Self-Efficacy Expectations Predict Survival for Patients With Chronic Obstructive Pulmonary Disease

Robert M. Kaplan, Andrew L. Ries, Lela M. Prewitt, and Elizabeth Eakin

The validity of self-efficacy expectations as predictors of mortality was evaluated for 119 patients with chronic obstructive pulmonary disease (COPD). Patients completed 4 physiological measures that represent common clinical indicators of disease severity: (a) forced expiratory volume in 1 s (FEV1), (b) arterial blood gas measurement of resting partial pressure of oxygen (PaO2), (c) single-breath diffusing capacity (DLCO), and (d) maximum oxygen uptake (V02max) during exercise. In addition, self-reported self-efficacy expectation for walking on a treadmill was measured. Self-efficacy was a significant univariate predictor of 5-year survival. However, when controlling for FEV1 in multivariate survival analysis, self-efficacy had only a marginal effect. We concluded that simple self-report scales could provide significant information about health status.

Key words: self-efficacy, pulmonary function, self-report, COPD, mortality

A predominant tradition in medical science has been to disregard patient self-reports of functioning as unreliable and of low validity. Amateur reports by patients are regarded as less meaningful than those offered by a disinterested third party who has used objective tests. However, self-evaluated health is often a significant predictor of mortality, even when other measures of health status are statistically controlled (Mossey & Shapiro, 1982). These findings have been replicated in several studies, and it has been argued that they do not represent methodological artifacts or the influence of other psychosocial variables (Idler & Kasl, 1991; Idler, Kasl, & Lemke, 1990). The purpose of this article is to compare a simple self-report measure against more traditional physiological measures for predicting survival among seriously ill adults with chronic lung disease.

Chronic obstructive pulmonary disease (COPD) is the fifth leading cause of death in the United States (Higgins, 1989) and is estimated to be present in 10%–15% of the adult population (Edelman et al., 1992; Feinleib et al., 1989). Prediction of survival for patients diagnosed with COPD has been difficult. However, several investigators have demonstrated that pulmonary function data can provide significant information about expected longevity (Postma et al., 1979; Traver, Cline & Burrows, 1979). In particular, the forced expiratory volume in 1 s (FEV1) is considered the best predictor of remaining life expectancy for these patients. Pulmonary function testing and related assessment of arterial blood gases and exercise tolerance are commonly used for patients with COPD. However, self-reported measures of health and functioning are rarely used.

In this article, we explore the validity of four physiological measures in comparison with a simple psychosocial measure as predictors of mortality among patients with COPD. The psychosocial variable is self-efficacy, which is a simple rating of the expectation to perform a defined behavior (Bandura, 1977, 1986, 1992). In previous studies, we showed self-efficacy expectations to be an important correlate of physiological status for patients with COPD (Kaplan, Atkins, & Reinsch, 1984; Toshima, Kaplan, & Ries, 1992). However, physiological variables gain validity through their ability to predict survival. In this article, we subject self-efficacy to the same test.

Method

Subjects

Over an 18-month period, 350 patients with COPD were screened for the study, and 129 met entry criteria and participated in an experimental trial, which was previously reported (Toshima, Kaplan, & Ries, 1990). Ten subjects dropped out before treatment, leaving 32 female and 87 male patients with COPD. This female/male ratio approximated the distribution of COPD in women and men in the general population at the time of the trial. To be included, the patient had to meet the following criteria:

1. Clinical diagnosis of COPD, mild to severe, confirmed by history, physical examination, spirometry, arterial blood gases, and chest roentgenograms. Patients with any of the specific diagnoses of emphysema, chronic bronchitis, or asthmatic bronchitis were accepted. Patients with a history of 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 the patient was unstable, the primary physician was contacted, and the treatment regimen was adjusted before inclusion in the study.

3. Patients were excluded if they had other significant disabling lung disease, serious heart problems, or other medical conditions that would interfere with their participation.
Assessment

Each patient underwent comprehensive pulmonary function tests, exercise tests, treadmill endurance walks, and psychosocial measures at baseline and on several follow-ups. A self-efficacy questionnaire and four physiological measures were used for this analysis:

**Self-efficacy questionnaire.** The self-efficacy questionnaire used in this study was used in a previous study by Kaplan et al. (1984) to demonstrate that specific rather than generalized expectancies mediate behavior changes in patients with COPD. The self-efficacy questionnaire was adapted from self-efficacy scales used to measure expectation for completing activities that imposed stress on the heart for patients with uncomplicated myocardial infarction (Ewart, Taylor, Reese, & DeBusk, 1983). The self-efficacy questionnaire used in this study was modified to more accurately measure the functional disabilities associated with COPD. This analysis used a single scale, requesting expectation for walking defined distances in defined time intervals, because the previous studies demonstrated that this one scale had the highest validity for patients with COPD. The scale included brief statements describing progressively more difficult performance requirements for walking. It consisted of the following statements: walk 1 block (approximately 5 min), walk 2 blocks (10 min), walk 3 blocks (15 min) … walk 3 miles (90 min). The scale for walking had nine items representing unequal intervals of increasing difficulty. For each item, the patient rated the degree of confidence or strength of their expectation to perform that activity on a 100-point probability scale, ranging in 10-point intervals from complete uncertainty (0) to complete certainty (100). The score reflects the highest level that the patient expressed 100% confidence or she could perform. If the highest level for which a patient indicated 100% confidence was the lowest level (walk 1 block), a score of 1 was assigned. If the highest level of 100% confidence was the third level (walk 3 blocks), a score of 3 was assigned, and so on.

**Physiological Measures**

We previously factor analyzed 28 common physiologic indicators of disease severity for COPD. The analysis showed that many physiologic measures were highly redundant and that the disease could best be described by four constructs (Ries, Kaplan, & Blumberg, 1991). We selected one variable to represent each of the four independent constructs: (a) pulmonary function measures of expiratory airflow, (b) diffusing capacity, (c) maximal exercise tolerance, and (d) arterial oxygen level.

**Pulmonary function tests of expiratory flow.** Pulmonary function was evaluated by means of standardized methods (American Thoracic Society, 1979; Clausen & Zarins, 1982). Spirometry is a test of the maximal volume of air that can be expelled from fully inflated lungs and is a standard test for assessing severity of COPD. The forced expiratory volume in 1 s (FEV1) is a measure of expiratory flow and is the maximum volume of air that can be exhaled in 1 s.

**Diffusing capacity.** Diffusing capacity for carbon monoxide (DLco) is another lung function test that measures the lungs’ ability to transfer gas (carbon monoxide) from the inspired air to the blood.

**Exercise tests.** The exercise tests included a symptom-limited exercise test to the maximal tolerable level on a treadmill. In this incremental exercise test, the treadmill speed was increased at 1-min intervals by 0.5 mph up to 3.0 mph with further work increments made by increasing elevation by 2% each minute. This multiple-stage test assessed the maximal exercise tolerance. During the exercise test, expired gas was analyzed to measure oxygen uptake (VO2) and other related variables (Wasserman, Hansen, Sue, & Whipp, 1987). The index we used to represent exercise is maximum VO2 (VO2max), which is a standard measure of maximal exercise tolerance.

**Arterial oxygen level.** Arterial blood was obtained from a radial artery catheter to measure arterial oxygen pressure (PaO2), arterial carbon dioxide pressure (PaCO2), and pH, which are standard measures of gas exchange. In this analysis, we concentrate on PaO2.

### Table 1

**Ranges, Means, and Standard Deviations for All Predictor Variables**

<table>
<thead>
<tr>
<th>Variable</th>
<th>Min</th>
<th>Max</th>
<th>M</th>
<th>SD</th>
<th>n</th>
</tr>
</thead>
<tbody>
<tr>
<td>Self-efficacy</td>
<td>0.00</td>
<td>9.00</td>
<td>4.05</td>
<td>3.29</td>
<td>119</td>
</tr>
<tr>
<td>VO2max (liters/min)</td>
<td>0.40</td>
<td>2.95</td>
<td>1.28</td>
<td>0.52</td>
<td>112</td>
</tr>
<tr>
<td>FEV1.0 (liters)</td>
<td>0.54</td>
<td>3.61</td>
<td>1.44</td>
<td>0.64</td>
<td>119</td>
</tr>
<tr>
<td>DLco (ml/min/mmHg)</td>
<td>0.60</td>
<td>34.30</td>
<td>14.61</td>
<td>7.02</td>
<td>116</td>
</tr>
<tr>
<td>PaO2 (mmHg)</td>
<td>57</td>
<td>105</td>
<td>75.31</td>
<td>11.08</td>
<td>118</td>
</tr>
</tbody>
</table>

Note. Min = minimum, Max = maximum

In summary, the four physiological measures were chosen because they are common clinical measures that tap different biological processes. Previous analysis has shown that the four measures have their primary loadings on different factors.

**Follow-up assessments.** All patients were followed for vital status for at least 5 years. Death certificates were obtained from all of the deceased.

**Statistical Methods**

The data were analyzed by means of survival analysis and the Cox proportional hazard model. The analyses were completed by means of the BMDP 2L programs.

### Results

The analyses were based on self-efficacy plus the four physiological indicators: FEV1.0, DLco, VO2max, and PaO2. The means, standard deviations, and ranges for these variables and cases available for analysis are summarized in Table 1. The variables were highly correlated at baseline (see Table 2). Among the 119 patients, 37 had died, and 82 were known to be living after 5 years of follow-up.

Survival analysis by means of the Cox model was performed using both univariate and multivariate evaluations. For the five-variable model, cases were excluded if there were any missing data. This left 75 living and 33 deceased patients. In univariate analysis, self-efficacy for walking was a significant predictor of survival: Approximate \( \chi^2(N = 108) = 9.01, p < .01 \). Univariate analysis also showed that three other variables were significant predictors of mortality. These were FEV1.0, approximate \( \chi^2(N = 108) = 15.93, p < .001 \); VO2max, \( \chi^2(N = 108) = 15.28, p < .001 \); and DLco, \( \chi^2(N = 108) = 4.41, p < .04 \). PaO2 was not a significant univariate predictor of survival. The multivariate analysis examined the effects of the physiological variables after self-efficacy had been removed. In this analysis, only FEV1.0 added significant information beyond self-efficacy. Overall, the five-variable model was statistically significant, \( \chi^2(N = 108) = 25.74, p < .0001 \).

A second analysis allowed self-efficacy and FEV1.0 to be entered simultaneously in a two-variable model. Because there were no

### Table 2

**Correlations Between Predictors of Survival**

<table>
<thead>
<tr>
<th>Predictor</th>
<th>Efficacy</th>
<th>FEV1.0</th>
<th>DLco</th>
<th>PaO2</th>
<th>VO2max</th>
</tr>
</thead>
<tbody>
<tr>
<td>Efficacy</td>
<td>—</td>
<td>0.40</td>
<td>—</td>
<td>—</td>
<td>—</td>
</tr>
<tr>
<td>FEV1.0</td>
<td>—</td>
<td>0.458</td>
<td>0.582</td>
<td>—</td>
<td>—</td>
</tr>
<tr>
<td>DLco</td>
<td>—</td>
<td>0.509</td>
<td>0.537</td>
<td>0.393</td>
<td>—</td>
</tr>
<tr>
<td>PaO2</td>
<td>—</td>
<td>0.523</td>
<td>0.591</td>
<td>0.839</td>
<td>0.379</td>
</tr>
<tr>
<td>VO2max</td>
<td>—</td>
<td>0.523</td>
<td>0.591</td>
<td>0.839</td>
<td>0.379</td>
</tr>
</tbody>
</table>
missing data for these two variables, this analysis allowed all 119 cases to be included. There were 37 deceased and 82 living cases. FEV$_{1.0}$ entered first and accounted for the greatest proportion of the variance, $\chi^2(1, N = 119) = 14.68, p < .0001$, whereas controlling for FEV$_{1.0}$ self-efficacy was a less powerful predictor of mortality with borderline statistical significance, $\chi^2(1, N = 119) = 2.39, p = .1$. No other variable significantly improved prediction of mortality when FEV$_{1.0}$ was removed.

Discussion

Our data suggest that a simple self-report rating of efficacy expectations is a significant univariate predictor of survival for patients with COPD. This observation complements earlier observations that indicated that self-efficacy was substantially correlated with measures of COPD severity—including pulmonary function, diffusing capacity, exercise tolerance, and blood gases (Toshima et al., 1992). However, after controlling for pulmonary function, other variables do not contribute significantly to the prediction of survival.

We are unaware of other reports demonstrating that self-efficacy expectations are significant predictors of mortality in patients with COPD. However, our data replicate several previous studies that have shown that pulmonary function tests are good predictors of survival among patients with this illness (Postma et al., 1979; Traver et al., 1979). As in previous studies, self-efficacy expectations and measures of pulmonary function were highly correlated (Toshima et al., 1992). Furthermore, in multivariate analysis, entry of pulmonary function information reduces the predictive value of the self-efficacy measure. This occurs because self-efficacy and pulmonary function share common variance.

It might be argued that the self-efficacy finding is unimportant because it only represents disease severity, which can also be expressed using physiologic measures. However, it is impressive that simple self-efficacy ratings can compete favorably with standardized laboratory tests as univariate predictors of mortality. Many authors have challenged the value of self-report tests as meaningful clinical variables. On the contrary, several lines of evidence suggest that patients can provide meaningful information if they are asked the right questions. For example, simple ratings of expectation to obstructive pulmonary disease.

In summary, univariate analysis demonstrates that self-efficacy expectations are good predictors of survival for patients with COPD. Even though these efficacy expectations are most likely driven by seriousness of the underlying illness, the finding supports the validity of simple patient reports about expected function.

References


