficacy for walking</td>
<td>03.70</td>
<td>03.22</td>
</tr>
</tbody>
</table>

### Table 2
Patient Follow-Up Status by Group at Initial, 2-Month, and 6-Month Evaluations

<table>
<thead>
<tr>
<th>Assessment Period*</th>
<th>Initial</th>
<th>2 Months</th>
<th>6 Months</th>
</tr>
</thead>
<tbody>
<tr>
<td>Status</td>
<td>R</td>
<td>E</td>
<td>R</td>
</tr>
<tr>
<td>Complete follow-up</td>
<td>57</td>
<td>62</td>
<td>48</td>
</tr>
<tr>
<td>Partial follow-up (questionnaires but no endurance walk)</td>
<td>0</td>
<td>0</td>
<td>3</td>
</tr>
<tr>
<td>No follow-up</td>
<td>0</td>
<td>0</td>
<td>6</td>
</tr>
<tr>
<td>Death</td>
<td>0</td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td>Too sick</td>
<td>0</td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td>Refused/no show</td>
<td>0</td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td>Unable to locate</td>
<td>0</td>
<td>0</td>
<td>2</td>
</tr>
<tr>
<td>Drop</td>
<td>0</td>
<td>0</td>
<td>1</td>
</tr>
</tbody>
</table>

Percentage of patients tested    | 100 | 100 | 89 |

*R = rehabilitation, E = education control.
Repeated-measures ANOVA was used to analyze the data. Among the outcome variables, exercise endurance was most significantly affected by treatment. Figure 1 summarizes changes in exercise endurance for both groups. As the figure indicates, there were substantial increases in exercise endurance immediately following the intervention for the rehabilitation group, whereas the education control group improved only minimally. Furthermore, the increases in endurance for the rehabilitation group, for the most part, remained at 6-month follow-up. The main effect for group, $F(1, 81) = 12.11, p < .001$, and the main effect for time, $F(3, 243) = 16.36, p < .0001$, were significant. In addition, there was a highly significant Group $\times$ Time interaction, $F(3, 243) = 7.65, p < .0001$.

Figure 2 is a scatter plot showing the relationship between initial endurance on the treadmill and performance after treatment. Rehabilitation and education groups are plotted separately. As the figure shows, the rehabilitation patients (open squares) who improved most were those with initial treadmill times of about 10 min. This was expected in that patients with initially high walking times had less room to improve on the endurance walk. The maximum amount of time a patient was allowed to walk on the treadmill was 34 min, 24 min at the target rate and 10 min at the increased rate. For the education group (solid squares), initial treadmill time was highly predictive of follow-up time. There was little improvement in endurance regardless of the initial treadmill times.

Changes in self-efficacy expectations for walking between the two groups are summarized in Figure 3. As the figure illustrates, there were small (nonsignificant) initial differences in self-efficacy for walking, with the rehabilitation group having lower initial scores than the education control
Following the intervention, there was a fairly large increase in mean self-efficacy ratings for the rehabilitation group, and this increase, for the most part, remained at the 6-month assessment. The education control group, on the other hand, experienced little change in mean self-efficacy ratings following the intervention. Results from the analyses revealed a significant *Group* \(\times\) *Time* interaction, \(F(3, 249) = 4.05, p < .008\); the main effects for group and time, however, were not significant. Differences between groups on the QWB and the CES–D were also not significant.
DISCUSSION

Several interesting results emerged from this investigation. First, seriously disabled patients randomly assigned to a comprehensive rehabilitation program that included exercise training, education, individualized instruction, and psychosocial support demonstrated strong and significant improvements in exercise endurance that remained even at the 6-month follow-up. There were related improvements in self-efficacy for walking, particularly right after the intervention, for the rehabilitation patients. These differences, however, diminished over time, with the education control group showing self-efficacy expectations comparable to baseline measurements. These results replicate earlier findings for exercise improvement (Atkins et al., 1984; Bass et al., 1970; Bell & Jensen, 1977; Moser et al., 1980) and self-efficacy enhancement (Kaplan, Atkins, & Timms, 1984) in COPD patients. To the best of our knowledge, however, this is the first randomized experimental trial demonstrating the benefits of exercise training within a clinical rehabilitation program with follow-up extending past 3 months.

We had hypothesized that improvements in exercise tolerance would be associated with decreases in depression and increases in general quality of well-being; the data, however, failed to confirm these hypotheses. Atkins et al. (1984) did find significant changes in quality of well-being scores following behavioral intervention for exercise in COPD patients. There are several notable differences, however, between the present study and the Atkins et al. investigation. The earlier study involved implementation of an exercise prescription within the home setting, and all exercise activities were linked to ongoing activities of daily living. In the present study, much of the exercise training was conducted on treadmills. Another difference is that the Atkins et al. investigation included a no-treatment control group, and the strongest differences were contrasts against the no-treatment group. In the present investigation, both groups were exposed to educational information. A no-treatment control group was considered; however, it was not included in the design for several reasons. First, there is an ethical problem in asking moderately to severely ill patients to appear for repeated measurements over a 2-year period and not to seek out alternative programs during this time, when no program is offered in exchange. In addition, there are several methodologic considerations. Patients who volunteer for research studies do so because they want to be in an experimental program. If assigned to a no-treatment control group, patients often join other community programs similar to the experimental treatment, thus producing uncontrolled cross-over effects. Furthermore, attrition tends to be higher in no-treatment control groups, producing a more self-selected group of patients by the final assessment. In previous work with adult diabetic...
patients, however, attrition in an education control group was no greater than in treatment groups (Kaplan & Atkins, 1987). Thus, in this clinical trial, we utilized an education control group as opposed to a no-treatment control group for ethical reasons and for minimizing the possibility of patients' seeking other treatment or dropping out of the study. It is possible that comparison to a no-treatment control group would have yielded quality of well-being differences in the present investigation. We will continue to follow these patients over a 2-year period to determine whether quality of well-being differences between the two groups emerge at a later time.

Our general finding—that exercise endurance improvement was not associated with decreases in depression—lends support to a similar study. Light, Merrill, Despars, Gordon, and Matalipassi (1985) found no significant relationships between measures of 12-min walking distance and depression in COPD patients. Specifically, the distance that patients were able to walk was not significantly related to level of depression. The prevalence of depression is higher in patients with COPD than it is in other medical patients (Borson et al., 1986). This is not surprising in that depressive symptoms have been found to be correlated with disability, and COPD patients rank high in their degree of disability and limitations to activities of daily living (Craig & Van Natta, 1983). In both the rehabilitation and education control groups, levels of self-reported depression remained relatively high and stable through the 6-month assessment. As the severity of the disease progresses and the immediate effects of the intervention begin to diminish, it will be interesting to see whether depression levels will differentially increase between the groups.

In summary, in comparison to an education program, a comprehensive rehabilitation program—which included physical conditioning—increased exercise endurance and self-efficacy expectations for walking in a group of moderate to severe COPD patients. Quality of well-being and depression scores were less clearly influenced by the rehabilitation intervention. The patients in the study will continue to be followed, at 12, 18, and 24 months, to determine the long-term effects of the rehabilitation and education interventions. Future analyses will also examine additional outcome variables.

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REFERENCES


