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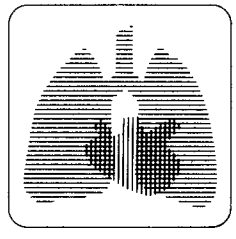

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Objective: **Evaluate the reliability and validity of a new version of the University of California, San Diego Shortness of Breath Questionnaire (SOBQ), a 24-item measure that assesses self-reported shortness of breath while performing a variety of activities of daily living.**
Design: **Patients enrolled in a pulmonary rehabilitation program were asked to complete the SOBQ, the Quality of Well-Being Scale, the Center for Epidemiologic Studies Depression Scale, and a 6-min walk with modified Borg scale ratings of perceived breathlessness following the walk.**
Setting: **University medical center pulmonary rehabilitation program.**
Patients: **Thirty-two male subjects and 22 female subjects with a variety of pulmonary diagnoses: COPD (n=28), cystic fibrosis (n=9), and postlung transplant (n=17).**
Measurements and results: **The current version of the SOBQ was compared with the previous version, the format of which often resulted in a significant number of "not applicable" answers. The results demonstrated that the SOBQ had excellent internal consistency (α=0.96). The SOBQ was also significantly correlated with all validity criteria.**
Conclusions: **The SOBQ is a valuable assessment tool in both clinical practice and research in patients with moderate-to-severe lung disease.** ***(CHEST 1998; 113:619-24)***

Key words: COPD; dyspnea; outcomes assessment; shortness of breath

Abbreviations: ADL=activity of daily living; BDI=Baseline Dyspnea Index; CESD=Center for Epidemiologic Studies Depression; CF=cystic fibrosis; D_{CO}=diffusion of carbon monoxide; MEP=maximal expiratory pressure; MIP=maximal inspiratory pressure; N/A=not applicable; PB=perceived breathlessness (modified Borg scale ratings post-6MW); QWB=Quality of Well-Being; RV=residual volume; 6MW=6-min walk distance (meters); SOBQ=Shortness of Breath Questionnaire; TLC=total lung capacity; UCSD=University of California, San Diego

Dyspnea is one of the most common and disabling symptoms for patients with chronic lung diseases.[1] Dyspnea is also an important outcome variable for clinical and research evaluations of lung diseases for which a primary goal is the reduction and management of breathlessness. However, as a subjective symptom, dyspnea has proved difficult to measure. Several instruments are available to assess dyspnea, including structured interviews, self-report questionnaires, visual analog, and numeric scales.[2] Dyspnea may also be measured in various settings, such as emergency departments, physicians' offices, clinics, rehabilitation programs, and pulmonary function and exercise laboratories. Patients may be asked to give historical reports of dyspnea during a given period of time in the past or to estimate the amount of dyspnea experienced as they perform various tasks. Given the complexity of the symptom and the various approaches to measurement, the choice of dyspnea measures should be based on information about their reliability and validity. This article describes the validation of a new dyspnea measure, the University of California, San Diego (UCSD) Shortness of Breath Questionnaire (SOBQ).

The SOBQ was developed and has been used extensively in the Pulmonary Rehabilitation Program at UCSD to assess shortness of breath with various activities of daily living (ADLs).[3] Since its initial development, the SOBQ has undergone a number of revisions that clarified and expanded the rating scale

*From the Joint Doctoral Program in Clinical Psychology (Dr. Eakin), University of California San Diego/San Diego State University, and the Division of Pulmonary and Critical Care Medicine (Drs. Resnikoff and Ries and Ms. Prewitt), and Department of Family and Preventive Medicine (Dr. Kaplan), University of California, San Diego.
†Currently at the Oregon Research Institute, Eugene.
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Reprint requests: Andrew L. Ries, MD, MPH, FCCP, UCSD Medical Center, 200 W Arbor Dr, San Diego, CA 92103-8377

of the original instrument. The new SOBQ asks patients to indicate the severity of shortness of breath experienced on a six-point scale (0=not at all, to 5=maximal or unable to do because of breathlessness) during 21 different ADLs associated with varying levels of exertion. Three additional questions about limitations due to shortness of breath, fear of harm from overexertion, and fear of shortness of breath are included for a total of 24 items (see Appendix). If patients do not routinely perform the activity, they are asked to estimate the degree of shortness of breath anticipated. The SOBQ is scored by summing responses across all 24 items to form a total score. Scores range from 0 to 120.

The previous version of the SOBQ, which included a "not applicable (N/A)" category and which queried frequency of dyspnea with specific activities, was validated in a study examining the reliability and validity of six commonly used dyspnea measures.[4] In that study, however, 122 of 143 patients (85.3%) had at least a single N/A answer. Based on the results of that study, the N/A category was replaced by an estimate of anticipated dyspnea because of the frequency of missing data. In addition, the rating system was changed from rating the frequency of dyspnea to a severity scale to make it easier for patients to understand and complete. The validation of the new version of the SOBQ, with these potentially significant changes, is described in this article.

Materials and Methods

Subjects

The 54 subjects in this study were a convenience sample of patients evaluated at the University of California, San Diego Pulmonary Rehabilitation Program. Subjects ranged in age from 12 to 82 years; 41% were female (Table 1). Diagnostic breakdown was as follows: COPD (n=28), cystic fibrosis (CF) (n=9), and postlung transplant (n=17). Three patients with restrictive parenchymal disease and two patients with pulmonary vascular disease were excluded due to small sample size. Of the postlung transplantation patients, the single lung transplant recipients included five with emphysema, and one each with α_1-antitrypsin deficiency, sarcoidosis, pulmonary vascular disease, and idiopathic pulmonary fibrosis. The five double-lung transplant recipients had underlying CF and the three heart-lung transplant recipients had Eisenmenger's syndrome. Subjects were participating in a variety of activities at the Rehabilitation Program, including a standard pulmonary rehabilitation program for patients with chronic lung disease (n=21), rehabilitation prior to lung transplantation (n=16), and postlung transplantation rehabilitation (n=17).

Procedures

Subjects completed the measures described below as part of their rehabilitation assessment. They completed both the previous and the new version of the SOBQ (with the order of administration randomly assigned), along with the 6-min walk (6MW) test, modified Borg scale ratings of perceived breathlessness (PB) following the 6MW test, the Quality of Well-Being (QWB) Scale, and the Center for Epidemiologic Studies Depression (CESD) Scale. Data on pulmonary function testing were

Table 1—*Subject Characteristics

Characteristic	Diagnosis		
	COPD (n=28)	CF (n=9)	Posttransplant (n=17)
Gender, M/F	18/10	7/2	7/10
Age, yr	64 (12)	23 (9)	48 (14)
QWB	0.573 (0.100)	0.624 (0.070)	0.646 (0.114)
CESD	11.7 (8.5)	8.2 (7.8)	7.8 (6.5)
6MW, m	312 (108)	458 (106)	504 (162)
PB	4.3 (1.3)	4.1 (1.9)	2.7 (1.8)
SOBQ (old)	54.8 (19.4)	28.2 (14.6)	18.4 (16.5)
SOBQ (new)	61.9 (18.8)	31.9 (17.1)	21.7 (19.8)
Pulmonary function tests			
No.	14	7	17
FVC, L	1.95 (0.49)	1.65 (0.49)	2.74 (0.88)
FVC, % pred	56 (22)	43 (13)	70 (15)
FEV_1, L	0.69 (0.22)	0.79 (0.20)	2.03 (0.96)
FEV_1, % pred	30 (17)	25 (9)	68 (25)
FEV_1/FVC, %	36 (14)	49 (8)	72 (17)
$FEF_{25-75\%}$, L/s	0.30 (0.25)	0.28 (0.10)	1.89 (1.66)
$FEF_{25-75\%}$, % pred	13 (14)	8 (5)	55 (42)
RV/TLC, %	71 (10)	63 (8)	46 (17)
Dco, mL/min/mm Hg	7.1 (1.9)	16.8 (2.5)	20.7 (4.6)
Dco, % pred	31 (12)	65 (18)	79 (12)
MIP, cm H_{20} (at RV)	52 (15)	98 (14)	124 (23)
MEP, cm H_{20} (at TLC)	102 (52)	142 (55)	172 (34)

*Results expressed as Mean (SD); n=54; pred=predicted; $FEF_{25-75\%}$=forced expiratory flow rate between 25% and 75% of the FVC.

taken from patients' medical records, if available, within 6 months of the rehabilitation assessment. Only those tests performed at UCSD Medical Center were accepted. Pulmonary function testing for posttransplant patients was retrieved with the additional criterion of same surgical status (posttransplant) as on the date of questionnaire completion. For the 38 patients with available pulmonary function test results, the time between pulmonary function testing and questionnaire administration was 14±45 days (mean±SD).

All pulmonary function tests included spirometric measurements of vital capacity and expiratory flow rates. Lung volumes measured by body plethysmography, single-breath diffusing capacity (Dco), maximal inspiratory pressure (MIP) (at residual volume [RV]), and maximal expiratory pressure (MEP) (at total lung capacity [TLC]) to assess respiratory muscle strength were performed in 68% of the pulmonary function tests (79% of COPD patients, 71% of CF patients, 59% of posttransplant patients). This was due to the inability of some patients to tolerate body plethysmography and the routine use of abbreviated pulmonary function testing for postlung transplant patients. All testing and quality control procedures were done according to standard and recommended methods.[5-7]

Measures

6MW Test: The 6MW is a standard measure of exercise tolerance used frequently with lung and heart disease populations.[8] The test was conducted in an area free from distractions with standardized encouragement provided by the staff. Subjects were asked to walk as far as possible in 6 min. The timed distance walk test has been shown to be highly reliable,[9] with moderate correlations with tests of pulmonary function and maximum exercise capacity.[10] Guyatt and colleagues[11] demonstrated a learning effect across subsequent trials of this test and recommend two practice tests prior to actual test administration. Because of time constraints in this study protocol, we used one practice test, followed by at least 10 min of rest and then a second test. Data from the longer of the two walks were used. Subjects rated their dyspnea using the modified Borg scale at the end of each walk.[12]

QWB Scale: 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 point in time from three separate scales: mobility, physical activity, and social activity. Second, each patient selects, from a list of 24 clusters of symptoms and problems, those that they had experienced over the last 6 days. Next, the observed level of function and the subjective symptomatic complaint are weighted by preference, or the utility for the state, on a scale ranging from 0 (for dead) to 1.0 (for optimum function). 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, with higher scores indicating better life quality. This system has been used extensively in a variety of medical and health services research studies.[13,14] In addition, validity data for patients with COPD have been published. Kaplan and coworkers[15] reported that the QWB was substantially correlated with both performance and physiologic variables relevant to the health status of patients with COPD.

CESD Scale: The CESD is a general measure of depression that has been used extensively in epidemiologic studies. The scale includes 20 items and taps dimensions of depressed mood, hopelessness, appetite loss, sleep disturbance, and energy level. Patients are asked to report how often they experienced a particular symptom during the past week on a four-point scale ranging from rarely or none of the time to most or all of the time. Total score on the CESD ranges from 0 to 60, with scores >16 indicative of clinically significant levels of depressive symptoms in adults. Radloff[16] has presented extensive data on the reliability and validity of the CESD. Test-retest correlations are good for a test designed to assess fluctuations in mood (r=0.57). The CESD discriminates between clinical and normal populations, and the reliability and validity have been replicated across various normal and clinical samples.

Statistical Analyses

The SOBQ was evaluated for reliability and validity. Reliability was assessed by calculation of coefficient α, a statistic used to evaluate internal consistency, or the extent to which the different items on the questionnaire measure the same construct.[17] The validity of the SOBQ was evaluated by examining its correlations with variables with which it is assumed to be related. The choice of variables against which we evaluated the validity of the SOBQ was based on clinical judgment and a review of the literature that indicated some empirical support for the relationships of dyspnea with exercise tolerance, health-related quality of life, lung function, and depression.[2]

Results

Subject characteristics are shown in Table 1. The 28 subjects with COPD were older and had higher scores on the CESD, SOBQ, and Borg ratings of PB after the 6MW, with lower QWB scores. These were associated with lower 6MW distances, FEV_1, Dco, MIP, and MEP. Mean scores on the old and new versions of the SOBQ were similar for each group, with slightly higher mean values on the new version.

An internal consistency criterion of 0.70 was chosen as good evidence for reliability.[18] The SOBQ demonstrated excellent internal consistency (α=0.96). Item-total correlations ranged from 0.49 to 0.87, indicating that each item contributed to the overall reliability of the instrument.

Figure 1 shows the correlation of the total SOBQ scores for the old and new versions for each diagnostic group. The correlation of the versions was excellent overall (0.96) and for each group (COPD: 0.89, $p<0.001$; CF: 0.91, $p<0.001$; posttransplant: 0.96, $p<0.001$). As seen in Table 2, the two versions of the SOBQ showed a similar pattern of correlations with the validity criteria. The SOBQ scores correlated negatively with physiologic measures of disease severity (percent predicted FVC and FEV_1, Dco, and MIP), health-related quality of life (QWB), and exercise tolerance (6MW). SOBQ scores correlated positively with Borg scale ratings of PB following the 6MW, with RV/TLC and with depression (CESD). All of these correlations were in the expected direction. MEP was also evaluated, but found to have no significant correlation with SOBQ scores. On breakdown by diagnosis, SOBQ scores for COPD patients correlated significantly only with 6MW distance

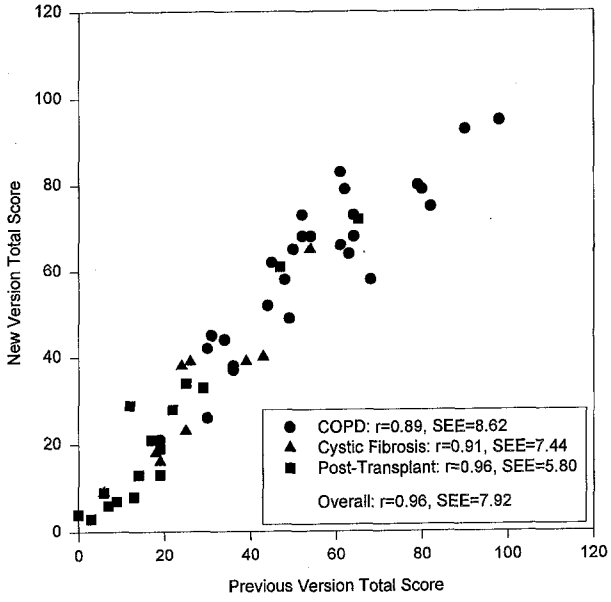

FIGURE 1. Correlation of the total SOBQ scores for the old and new versions for each diagnostic group.

(r=−0.47 and −0.42 for the older and newer versions, respectively, $p<0.05$). Posttransplant patients also showed a significant correlation between SOBQ scores and 6MW distance (r=−0.64 and −0.64 for the older and newer versions, respectively, $p=0.006$), and nonsignificant correlations with QWB and CESD scores. Patients with CF showed nonsignificant correlations with percent-predicted DCO, MIP, and PB.

DISCUSSION

The results of this study and our previous experience[4] indicate that the UCSD SOBQ is a reliable and valid instrument that can be used to assess dyspnea associated with ADLs in patients with moderate-to-severe chronic lung disease. Dyspnea is a primary symptom and an important outcome measure in evaluating patients with chronic lung diseases.[19,20] The choice of a dyspnea measure depends not only on the purpose of the application, but also on the reliability and validity of the measure.

We have developed and used earlier versions of the SOBQ in our pulmonary rehabilitation program for nearly 30 years. As a clinical tool, it was used primarily in the screening evaluation for the rehabilitation program to assess dyspnea associated with specific ADLs. We have found this information useful in the screening process to better understand the impact of lung disease on a person's life and also to help set specific, individual goals for the program. Only in recent years, however, did we begin to use and evaluate the SOBQ as an outcome measure of dyspnea in research studies. Because of this, we have made a series of modifications in the rating and scoring system used in the questionnaire to minimize missing responses for specific daily activities that are N/A or no longer performed by individual subjects.

Although the current study is limited by its small sample size and the use of a convenience sample of patients, the results are consistent with those from a previous study in which an older version of the SOBQ was evaluated on a larger sample of patients with COPD.[4] The new version of the SOBQ correlates well with the previous version (Fig 1). It should be noted that this study included not only 28 patients with COPD, but also 9 patients with CF and 17 patients after lung transplantation. This suggests that the instrument has validity for dyspnea symptoms in different lung diseases. The number of patients in each subgroup was not large enough to reach statistical significance for many of the individual correlations.

Correlations between ratings of dyspnea and physiologic parameters have been observed previously. In patients with COPD, FEV_1 and FVC have been correlated with the Baseline Dyspnea Index (BDI).[21–23] However, Wolkove et al[24] did not find a significant correlation between Borg scores of dyspnea and FEV_1 and FVC in patients with COPD. Recently, Redelmeier et al[25] investigated the change in FEV_1 associated with a change in subjective dyspnea rating on a 7-point scale from "much better . . ." to "much worse . . ." Using this scale, a change of 4% of predicted FEV_1 was required to change the rating, with mild correlation (r=0.29). Dyspnea by the BDI measure has also been correlated with percent-

Table 2—*Validity Correlations of the Two Versions of the SOBQ

	SOBQ (Previous)		SOBQ (New)
	n	r	r
QWB	52	−0.40†	−0.41†
CESD	52	0.35‡	0.37†
6MW	52	−0.68§	−0.68§
PB	52	+0.42†	+0.45§
FVC, % pred	38	−0.36‡	−0.36‡
FEV_1, % pred	38	−0.49†	−0.50†
FEV_1/FVC, %	38	−0.50†	−0.51†
$FEF_{25-75\%}$, % pred	38	−0.42†	−0.44†
RV/TLC, %	26	+0.48‡	+0.47‡
DCO, % pred	29	−0.69§	−0.67§
MIP, cm H_2O (at RV)	30	−0.64§	−0.60§

*For explanation of abbreviations, see text and Table 1 footnotes.
†$p<0.01$.
‡$p<0.05$.
§$p<0.001$.

predicted DCO in 37 patients with chronic airflow limitation[26] (r=0.68). In the current study, SOBQ scores and percent-predicted DCO appear to correlate best, although not significantly, for the CF group. Interestingly, no correlation was seen for the COPD group. Timed walk distances have also been correlated with dyspnea, most commonly in COPD. For example, Mahler et al[21] found a strong correlation between a 12-min walk distance and the BDI scores (r=0.6). As seen in Table 2, similar relationships were seen in the current study for the 6MW.

The causes of dyspnea are multifactorial, with contributions from oxygen and acid-base abnormalities, mechanical factors such as expiratory flow limitation and lung hyperinflation, and psychological factors. Which of these contribute the most in any particular disease remains poorly defined. This study, done as an evaluation of the SOBQ, adds to the growing literature examining determinants of dyspnea, but does not answer the question of which factors contribute the most in each disease. The SOBQ may be used as a tool to further evaluate these relationships in future studies.

The SOBQ is a relative newcomer among the group of commonly used dyspnea measures (*ie*, the BDI,[21] the American Thoracic Society Dyspnea Scale,[27] and the Oxygen Cost Diagram[28]). In a previous study, we compared the previous version of the SOBQ with these other dyspnea measures in terms of its reliability, validity, and ease of administration.[4] The SOBQ demonstrated higher levels of reliability than the other measures evaluated. It is the only one of these instruments that evaluates dyspnea in relation to specific ADLs; thus, it provides more detailed information than the global scores obtained from the American Thoracic Society Dyspnea Scale and Oxygen Cost Diagram. While clinicians experienced in evaluating patients with lung disease may find the interviewer-administered BDI easy to complete, we believe that the self-report nature of the SOBQ makes it particularly useful for research and clinical applications. The SOBQ can be completed quickly and easily by patients with little instruction or supervision.

Given the replication of our previous findings, and the correlation between the previous and current versions of the SOBQ (r=0.96), we feel confident that the SOBQ is a reliable and valid measure of dyspnea. In this study, the SOBQ demonstrated excellent internal consistency (α=0.96) and moderate-to-strong correlations with exercise tolerance, Borg scale ratings of dyspnea following a 6MW, disease severity, health-related quality of life, and depression for various disease processes. Its high levels of reliability and validity make it an excellent tool for research applications. We have also found the SOBQ to be a useful clinical instrument to assess dyspnea during common ADLs in order to set goals for improvement in specific activities through pulmonary rehabilitation or other interventions.

APPENDIX—UCSD SOBQ

UCSD Medical Center Pulmonary Rehabilitation Program Shortness-of-Breath Questionnaire

Instructions: For each activity listed below, please rate your breathlessness on a scale between zero and five where 0 is not at all breathless and 5 is maximally breathless or too breathless to do the activity. If the activity is one which you do not perform, please give your best estimate of breathlessness. Your responses should be for an "average" day during the past week. Please respond to all items. Read the two examples below then turn the page to begin the questionnaire.

0 Not at all
1
2
3
4 Severely
5 Maximally or unable to do because of breathlessness

Example 1:
How short of breath do you get while:
1. Brushing teeth . . . 0 1 2 ③ 4 5
Harry has felt moderately short of breath during the past week while brushing his teeth and so circles a three for this activity.

Example 2:
How short of breath do you get while:
2. Mowing the lawn . . . 0 1 2 3 4 ⑤
Anne has never mowed the lawn before but estimates that she would have been too breathless to do this activity during the past week. She circles a five for this activity.

---

0 Not at all
1
2
3
4 Severely
5 Maximally or unable to do because of breathlessness

How short of breath do you get:

1. At rest . . .	0	1	2	3	4	5
2. Walking on a level at your own pace . . .	0	1	2	3	4	5
3. Walking on a level with others your age . . .	0	1	2	3	4	5
4. Walking up a hill . . .	0	1	2	3	4	5
5. Walking up stairs . . .	0	1	2	3	4	5
6. While eating . . .	0	1	2	3	4	5
7. Standing up from a chair . . .	0	1	2	3	4	5
8. Brushing teeth . . .	0	1	2	3	4	5
9. Shaving and/or brushing hair . . .	0	1	2	3	4	5
10. Showering/bathing . . .	0	1	2	3	4	5
11. Dressing . . .	0	1	2	3	4	5
12. Picking up and straightening . . .	0	1	2	3	4	5
13. Doing dishes . . .	0	1	2	3	4	5
14. Sweeping/vacuuming . . .	0	1	2	3	4	5

15. Making bed . . .	0	1	2	3	4	5
16. Shopping . . .	0	1	2	3	4	5
17. Doing laundry . . .	0	1	2	3	4	5
18. Washing car . . .	0	1	2	3	4	5
19. Mowing lawn . . .	0	1	2	3	4	5
20. Watering lawn . . .	0	1	2	3	4	5
21. Sexual activities . . .	0	1	2	3	4	5
How much do these limit you in your daily life?						
22. Shortness of breath . . .	0	1	2	3	4	5
23. Fear of "hurting myself" by overexerting . . .	0	1	2	3	4	5
24. Fear of shortness of breath . . .	0	1	2	3	4	5

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