Measurement of Short-term Changes in Dyspnea and Disease-Specific Quality of Life Following an Acute COPD Exacerbation*

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Study objective: To determine whether currently available measurement tools can be used to obtain valid measurements of short-term changes in dyspnea and disease-specific quality of life (QOL) in outpatients with an acute COPD exacerbation.

Design: Prospective cohort study.

Methods: Sixty-six patients with an acute COPD exacerbation who presented to the emergency department completed the chronic respiratory disease index questionnaire (CRQ) and the baseline dyspnea index (BDI) and were discharged home receiving 10 days of medical therapy. Reassessment with the CRQ and the transitional dyspnea index (TDI) occurred within 48 h of relapse (defined as an urgent hospital revisit within 10 days because of worsening respiratory symptoms), or 10 days later if relapse did not occur.

Results: Patients who did not relapse (n = 49) showed moderate-to-large improvements in disease-specific QOL across all four CRQ domains (improvements in each domain of 1.4 to 1.9 U; p < 0.001 for all domains) and large positive changes in the TDI (total TDI score, + 5.02 ± 0.55 U; p = 0.0001). In contrast, patients who had a relapse (n = 17) did not have improved CRQ or TDI scores (mean negative change in three of four CRQ domains, total TDI score = 3.06 ± 1.14 U; p = 0.02). Changes in the CRQ dyspnea score and TDI correlated with each other (r = 0.78; p = 0.0001) and with changes in FEV₁ (CRQ, r = 0.48 and p = 0.0001; TDI, r = 0.46 and p = 0.0002). Ten control patients with stable COPD showed no changes in the CRQ or TDI over 10 days.

Conclusion: The CRQ and BDI/TDI can be used to obtain valid, responsive measures of acute changes in QOL and dyspnea associated with a COPD exacerbation. The direction and magnitude of change in these scores was highly correlated with clinical outcome and with other health measures. Most outpatients treated for a COPD exacerbation experience significant short-term improvements in QOL and dyspnea, with the exception of patients who have a clinical relapse of symptoms.

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Key words: chronic bronchitis; COPD; dyspnea; emphysema; quality of life

Abbreviations: BDI = baseline dyspnea index; CRQ = chronic respiratory disease index questionnaire; ED = emergency department; QOL = quality of life; TDI = transitional dyspnea index

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Although several measurement tools have been developed to assess dyspnea and quality of life (QOL) in patients with COPD,1–4 these instruments were designed and validated for use in patients with chronic stable COPD, rather than for use in patients with acute COPD exacerbation. Thus, many studies5,6 that evaluate QOL in patients with COPD have been discriminative in nature, such as those designed to distinguish between groups of patients in stable condition. Similarly, studies7–9 that have used QOL measures to evaluate outcome of therapies have
focused on long-term changes that occur in patients following months of therapy, such as following respiratory rehabilitation or following a prolonged trial of bronchodilator therapy.

A previous study\textsuperscript{10} has suggested that frequent COPD exacerbations are associated with adverse long-term QOL changes over a 1-year period in patients with moderate or severe COPD. However, QOL studies exploring acute COPD exacerbations are lacking, and the impact of an acute COPD exacerbation on short-term changes in dyspnea and QOL in these patients is unknown.

The objective of our study was to determine the validity with which short-term changes in dyspnea and QOL can be measured in the context of an acute COPD exacerbation. If dyspnea and QOL measurement tools can be demonstrated to be valid and reliable in this clinical situation, then they can be utilized in clinical trials that assess the short-term effects of various treatments for an acute COPD exacerbation.

This study assessed changes in disease-specific QOL across four domains (dyspnea, fatigue, emotional function, and mastery) using the chronic respiratory disease index questionnaire (CRQ).\textsuperscript{2,11} Changes in patient dyspnea were also assessed using the baseline dyspnea index (BDI) and transitional dyspnea index (TDI).\textsuperscript{3,12} The study assessed whether these measurement instruments demonstrate construct and concurrent validity in the setting of an acute COPD exacerbation. Demonstration of construct validity requires that the CRQ and BDI/TDI scores correlate highly with clinical outcome.\textsuperscript{13} Demonstration of concurrent validity requires that correlations with other health measures are in the direction and magnitude that one would expect if the instrument under study is working the way it should.\textsuperscript{14} The study also assessed whether the instruments were responsive and whether they could detect real change over short time periods, such as would be important to evaluate in an acute COPD exacerbation.

\section*{Materials and Methods}

\subsection*{Patients}

Patients with an acute COPD exacerbation (characterized by increased chronic baseline dyspnea, increased sputum volume, and/or increased sputum purulence)\textsuperscript{15} were recruited to the study from four Eastern Ontario emergency departments (EDs) during the winter months from January 1998 to March 2000. Inclusion criteria for entry included: (1) a history of diagnosed asthma; (2) reversible airflow obstruction in the ED (improvement in the FEV\textsubscript{1} of at least 20\% and 200 mL after inhalation of bronchodilator); (3) pneumonia or congestive heart failure in the ED; (4) use of oral steroids within 1 month preceding entry into the study; (5) history of renal, hepatic, or cardiac failure; or (6) inability to comply with the study protocol due to cognitive impairment or language barrier. Only outpatients being discharged from the ED were admitted into the study.

Ten control patients were recruited from the original cohort at least 9 months following their original exacerbation. These patients were studied on two occasions during the winter months, 10 days apart, during a time of clinical stability. The study was approved by the ethics review boards of the participating hospitals, and informed consent was obtained from all study subjects.

\subsection*{Study Methods}

Patients were initially evaluated on the day of presentation to the ED. Postbronchodilator spirometry was performed and the CRQ and the BDI were administered by trained interviewers prior to discharge from the ED. Patients were treated with short-acting bronchodilators (ipratropium and salbutamol administered four times daily), antibiotics, and/or oral steroids for a 10-day period. Patients were reassessed 10 days later by the same interviewer, and spirometry, the CRQ, and the TDI were readministered.

Patients were considered to have had a relapse of COPD if they urgently presented again to the ED or to another physician within 10 days of being enrolled into the study because of worsening respiratory symptoms. For patients who had a relapse, the TDI and CRQ were readministered within 48 h of the time of relapse.

\subsection*{Measurement Tools}

The BDI was used to rate the severity of dyspnea at a single point in time, and the TDI was used to assess changes from that baseline.\textsuperscript{3,12} A complete copy of the BDI and TDI questionnaires can be found in the Appendix.\textsuperscript{3} The BDI rates dyspnea according to three categories: functional impairment, magnitude of task, and magnitude of effort. At baseline, dyspnea in each category is rated on a 5-point scale from 0 (severe) to 4 (unimpaired). Ratings for each of the three categories are added to form a baseline total dyspnea score (range, 0 to 12). The TDI rates changes in each of the three categories of dyspnea using a 7-point scale from −3 (major deterioration) to +3 (major improvement). Ratings from the TDI are added to form a transition dyspnea total score (range, −9 to +9). For this study, the trained interviewer transcribed notes during the administration of the BDI/TDI indexes, and scoring was verified by a second investigator who reviewed the transcribed notes.

The CRQ is an interviewer-administered instrument that measures disease-specific QOL.\textsuperscript{2,5,11} The CRQ evaluates four aspects of QOL in patients with obstructive lung disease: dyspnea, fatigue, emotional function, and mastery. Each domain includes four to seven items, and each item is scored on a scale from 1 to 7 (1 = extremely short of breath, 7 = not at all short of breath). Higher scores imply better self-reported disease-specific QOL.

Previous work has shown that a change in score in any domain of the CRQ of ≥ 0.5 represents the minimal clinically important difference that is noticeable to patients,\textsuperscript{16} and that changes in any domain of the CRQ > 1.0 and > 1.5 represent moderate improvements and large improvements, respectively, in disease-specific QOL.\textsuperscript{17}
For the purposes of this study, which was designed to assess very short-term changes in QOL following a COPD exacerbation, we adapted the questionnaire by replacing “2 weeks” with “2 to 3 days” in all questions. This allowed us to assess changes over a 2-day to 3-day recall period rather than a 2-week recall period. At the time of the second administration of the CRQ, patients were informed of their previous responses, since studies suggest that informed administration enhances the measurement properties of the questionnaire. Each questionnaire was scored according to guidelines of the developers, using their methods for handling missing items.

### Statistical Analysis

Absolute changes in mean scores of the four domains of the CRQ over the 10-day period were compared using paired t tests within groups after assessing for normality. Differences for scores between groups were compared using independent t tests. The relationships between changes in CRQ score and TDI, and changes in FEV1, were examined using Pearson’s correlation.

Test-retest reliability was assessed using the intraclass correlation coefficient. Responsiveness of the instruments was assessed using the responsiveness statistic.

### Results

Seventy patients with acute COPD exacerbation were recruited into the study on initial presentation to the ED. Of these 70 patients, 66 patients completed the initial and day-10 follow-up assessments. Four patients did not complete the study: one patient dropped out of the study on day 3, one patient was unavailable for follow-up until day 17, and two patients returned for reassessment on day 10 but refused to complete the day-10 CRQ and TDI.

Baseline characteristics of the 70 enrolled patients are listed in Table 1. Mean age (± SD) of the patients was 70 ± 9 years, 57% of the patients were male, and the mean postbronchodilator FEV1 on the day of COPD exacerbation was 0.96 ± 0.41 L.

Seventeen of 66 patients (26%) had a clinical relapse, defined as an urgent return to the ED or to a physician, due to worsening respiratory symptoms within 10 days of being enrolled into the study. The average time to relapse was 4.7 ± 2.8 days following the initial presentation to the ED.

### Changes in Pulmonary Function

Mean postbronchodilator FEV1 improved from 0.96 ± 0.41 to 1.20 ± 0.60 L over the 10-day study period (p < 0.001) for the entire group (n = 66). Those patients who had a relapse did have slightly, but not significantly, lower FEV1 measures on entrance into the study compared to patients who did not have a relapse (FEV1, 0.86 ± 0.40 L for relapsing patients vs 0.99 ± 0.40 L for nonrelapsing patients, p = 0.24). Patients who had a clinical relapse (n = 17) did not improve their pulmonary function over the study period (mean FEV1 was 0.86 ± 0.40 L at baseline on the day of exacerbation, and 0.85 ± 0.41 L on the relapse assessment day). In contrast, patients who did not have a relapse.

### Table 2—Changes in Pulmonary Function

<table>
<thead>
<tr>
<th>Variables</th>
<th>FEV1 at Day 0, L</th>
<th>FEV1 at Day 10 or Relapse Day, L</th>
<th>Change in FEV1, L</th>
<th>p Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>All patients (n = 66)</td>
<td>0.96 ± 0.41</td>
<td>1.20 ± 0.60</td>
<td>0.23 ± 0.35</td>
<td>&lt; 0.001</td>
</tr>
<tr>
<td>Relapsing patients (n = 17)</td>
<td>0.86 ± 0.40</td>
<td>0.83 ± 0.41</td>
<td>−0.03 ± 0.22</td>
<td>0.04</td>
</tr>
<tr>
<td>Nonrelapsing patients (n = 49)</td>
<td>0.99 ± 0.40</td>
<td>1.23 ± 0.51</td>
<td>0.24 ± 0.36</td>
<td>&lt; 0.001</td>
</tr>
<tr>
<td>Control patients (n = 10)</td>
<td>1.18 ± 0.50</td>
<td>1.24 ± 0.51</td>
<td>0.06 ± 0.23</td>
<td>0.45</td>
</tr>
</tbody>
</table>

*Data are presented as mean ± SD.
(n = 49) had a significant improvement in FEV₁ over the 10-day period, from 0.99 ± 0.30 to 1.31 ± 0.61 L (p < 0.001; Table 2). The difference in the change in FEV₁ between the relapsing and nonrelapsing group of patients was statistically significant (p = 0.001). Control patients showed no change in postbronchodilator FEV₁ over the 10-day period (mean change, 0.06 ± 0.23 L; p = 0.45).

Changes in Reported Dyspnea Over the 10-Day Postexacerbation Period

Table 3 depicts mean BDI scores in each category (functional impairment, magnitude of task, magnitude of effort, and total score) for the 66 subjects on the day of exacerbation. The total BDI score of 4.47 ± 0.26 is indicative of moderate-to-severe dyspnea in this cohort of patients experiencing an acute COPD exacerbation.

The results of the TDI scores done 10 days after a COPD exacerbation for the entire cohort of 66 subjects are depicted in Table 3. Scores across each of the three categories of the TDI improved by 0.83 to 1.06 U, and the total TDI score was +2.94 ± 0.66, indicative of small-to-moderate improvements over the 10-day postexacerbation period for the entire cohort (p = 0.0001). Changes in dyspnea score depended on clinical outcome. Thus, for the nonrelapsing patients, scores across each of the three categories of the TDI improved 1.57 to 1.88 U, and the total TDI score was +5.02 ± 0.55, indicative of moderate-to-large improvements in dyspnea over the 10-day postexacerbation period (p = 0.0001). However, those patients who had a relapse deteriorated across all three categories of the TDI, and the total TDI score was −3.06 ± 1.14, indicating worsening of dyspnea over the postexacerbation study period (p = 0.0001). Differences in total TDI scores between patients who had a relapse and those who did not were statistically significant (p = 0.001). Control patients showed no change in dyspnea score over 10 days (total TDI score, −0.20 ± 0.13; p = 0.90).

Changes in Disease-Specific QOL Over the 10-Day Postexacerbation Period

Table 4 depicts mean CRQ scores in each category for the entire cohort of 66 subjects on the day of exacerbation and 10 days later. Improvements across all four domains of the CRQ were statistically significant (p < 0.001) and are indicative of moderate improvements in short-term disease-specific QOL (Fig 1).

Improvements in disease-specific QOL depended on clinical outcome. For the nonrelapsing patients, scores across each of the four domains of the CRQ improved markedly. Mean changes for the dyspnea, fatigue, emotional function, and mastery domains were 1.8 ± 0.3 U, 1.9 ± 0.2 U, 1.4 ± 0.2 U, and 1.8 ± 0.2 U, respectively (p < 0.001 for each domain), indicative of large clinical improvements in dyspnea, fatigue, and mastery, with moderate improvements in emotional function (Fig 1). In contrast, those patients who had a clinical relapse did not improve on any domain of the CRQ, and three of the four domains showed a trend (not statistically significant) toward deterioration in QOL in this subset of patients (Fig 1). Differences in the change in scores across each domain of the CRQ between the relapsing and nonrelapsing patients were statistically significant (p < 0.0002 for each of the four domains). Control patients showed no change across any of the four CRQ domains (mean change, 0.0, 0.0, 0.1, and 0.1 for the dyspnea, fatigue, emotional function, and mastery domains, respectively, over the 10-day period).

<table>
<thead>
<tr>
<th>Variables</th>
<th>Functional Impairment</th>
<th>Magnitude of Task</th>
<th>Magnitude of Effort</th>
<th>Total Score</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>BDI, day 0</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>All patients (n = 66)</td>
<td>1.45 ± 0.17</td>
<td>0.59 ± 0.07</td>
<td>2.42 ± 0.12</td>
<td>4.47 ± 0.26</td>
</tr>
<tr>
<td>Relapsing patients (n = 17)</td>
<td>1.35 ± 0.34</td>
<td>0.65 ± 0.17</td>
<td>2.06 ± 0.22</td>
<td>4.06 ± 0.52</td>
</tr>
<tr>
<td>Nonrelapsing (n = 49)</td>
<td>1.49 ± 0.20</td>
<td>0.57 ± 0.09</td>
<td>2.55 ± 0.15</td>
<td>4.61 ± 0.30</td>
</tr>
<tr>
<td>Control patients (n = 10)</td>
<td>3.90 ± 0.10</td>
<td>1.70 ± 0.30</td>
<td>3.40 ± 0.16</td>
<td>9.00 ± 0.33</td>
</tr>
<tr>
<td>TDI, day 10 or relapse day</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>All patients (n = 66)</td>
<td>0.53 ± 0.22</td>
<td>1.06 ± 0.21</td>
<td>1.05 ± 0.29</td>
<td>2.94 ± 0.66</td>
</tr>
<tr>
<td>Relapsing patients (n = 17)</td>
<td>−1.29 ± 0.38</td>
<td>−0.40 ± 0.37</td>
<td>−1.35 ± 0.51</td>
<td>−3.06 ± 1.14</td>
</tr>
<tr>
<td>Nonrelapsing (n = 49)</td>
<td>1.57 ± 0.12</td>
<td>1.57 ± 0.21</td>
<td>1.88 ± 0.26</td>
<td>5.02 ± 0.55</td>
</tr>
<tr>
<td>Control patients (n = 10)</td>
<td>0.00 ± 0.00</td>
<td>0.00 ± 0.00</td>
<td>−0.20 ± 0.13</td>
<td>−0.20 ± 0.13</td>
</tr>
</tbody>
</table>

*Data are presented as mean ± SD.

1p = 0.0001.

1p = 0.02.
Analyzing the data for the entire cohort of 66 days (mean TDI score, 1.0, 0.83, 0.45, and 0.66, respectively, for changes across each of the four domains). Similarly, these 10 clinically stable control patients had no significant change in the TDI score after 10 days (p = 0.0001), and worsened in the relapsing patients (mean total TDI score = 3.06 ± 1.10; p = 0.02), indicating that the instrument was able to discriminate changes in dyspnea and that these changes were reflective of clinical outcome. Differences in TDI scores between the relapsing and nonrelapsing patients were statistically significant (p = 0.001).

Similarly, CRQ scores across all four domains improved significantly in the nonrelapsing patients over 10 days, but CRQ scores did not change or deteriorated slightly in the relapsing patients (Table 4). Differences in changes in CRQ scores between the relapsing and nonrelapsing patients were statistically significant across all four domains.

Table 5 depicts the relationship between changes in the CRQ scores with changes in the FEV1 and TDI scores for the entire cohort of 66 subjects. Changes in the CRQ dyspnea score correlated moderately with changes in FEV1 (r = 0.48; p = 0.001) and highly with the TDI score (r = 0.78; p = 0.0001). The TDI showed similar moderate correlation with the change in FEV1 (r = 0.46; p = 0.0002).

Reproducibility and Responsiveness of the Measurement Tools

The CRQ was presented to 10 patients with clinically stable COPD on two occasions 10 days apart. The intraclass correlation was used to compare the variability among patients to the variability within patients over time for the four domains of the CRQ (dyspnea, fatigue, emotion, and mastery). The intraclass correlation was 0.79, 0.96, 0.94, and 0.95, respectively, for the four domains. Similarly, these 10 patients had no significant change in the CRQ domain scores after 10 days (p = 1.0, 0.83, 0.45, and 0.66, respectively, for changes across each of the four domains). The 10 clinically stable control patients had no significant change in the TDI score after 10 days (mean TDI score, −0.20 ± 1.07).

Responsiveness of the CRQ was assessed using the responsiveness statistic.17 This statistic provides a ratio of the change in TDI scores for the subgroup who did not relapse. In contrast, relapsing patients and control patients did not significantly change their CRQ scores in any domain. *p < 0.001; closed triangles = emotional function domain; open triangles = mastery domain; closed circles = dyspnea domain; open circles = fatigue domain.

Validity of the Measurement Tools

TDI scores improved significantly in the nonrelapsing patients (mean total TDI score, + 5.02 ± 0.55; p = 0.0001), and worsened in the relapsing patients (mean total TDI score = 3.06 ± 1.10; p = 0.02), indicating that the instrument was able to discriminate changes in dyspnea and that these changes were reflective of clinical outcome. Differences in TDI scores between the relapsing and nonrelapsing patients were statistically significant (p = 0.001).

FIGURE 1. Mean changes across all four domains of the CRQ for all patients with an acute COPD exacerbation (n = 66), relapsing patients (n = 17), nonrelapsing patients (n = 49), and 10 control clinically stable patients who did not have a COPD exacerbation. Improvements across all four domains of the CRQ were statistically significant for the entire cohort of acute patients as well as for the subgroup who did not relapse. In contrast, relapsing patients and control patients did not significantly change their CRQ scores in any domain. *p < 0.001; closed triangles = emotional function domain; open triangles = mastery domain; closed circles = dyspnea domain; open circles = fatigue domain.

Table 4—CRQ Scores*

<table>
<thead>
<tr>
<th>CRQ Domains</th>
<th>Day 0 Scores</th>
<th>Day 10 or Relapse Day Scores</th>
<th>Mean Change</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dyspnea</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>All patients</td>
<td>2.9 ± 1.0</td>
<td>4.2 ± 1.6</td>
<td>1.3 ± 0.2</td>
</tr>
<tr>
<td>Relapsing</td>
<td>3.0 ± 0.2</td>
<td>2.7 ± 0.4</td>
<td>−0.3 ± 0.3</td>
</tr>
<tr>
<td>Nonrelapsing</td>
<td>2.8 ± 1.1</td>
<td>4.6 ± 1.3</td>
<td>1.8 ± 0.3</td>
</tr>
<tr>
<td>Control</td>
<td>4.2 ± 0.9</td>
<td>4.2 ± 1.0</td>
<td>0.0 ± 0.2</td>
</tr>
<tr>
<td>Fatigue</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>All patients</td>
<td>2.5 ± 1.0</td>
<td>3.9 ± 1.6</td>
<td>1.4 ± 0.2</td>
</tr>
<tr>
<td>Relapsing</td>
<td>2.8 ± 0.3</td>
<td>2.5 ± 0.3</td>
<td>−0.3 ± 0.4</td>
</tr>
<tr>
<td>Nonrelapsing</td>
<td>2.5 ± 1.0</td>
<td>4.4 ± 1.5</td>
<td>1.9 ± 0.2</td>
</tr>
<tr>
<td>Control</td>
<td>4.0 ± 1.1</td>
<td>4.1 ± 1.2</td>
<td>0.1 ± 0.1</td>
</tr>
<tr>
<td>Emotional function</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>All patients</td>
<td>3.6 ± 1.4</td>
<td>4.6 ± 1.5</td>
<td>1.0 ± 0.2</td>
</tr>
<tr>
<td>Relapsing</td>
<td>3.6 ± 0.4</td>
<td>3.4 ± 0.3</td>
<td>−0.2 ± 0.3</td>
</tr>
<tr>
<td>Nonrelapsing</td>
<td>3.6 ± 1.4</td>
<td>5.0 ± 1.3</td>
<td>1.4 ± 0.2</td>
</tr>
<tr>
<td>Control</td>
<td>5.0 ± 1.1</td>
<td>5.1 ± 1.2</td>
<td>0.1 ± 0.1</td>
</tr>
<tr>
<td>Mastery</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>All patients</td>
<td>3.1 ± 1.3</td>
<td>4.5 ± 1.6</td>
<td>1.4 ± 0.2</td>
</tr>
<tr>
<td>Relapsing</td>
<td>2.7 ± 0.2</td>
<td>3.0 ± 0.3</td>
<td>0.3 ± 0.3</td>
</tr>
<tr>
<td>Nonrelapsing</td>
<td>3.3 ± 1.4</td>
<td>5.1 ± 1.4</td>
<td>1.8 ± 0.2</td>
</tr>
<tr>
<td>Control</td>
<td>5.2 ± 1.1</td>
<td>5.3 ± 1.1</td>
<td>0.1 ± 0.1</td>
</tr>
</tbody>
</table>

*Data are presented as mean ± SD.
†p < 0.001.
DISCUSSION

This study has been successful in documenting short-term changes in disease-specific QOL and dyspnea that occur immediately following acute COPD exacerbation. Our study demonstrates that most patients experience significant improvements in QOL and dyspnea following 10 days of medical therapy for an acute COPD exacerbation. However, this study has also shown that there exists a subset of outpatients whose dyspnea and QOL clearly do not improve, and that these are the patients who seek further urgent medical attention within 10 days of their initial presentation to the ED.

This study adds further insights into the growing knowledge base concerning the effects of COPD on QOL. A previous study by Seeungal et al.10 studied the effects of exacerbations on QOL in COPD patients. This study showed that over a 1-year period, patients who had frequent exacerbations (>2/yr) had significantly worse QOL scores after 1 year than patients with less frequent exacerbations. Another recently published study21 has also shown that health status (synonymous with QOL) deteriorates steadily in patients with chronic COPD over a 3-year period.

Results of our study suggest that the progressive slow decline in disease-specific QOL that occurs in these patients is punctuated by short-term acute declines in QOL that occur during exacerbations. It is gratifying to see that most patients show significant improvements in dyspnea and QOL within 10 days of beginning medical therapy for an exacerbation. We did not study these patients a third time several months later, when they would presumably have returned to their stable state. Therefore, although we can conclude that short-term improvements in dyspnea and QOL do occur after a COPD exacerbation, we do not have a measure of the time required for patients to return to a baseline (but presumably still slowly deteriorating) health status.

Because we were unable to find a validated measure of dyspnea and disease-specific QOL in the setting of acute exacerbations of COPD, we chose to assess existing instruments in this setting. The measurement tools that we employed were originally designed and validated for use in patients with chronic, stable COPD. Therefore, a necessary step of our research involved validating the use of the CRQ and BDI/TDI instruments in the clinical context of outpatient acute COPD exacerbation.

This study has shown that the instruments used did demonstrate concurrent validity in the clinical context of outpatient acute COPD exacerbation. Correlations of the TDI and CRQ dyspnea results with each other, and with changes in the FEV1, were in the direction and magnitude that one would expect if the instruments under study were working the way they should. Even more importantly, the BDI/TDI and CRQ demonstrated construct validity, in that the direction and magnitude of change in these scores was highly correlated with clinical outcome. Thus, those patients who had a clinical relapse did not show improvements in dyspnea or QOL, whereas those who did have a relapse demonstrated significant positive improvements in these measurements.

We adapted the CRQ questionnaire slightly for our study by replacing “2 weeks” with “2 to 3 days” in all questions. With this adaptation, the instrument proved to be highly responsive to short-term improvements in QOL over the 10-day study period. However, one slightly surprising result was that patients who had a relapse did not show significant deterioration in their CRQ scores from baseline exacerbation values. This may simply reflect a small sample size and inadequate power, since only 26% of patients in our cohort experienced a relapse within 10 days of presentation. Another alternative explanation is that this occurred because of the “floor effect” phenomenon. In other words, QOL in these patients during acute exacerbation was already very low, and the instrument did not have the power to discriminate further deterioration from an already very low baseline value.

Those patients who had a relapse did have slightly but not significantly lower FEV1 measures on entrance into the study compared to patients who did not relapse (FEV1, 0.56 ± 0.40 L for relapsing patients vs 0.99 ± 0.40 L for nonrelapsing patients, p = 0.24). However, on entrance into the study, BDI scores and baseline CRQ scores were not significantly different between the two groups for any domain (Table 4). This suggests that symptoms of dyspnea on presentation to the ED were not dissimilar between the two groups, despite slightly lower

<table>
<thead>
<tr>
<th>Variables</th>
<th>Change in CRQ Dyspnea</th>
<th>Change in CRQ Fatigue</th>
<th>Change in CRQ Emotional Function</th>
<th>Change in CRQ Mastery</th>
</tr>
</thead>
<tbody>
<tr>
<td>Change in FEV1</td>
<td>0.48*</td>
<td>0.39*</td>
<td>0.43*</td>
<td>0.47*</td>
</tr>
<tr>
<td>TDI total score</td>
<td>0.78*</td>
<td>0.73*</td>
<td>0.63*</td>
<td>0.64*</td>
</tr>
</tbody>
</table>

*p < 0.001.
FEV$_1$ measures seen in the group who had eventual relapses. Comparison of short-term changes in dyspnea and CRQ scores between the relapsing and nonrelapsing group is therefore pertinent, since the two groups entered into the study with similar BDI and CRQ scores.

The developers of the CRQ recommend reminding patients of the answer that they provided the last time they answered the questionnaire (“informed administration”). Studies by the developers of the CRQ suggest that informed administration enhances the measurement properties of the questionnaire.$^{2,11}$ In addition to giving the patient a basis for comparison, data have shown that this method results in a decrease in the random error of measurement of dyspnea, fatigue, and emotional function.$^{22,23}$ Therefore, for the purposes of our study, patients were informed of their previous responses at the time of the second administration of the CRQ.

In practice, measurement of dyspnea and QOL in these acutely ill, elderly outpatients proved to be slightly difficult at times. We excluded patients who were being admitted to hospital from this study, since many of these patients were seriously ill and unable to understand or complete the questionnaires. Ideally, we would have liked to perform measures of test-retest reliability in the patients with acute exacerbations, in addition to those with stable disease. However, in practice this was not possible, since it was not feasible to keep (often exhausted) patients in the ED for the several-hour time interval needed before retesting.

In summary, this study has shown that the BDI/TDI and CRQ instruments demonstrate good performance characteristics in the setting of acute outpatient COPD exacerbation. Use of these instruments is therefore appropriate in this setting. Clinical trials that seek to assess the short-term effects of medications for treatment of acute COPD exacerbation can make use of these measurement tools to provide important information concerning patients’ sense of dyspnea and disease-specific QOL.

**Appendix**

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**BDI**

**Functional Impairment**

Grade 4: No impairment. Able to carry out usual activities and occupation without shortness of breath.

Grade 3: Slight impairment. Distinct impairment in at least one activity but no activities completely abandoned. Reduction in activity at work or in usual activities, that seems slight or not clearly caused by shortness of breath.

Grade 2: Moderate impairment. Patient has changed jobs and/or had abandoned at least one usual activity due to shortness of breath.

Grade 1: Severe impairment. Patient unable to work or has given up most or all usual activities due to shortness of breath.

Grade 0: Very severe impairment. Unable to work and has given up most or all usual activities due to shortness of breath.

W. Amount uncertain. Patient is impaired due to shortness of breath, but amount cannot be specified. Details are not sufficient to allow impairment to be categorized.

X. Unknown. Information unavailable regarding impairment.

Y. Impaired for reasons other than shortness of breath. For example, musculoskeletal problem of chest pain.

**Magnitude of Task**

Grade 4: Extraordinary. Becomes short of breath only with extraordinary activity such as carrying very heavy loads on the level, lighter loads uphill, or running. No shortness of breath with ordinary tasks.

Grade 3: Major. Becomes short of breath only with such major activities as walking up a steep hill, climbing more than three flights of stairs, or carrying a moderate load on the level.

Grade 2: Moderate. Becomes short of breath with moderate or average tasks such as walking up a gradual hill, climbing fewer than three flights of stairs, or carrying a light load on the level.

Grade 1: Light. Becomes short of breath with light activities such as walking on the level, washing, or standing.

Grade 0: No task. Becomes short of breath at rest, while sitting, or lying down.

W. Amount uncertain. Patient’s ability to perform tasks is impaired due to shortness of breath but amount cannot be specified. Details are not sufficient to allow impairment to be categorized.

X. Unknown. Information unavailable regarding limitation of magnitude of task.

Y. Impaired for reasons other than shortness of breath. For example, musculoskeletal problem or chest pain.

**Magnitude of Effort**

Grade 4: Extraordinary. Becomes short of breath with the greatest imaginable effort. No shortness of breath with ordinary effort.

Grade 3: Major. Becomes short of breath with effort distinctly submaximal, but of major proportion. Tasks performed without pause unless the task requires extraordinary effort that may be performed with pauses.

Grade 2: Moderate. Becomes short of breath with moderate effort. Tasks performed with occasional pauses and requiring longer to complete than the average person.

Grade 1: Light. Becomes short of breath with little effort. Tasks performed with little effort or more difficult tasks performed with frequent pauses and requiring 50 to 100% longer to complete than the average person might require.

Grade 0: No effort. Becomes short of breath at rest, while sitting, or lying down.

W. Amount uncertain. Patient’s exertional ability is impaired due to shortness of breath, but amount cannot be specified. Details are not sufficient to allow impairment to be categorized.

X. Unknown. Information unavailable regarding limitation of magnitude of task.

Y. Impaired for reasons other than shortness of breath. For example, musculoskeletal problem or chest pain.

**TDI**

**Change in Functional Impairment**

– 3: Major deterioration. Formerly working and has had to
stop working and has completely abandoned some of usual activities due to shortness of breath.

- 2. Moderate deterioration. Formerly working and has had to stop working or has completely abandoned some of usual activities due to shortness of breath.

- 1. Minor deterioration. Has changed to a lighter job and/or reduced activities in number or duration due to shortness of breath. Any deterioration less than preceding categories.

0: No change. No change in functional status due to shortness of breath.

+ 1: Minor improvement. Able to return to work at reduced pace or has resumed some customary activities with more vigor than previously due to improvement in shortness of breath.

+ 2: Moderate improvement. Able to return to work at nearly usual pace and/or able to return to moderate activities with moderate restrictions only.

+ 3: Major improvement. Able to return to work at former pace and able to return to full activities with only mild restrictions due to improvement of shortness of breath.

Z: Further impairment for reasons other than shortness of breath. Patient has stopped working, reduced work, or has given up or reduced other activities for other reasons. For example, other medical problems, being laid off from work, etc.

Change in Magnitude of Task

- 3: Major deterioration. Has deteriorated two grades or greater from baseline status.

- 2: Moderate deterioration. Has deteriorated at least one grade but fewer than two grades from baseline status.

- 1: Minor deterioration. Has deteriorated less than one grade from baseline. Patient with distinct deterioration within grade but has not changed grades.

0: No change. No change from baseline.

+ 1: Minor improvement. Able to return to work at reduced pace or has resumed some customary activities with more vigor than previously due to improvement in shortness of breath.

+ 2: Moderate improvement. Has improved at least one grade but fewer than two grades from baseline.

+ 3: Major improvement. Has improved two grades or greater from baseline.

Z: Further impairment for reasons other than shortness of breath. Patient has reduced exertional capacity, but not related to shortness of breath, for example, musculoskeletal problem or chest pain.

Change in Magnitude of Effort

- 3: Major deterioration. Severe decrease in effort from baseline to avoid shortness of breath. Activities now take 50 to 100% longer to complete than required at baseline.

- 2: Moderate deterioration. Some decrease in effort to avoid shortness of breath, although not as great as preceding category. There is greater pausing with some activities.

- 1: Minor deterioration. Does not require more pauses to avoid shortness of breath, but does things with distinctly less effort than previously to avoid breathlessness.

0: No change. No change in effort to avoid shortness of breath.

+ 1: Minor improvement. Able to do things with distinctly greater effort without shortness of breath, for example, may be able to carry out tasks somewhat more rapidly than previously.

+ 2: Moderate improvement. Able to do things with fewer pauses and distinctly greater effort without shortness of breath. Improvement is greater than preceding category but not of major proportion.

+ 3: Major improvement. Able to do things with much greater effort than previously with few, if any, pauses. For example, activities may be performed 50 to 100% more rapidly than at baseline.

Z: Further impairment for reasons other than shortness of breath. Patient has reduced exertional capacity, but not related to shortness of breath. For example, musculoskeletal problem or chest pain.

References


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