Reproducibility of Borg Scale Measurements of Dyspnea During Exercise in Patients With COPD

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The purpose of this study was to evaluate the moderate term (5 weeks) reproducibility of Borg scale ratings of the effort to breathe (Borg$_e$) and the degree of discomfort evoked by breathing (Borg$_d$) in patients with COPD during exercise. Six subjects with moderately severe COPD (FEV$_1$, 1.42 ± 0.50 L) underwent progressive incremental exercise (15 W/min) on a cycle ergometer to a symptom-limited maximum every week for 6 weeks (first week used as practice session). Minute ventilation (VE), oxygen consumption (VO$_2$), and Borg ratings were obtained every minute during exercise. Borg$_e$ and Borg$_d$ were highly correlated in each subject (r=0.99 ± 0.01). Borg scores were not significantly different across study days during both maximal and submaximal exercise. The within-subject coefficient of variation (CV) for Borg$_d$ during maximal exercise was 13.9 ± 9.0% (range, 6 to 31%) which was not significantly different from that observed for the physiological indices: 8.5 ± 4.1% (range, 4 to 15%) for VE and 5.2 ± 3.4% (range, 1 to 10%) for VO$_2$. In contrast, at 66% of the maximum workload, the within-subject CV for Borg$_e$ was 25.0 ± 13.0% (range, 12 to 50%) which was significantly greater than that observed for the physiologic indices: 5.8 ± 2.0% (range, 3 to 9%) for VE and 4.6 ± 1.1% (range, 3 to 6%) for VO$_2$. In every subject, Borg$_e$ was linearly correlated with VE, VO$_2$, and workload. However, within an individual subject, the slope of these relationships varied between trials; within-subject CV for the slope of the Borg$_d$/VE relationship was 20.2 ± 8.0% (range, 12 to 32%). In conclusion, during incremental exercise Borg ratings of dyspnea are not as reproducible as physiologic indices in patients with COPD. (CHEST 1995; 107:1590-97)

A method for reliably quantifying the degree of dyspnea in patients during exercise would be desirable. The two scales most commonly used to accomplish this task are the Borg scale and the visual analog scale (VAS). Short-term studies comparing the two scales have not shown any clear-cut advantages for either scale.1,2 Both scales have been shown to be highly reproducible in the short-term (exercise repeated on the same day or within several days of the initial study).2,3 However, therapeutic interventions often are best assessed after several weeks to months of therapy. Thus, it is important to know the moderate to long-term reproducibility of these scales, particularly in patients with respiratory disease. In a prior study, we evaluated the moderate-term (8 weeks) reproducibility of VAS measurements of dyspnea during exercise in patients with COPD.4 The VAS dyspnea measurements did not vary systematically over time. However, during submaximal exercise the within-subject week-to-week variability of these measurements was relatively large. The purpose of this study was to evaluate the moderate-term reproducibility of Borg measurements of dyspnea during exercise in patients with COPD. With the patient on a cycle ergometer, Borg measurements were obtained during incremental exercise to a symptom-limited maximum. Exercise was performed weekly over a 6-week period.

There is no universally accepted definition of dyspnea. Because of the lack of an accepted definition, some investigators have defined dyspnea in terms of the “effort to breathe”2,3 while others have emphasized the “uncomfortable” nature of the sensation.1 In our prior study, we asked patients to rate both the “effort to breathe” and the degree of “discomfort evoked by breathing” on separate VAS. We found that our patients were unable to distinguish between these sensations during exercise. To deter-

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Footnotes:

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mine if this finding was reproducible, we asked our patients to rate both the “effort to breathe” (Borg_e) and the degree of “respiratory discomfort” (Borg_d) on separate Borg scales.

**Methods**

**Subjects**

Six male subjects with moderate to severe COPD who were 63.3 ± 6.4 years of age were studied. Their mean weight and height were 79 ± 13 kg and 172 ± 6 cm, respectively. All subjects were clinically stable outpatients receiving a regular schedule of orally administered or inhaled bronchodilators. Two subjects were receiving prednisone (dose, 10 mg). The study was approved by the appropriate institutional review boards, and informed consent was obtained from all subjects. However, all subjects did not know the purpose of the experiment.

**Pulmonary Function Testing**

FVC, FEV₁, and maximum voluntary ventilation (MVV) were measured with a dry rolling-seal spirometer (Model 822; Ohio Instruments, Madison, Wis) using standard techniques. Residual volume was measured by body plethysmography (P.K. Morgan, Chatham, Kent, England). Predicted normal values were those of Crapo and coworkers. Arterial blood gas values were obtained while patients breathed room air at rest using a pH/blood gas analyzer (ABL-3; Radiometer, Copenhagen, Denmark).

**Apparatus**

The subjects breathed through a two-way nonrebreathing valve of low resistance and dead space (Model 2700; Hans Rudolph, Kansas City, Mo). Expired gas was passed through a mixing chamber and analyzed for O₂ and CO₂ by a paramagnetic O₂ analyzer and an infrared CO₂ analyzer, respectively. The heart rate (HR) was measured from the electrocardiograph. Minute ventilation (VE), tidal volume (VT), and frequency were measured with a turbine pneumotachograph. Average values of VE, VT, frequency, HR, O₂ consumption (VO₂), and CO₂ production (VCO₂) were calculated every 60 s. Oxygen saturation was measured with a pulse oximeter (Biox III; Ohmeda, Boulder, Colo).

**Borg Scale**

Patients were asked to rate both Borg_e and Borg_d. The modified Borg scale consists of a vertical scale labelled 0 to 10 with corresponding verbal expressions of progressively increasing sensation intensity. For measurements of effort to breathe, patients were instructed to point to the number on the Borg scale that best indicated the intensity of their sensation of respiratory effort at that particular point in time (an attendant made the actual mark on the line). The patients were specifically instructed to scale their “effort to breathe” and to disregard any other sensations associated with whole-body exercise. For measurements of respiratory discomfort, the patients were instructed to rate the degree of discomfort evoked by breathing. The top end of the scale was anchored as the most severe degree of respiratory effort or discomfort experienced by the patient in the past. The bottom end of the scale was anchored as the sense of respiratory effort or discomfort experienced at rest. The Borg scales were presented 10 s apart during the last 30 s of each workload (Borg scale for respiratory effort always presented first).

**Exercise Testing**

Patients performed a progressive incremental exercise test to a symptom-limited maximum on an electronically braked cycle ergometer (Rodby Elektronik; Enhorna, Sweden). Prior to each test, the patients rested while sitting on the bicycle for 5 min to acclimatize to the breathing circuit. After 1 min of unloaded cycling, the workload was increased by 15 W each minute until the patient was unable to continue. All tests were stopped by the patient because of shortness of breath. Predicted normal values for maximal oxygen consumption (VO₂max) based on age and height were those of Jones. TenVO₂max=0.83 height².7(1−0.007 age). Predicted maximal heart rate (HRmax) was based on the equation: HRmax=(beats per minute)=210−0.65 age.

Exercise testing was performed weekly for 6 weeks. The first trial was used as a practice session to familiarize the patient with the exercise protocol and the Borg rating scales, and data from this trial were not used in the analysis. Spirometry was performed on each study day to determine whether lung function had remained stable. A long-acting aerosol bronchodilator (albuterol, two puffs) was administered via a spacer device (InspirEase) 1 h prior to exercise testing.

**Data Analysis**

Variability of objective and subjective measurements was assessed from mean absolute values and from the coefficient of variation (CV). To assess variability during submaximal exercise, the workloads that most closely approximated 33 and 66% of the patient’s maximal workload (Wmax) were determined, and subjective and objective measurements were compared at these workloads in all trials for that subject. Statistical significance of differences in mean values of objective and subjective measurements was determined by repeated measures analysis of variance. If the F value was significant, Tukey’s multiple comparison test was employed to determine which study days were responsible. Because the Borg scale is an ordinal rating scale, parametric statistical testing may not be appropriate. Accordingly, we also analyzed the Borg scale measurements using the nonparametric Friedman two-way analysis of variance (factor 1, study day; factor 2, subjects). The relationship between Borg scale and objective indices (VO₂, VE, or workload) was calculated by linear regression.

**Table 1—Pulmonary Function and Blood Gas Tensions**

<table>
<thead>
<tr>
<th>Patient No.</th>
<th>FVC, % Predicted</th>
<th>FEV₁, L % Predicted</th>
<th>FEV₁/FVC, %</th>
<th>RV, % Predicted</th>
<th>MVV, L/min</th>
<th>MIP, cm H₂O</th>
<th>pH</th>
<th>Pco₂ (mm Hg)</th>
<th>Pco₂ (mm Hg)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>35</td>
<td>0.74</td>
<td>22</td>
<td>48</td>
<td>196</td>
<td>28</td>
<td>28</td>
<td>7.43</td>
<td>41</td>
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<tr>
<td>2</td>
<td>80</td>
<td>1.95</td>
<td>48</td>
<td>47</td>
<td>142</td>
<td>57</td>
<td>28</td>
<td>7.44</td>
<td>40</td>
</tr>
<tr>
<td>3</td>
<td>50</td>
<td>0.95</td>
<td>27</td>
<td>44</td>
<td>207</td>
<td>43</td>
<td>123</td>
<td>7.44</td>
<td>32</td>
</tr>
<tr>
<td>4</td>
<td>92</td>
<td>1.94</td>
<td>52</td>
<td>44</td>
<td>175</td>
<td>91</td>
<td>116</td>
<td>7.43</td>
<td>34</td>
</tr>
<tr>
<td>5</td>
<td>83</td>
<td>1.69</td>
<td>46</td>
<td>43</td>
<td>210</td>
<td>76</td>
<td>75</td>
<td>7.46</td>
<td>29</td>
</tr>
<tr>
<td>6</td>
<td>95</td>
<td>1.84</td>
<td>63</td>
<td>50</td>
<td>145</td>
<td>85</td>
<td>97</td>
<td>7.45</td>
<td>35</td>
</tr>
</tbody>
</table>

Mean ± SD: 73 ± 24, 1.42 ± 0.50, 43 ± 16, 46 ± 3, 179 ± 30, 63.3 ± 24.9, 84.3 ± 35.3, 7.44 ± 0.01, 35 ± 5, 78 ± 10

*RV = residual volume; MIP = maximum inspiratory pressure (measured using standard techniques, noted by Black and Hyatt)*.
using the least squares method. In some patients, it took several workloads before Borg ratings were scored above zero. Because of this phenomenon, only data points in which Borg scores were greater than zero were included in the regression analysis. Differences across study days in the slope and intercept of the Borg score/objective index relationships were determined by repeated measures analysis of variance. The results are expressed as the mean ± SD unless otherwise stated, and a probability value less than 0.05 was considered significant.

**RESULTS**

Resting pulmonary function and arterial blood gas data are shown in Table 1. Maximal exercise data are shown in Table 2. Oxygen saturation remained above 90% during exercise in all tests in every patient. Mean Borg scores during maximal and submaximal exercise are shown in Table 3.

The mean absolute value of the objective (\(\dot{V}O_2, \dot{V}E\)) and subjective indices (Borg\textsubscript{e} and Borg\textsubscript{d}) were examined across the 5 study days during the last minute of exercise (maximal exercise) and during submaximal exercise (Fig 1). There were no significant differences across study days during either maximal or submaximal exercise for any of the objective or subjective indices. For the Borg scores, no significant differences were observed for both parametric and nonparametric statistical analysis. The Borg scores for each subject during maximal and submaximal exercise are shown in Figure 2. In subject 6, the Borg scores systematically decreased over time. However, in the other subjects there was no obvious trend in the Borg scores over time (either increase or decrease).

The CV (within-subject across study days) for \(\dot{V}O_2, \dot{V}E, \) Borg\textsubscript{e}, and Borg\textsubscript{d} are shown in Table 4. The \(\dot{V}O_2\) and \(\dot{V}E\) were reproducible (CV≤11%) at both submaximal and maximal levels of exercise. Borg scores were significantly more variable than objective indices at submaximal levels of exercise (p<0.03) but not at maximal exercise. The CV may overestimate variability when mean values are low, which very likely accounts for the very large Borg score CV at 33% of Wmax.

We performed spirometry before each exercise trial. There were no significant changes across study days in the FEV\textsubscript{1}, FVC, or MVV (analysis of variance). However, the within-subject CV for the FEV\textsubscript{1} was 10.2±5.4%. Furthermore, the FEV\textsubscript{1} significantly influenced the Borg score (analysis of covariance, p<0.0001).

Our subjects’ exercise capacities varied from day to day, with a within-subject CV for Wmax of 5.0±4.5%. For each subject, we have compared submaximal Borg\textsubscript{e} scores at the same absolute workload. Thus, the variability in submaximal Borg\textsubscript{e} scores could reflect, in part, the variability in exercise capacity. To normalize for changes in exercise capacity, we calculated Borg\textsubscript{e} scores by interpolation (from a linear regression of Borg\textsubscript{e} and workload) at 66% of Wmax for each trial in each subject. Using this method, the within-subject CV for Borg\textsubscript{e} was slightly improved, 18.7±21.0%, although this difference did not reach statistical significance.

### Table 2—Maximum Exercise Data

<table>
<thead>
<tr>
<th>Patient No.</th>
<th>VO\textsubscript{max} L/min</th>
<th>VO\textsubscript{max} % Predicted</th>
<th>HR\textsubscript{max} Beats per Minute</th>
<th>HR\textsubscript{max} % Predicted</th>
<th>Maximum (\dot{V}E) L/min</th>
<th>Maximum (\dot{V}E) % of MVV</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>0.81</td>
<td>39</td>
<td>139</td>
<td>81</td>
<td>29.3</td>
<td>104.6</td>
</tr>
<tr>
<td>2</td>
<td>1.74</td>
<td>104</td>
<td>172</td>
<td>104</td>
<td>57.9</td>
<td>101.6</td>
</tr>
<tr>
<td>3</td>
<td>1.18</td>
<td>56</td>
<td>132</td>
<td>76</td>
<td>37.0</td>
<td>86.4</td>
</tr>
<tr>
<td>4</td>
<td>1.90</td>
<td>78</td>
<td>137</td>
<td>80</td>
<td>69.4</td>
<td>76.5</td>
</tr>
<tr>
<td>5</td>
<td>1.44</td>
<td>65</td>
<td>156</td>
<td>92</td>
<td>47.3</td>
<td>62.2</td>
</tr>
<tr>
<td>6</td>
<td>1.48</td>
<td>91</td>
<td>111</td>
<td>69</td>
<td>52.7</td>
<td>62.3</td>
</tr>
<tr>
<td>Mean ± SD</td>
<td>1.43 ± 0.39</td>
<td>72.1 ± 23.8</td>
<td>141 ± 83.7</td>
<td>82.2 ± 12.5</td>
<td>48.9 ± 8.2</td>
<td>82.2</td>
</tr>
</tbody>
</table>

### Table 3—Mean Borg Scores During Exercise*

<table>
<thead>
<tr>
<th>Workload</th>
<th>33% of Maximum</th>
<th>66% of Maximum</th>
<th>100% of Maximum</th>
</tr>
</thead>
<tbody>
<tr>
<td>Borg\textsubscript{e}</td>
<td>1.10±0.91</td>
<td>3.70±1.29</td>
<td>6.77±2.1</td>
</tr>
<tr>
<td>Borg\textsubscript{d}</td>
<td>1.05±0.88</td>
<td>3.78±1.38</td>
<td>6.80±2.0</td>
</tr>
<tr>
<td>VAS effort, mm†</td>
<td>31.6±13.9</td>
<td>59.3±16.3</td>
<td>93.7±6.2</td>
</tr>
<tr>
<td>VAS discomfort, mm†</td>
<td>32.9±14.3</td>
<td>61.4±17.2</td>
<td>94.3±6.6</td>
</tr>
</tbody>
</table>

*Values are mean ± SD (n=6). Results from our previous study with the VAS are shown for comparison.
†Noted by Mador and Kufel.4
**RELATIONSHIP BETWEEN BORG SCORES AND OBJECTIVE INDICES OF EXERCISE INTENSITY**

Borg, was highly correlated with objective indices of exercise intensity for all subjects in all trials (r=0.96 ± 0.04 for VE, r=0.95 ± 0.04 for VO₂, and r=0.96 ± 0.02 for workload). Pooling all trials, a highly significant correlation was observed in each subject (r=0.89 ± 0.09; range, 0.72 to 0.96). Similar results were obtained for the relationship between Borg, and VO₂ (r=0.90 ± 0.08; range, 0.74 to 0.95) and for the relationship between Borg, and workload (r=0.91 ± 0.09; range, 0.73 to 0.96).

The Borg, and Borg₄ scores were highly correlated in each subject (r=0.99 ± 0.01). The relationship between Borg₄ and Borg, for all subjects in all trials is shown in Figure 3 (r=0.99). The slope of the Borg₄/Borg relationship was not significantly different from 1 (slope=0.99) while the Y intercept was not significantly different from 0 (Y intercept=0.015). Our subjects rated respiratory effort and discomfort with the same number in 222 of 248 observations.

Because Borg scores were linearly related to objective indices (VE, VO₂, and workload), these relationships can be described by the slope and position of the linear regression line. There was no significant variation in the slope of any of the Borg/objective index relationships (analysis of variance) across study days. The CV (within-subject across study days) for the slope of the Borg₄/VE relationship was 20.2 ± 8.0% (range, 12 to 32%). Similar results were obtained for the relationships between Borg₄/VO₂ and Borg₄/workload (CV=16.5 ± 6.7% [range, 9 to 29%] for Borg₄/VO₂; and CV=15.2 ± 4.5% [range, 10 to 22%] for Borg₄/workload. The position of the Borg₄/VE relationships...
relationship was examined by calculating the Borg scores by interpolation at a \( \dot{V}E \) of 85% of maximum. Analysis of variance revealed a significant change in Borg scores across study days (p<0.01). Similar results were obtained for the Borg\(_{es} / \dot{V}O_2 \) relationship (p<0.02) but not for the Borg\(_{es} / \)workload relationship.

\[ W_{\text{max}} \]

\[ \text{BORG effort} \]

\[ 10 \]

\[ 8 \]

\[ 6 \]

\[ 4 \]

\[ 2 \]

\[ 0 \]

\[ 2 \]

\[ 3 \]

\[ 4 \]

\[ 5 \]

\[ 6 \]

\[ \text{TRIAL NUMBER} \]

\[ 66\% \, W_{\text{max}} \]

\[ \text{BORG effort} \]

\[ 10 \]

\[ 8 \]

\[ 6 \]

\[ 4 \]

\[ 2 \]

\[ 0 \]

\[ 2 \]

\[ 3 \]

\[ 4 \]

\[ 5 \]

\[ 6 \]

\[ \text{TRIAL NUMBER} \]

FIGURE 2. Borg scores of respiratory effort (Borg\(_{es} \)) in each subject during the different study days during Wmax (top) and submaximal exercise (66% of Wmax [bottom]). Only subject 6 displayed an obvious systematic trend (decrease) in the Borg scores over time.

**Discussion**

The major findings of this study were as follows: (1) The perceptual estimate of the sense of respiratory effort or discomfort with the Borg scale did not vary systematically over time. (2) The Borg\(_{es} \) and Borg\(_{s} \) ratings were correlated with objective indices of exercise intensity (\( \dot{V}O_2, \dot{V}E, \) and workload). (3) Patients were unable to discriminate in a quantitative fashion between the sense of respiratory effort and discomfort during exercise. (4) The variability of Borg dyspnea scores was greater than that of objective exercise parameters.

Belman et al\(^{11} \) showed that Borg ratings of breathlessness systematically decreased with successive exercise tests in patients with COPD. However, in their study, constant load rather than incremental exercise was performed, which may account for the difference between studies. A prior study in normal subjects failed to show any systematic change in Borg ratings of breathlessness when incremental exercise was repeated (7 trials) over a 40-week period.\(^{12} \)

In our study, the variability of Borg scores exceeded that of the objective exercise parameters whether expressed as an absolute Borg score at a given workload or as the slope or position of a Borg/objective index relationship. However, the within-subject CV for maximal Borg scores; 13.9±9.0% or the slope of the Borg\(_{es} / \)objective index relationship; 15 to 20% is sufficiently small to make these measurements useful in evaluating group changes following therapeutic interventions. Detecting changes in an individual subject is more problematic. The 95% confidence limit for Borg dyspnea scores can be calculated as 2.57XCV (based on t-distribution with 5 degrees of freedom). Thus, an individual subject’s maximum Borg score would need to change by 36% or more before a significant change from baseline could be inferred.

What might account for the increased variability of Borg dyspnea measurements? The modified Borg scale is a category scale from 0 to 10. Our patients were instructed to point to a specific number on the Borg scale to rate their sense of respiratory effort and were not allowed to choose a point between numbers. Using the scale in this way must place limits on its resolution and could adversely influence variability. For example, if we measured \( \dot{V}E \) to the nearest 10 L/min or \( \dot{V}O_2 \) to the nearest 200 mL/min, the variability of these indices might be increased. Whether permitting patients to use decimals would improve variability remains to be determined.

Changes in the mechanics of breathing will alter the intensity of respiratory effort sensation at any given level of ventilation.\(^{13} \) Spirometry was performed prior to exercise in all subjects. The within-subject CV for the FEV\(_1 \) was 10.2±5.4%, which is
similar to the variability observed in previous studies of patients with clinically stable COPD, but it exceeds that observed in normal subjects. Not surprisingly, we found that the FEV₁ significantly influenced the Borgₐ scores (analysis of covariance). Thus, fluctuations in the level of airway obstruction which are common in patients with COPD will adversely influence the variability of Borgₐ scores.

Several previous studies have evaluated the reproducibility of dyspnea measurements during exercise. Muza et al² and Silverman and colleagues³ found that Borg ratings of dyspnea were surprisingly reproducible (CV=3%) in the short term (same day to within several days) in patients with COPD. Other investigators have found considerably more short-term variability in dyspnea measurements (CV=18%) even in normal subjects. In our study, we found that the within-subject CV for Borg dyspnea measurements over a 5-week period considerably exceeded that observed by Silverstein and colleagues. Certainly, it would not be surprising if the reproducibility of dyspnea measurements deteriorated with time.

Indeed, Adams and colleagues¹⁷ found that the reproducibility of VAS measurements was less at 1 year than at 1 week in normal subjects.

Borg ratings of respiratory effort and discomfort were less reproducible at submaximal levels of exercise compared with maximal exercise. Similar findings were noted in our previous study. In contrast, objective indices of exercise performance had similar variability during submaximal and maximal exercise. The reason for the increase in variability of dyspnea ratings during submaximal exercise is unclear. It is not due to an increase in the variability of the breathing pattern during submaximal exercise. The within-subject CV at a workload of 33% of Wmax was 4.1 ± 1.2% for the duty cycle, 8.5 ± 3.3% for respiratory rate, and 7.2 ± 3.1% for mean inspiratory flow (measured with a wire screen pneumotachograph). Similar variability was observed at 66% and 100% of Wmax.

In our study, there were no systematic changes over time in the slope of any of the Borg₉/objective index relationships. In contrast, changes in the posi-
tion of the Borg$_r$/VE and Borg$_e$/VO$_2$ relationships were observed over time. Thus, it appears that more than one practice session is required before the position of the Borg$_r$/VE or Borg$_e$/VO$_2$ relationship stabilizes.

In our study, only the first three patients were “ventilatory-limited” and only patients 1, 2, 3, and 6 exercised maximally according to standard criteria. All our patients stopped exercise because of intolerable dyspnea. Whether the reproducibility of our Borg dyspnea scores would have been any different if we had restricted study entry to ventilatory-limited patients remains to be determined. However, many patients with COPD stop exercising at submaximal ventilations and submaximal heart rates presumably because of intolerable sensations of dyspnea or leg fatigue.

**Relationship Between Borg Scores and Objective Indices of Exercise Intensity**

To quantitate sensory experiences, sensation intensity is examined in relation to the intensity of the stimulus employed to provoke the sensation. Accordingly, investigators have compared dyspnea intensity with the magnitude of the exercise task (ie, work or power production). We found a strong linear relationship between Borg ratings of respiratory effort and external work ($r=0.91 \pm 0.09$, range 0.73-0.96) as have others. Alternatively, investigators have compared dyspnea ratings with VE $r=0.89 \pm 0.09$; range, 0.72 to 0.96). However, this relationship was no stronger than that observed between Borg ratings of respiratory effort and external work suggesting that VE may not always be a better “stimulus” than workload when examining dyspnea during exercise. It must be remembered that a host of physiologic variables independently affect the sensation of dyspnea. Thus, both VE and workload will only correlate with dyspnea intensity to the extent that they reflect these underlying variables.

**Similarity Between Effort and Sensation Scores**

Dyspnea is a complex sensation that may encompass multiple qualitatively distinct sensations. Indeed, prior studies have shown that normal subjects and patients describe dyspnea with different verbal descriptors depending on the stimulus used and/or disease process that provokes dyspnea. Attempts at quantifying dyspnea may be influenced not only by the magnitude of the sensation but also by the quality of the sensation and the individual’s reaction to the sensation (affective component). In this study, we examined whether patients could distinguish in a quantitative fashion between the sensation of respiratory effort and the degree to which breathing caused discomfort. We chose these two descriptors because some investigators in the field have defined dyspnea in terms of respiratory effort while others have emphasized the uncomfortable nature of the sensation, leading to the concern that different investigators are measuring different aspects of the sensation; thus, their work may not be comparable. We found that our patients were unable to distinguish respiratory effort from respiratory discomfort when forced to make rapid decisions during incremental exercise, suggesting that both scales were measuring a common element. Similar findings were observed in our prior study with the VAS. In these studies, patients were presented with the two scales at each workload during the same exercise trial. Thus, the patient’s sensation estimates with one descriptor may have influenced his or her estimates with the other descriptor. Whether the patients would have distinguished between these two dyspnea descriptors if they had been presented on different days remains to be determined. Wilson and Jones found that normal subjects were able to distinguish between the intensity of breathlessness (defined as an uncomfortable need to breathe) and the amount of distress evoked by breathlessness during exercise. Similarly, Demediuk and colleagues found that breathlessness defined as an unpleasant urge to breathe and the degree of respiratory effort could be discriminated by normal subjects during voluntary hyperpnea. Furthermore, addition of CO2 during voluntary hyperpnea resulted in changes in respiratory effort and breathlessness that were opposite in direction. The sensations compared in our study (discomfort vs effort) were somewhat different than in previous studies (breathlessness vs distress, breathlessness vs effort), which may be important. Our patients were older and of limited educational background which could have impaired their ability to make subtle distinctions in sensation quality. Finally, the quality of the sensation of dyspnea in patients with COPD is likely to be quite different from that experienced by normal subjects.

In conclusion, during incremental exercise the variability of Borg ratings of dyspnea is greater than the variability of objective indices, but it is still sufficiently small to allow their use as outcome measures in studies involving patients with COPD.

ACKNOWLEDGMENT: The writers thank Mrs. Diane Poch for preparation of the manuscript.
REFERENCES

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