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Validation of the COPD severity score for use in primary care: the NEREA study

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ABSTRACT: Spirometry is underused for the assessment of severity of chronic obstructive pulmonary disease (COPD) in primary care (PC). Therefore, simple assessment tools are required in this setting. The aim of the present study was to validate the COPD severity score (COPDSS) for use in PC.

A multicentric study was carried out in stable COPD patients in PC. The concurrent validity of the COPDSS was evaluated by examining the association between COPDSS, COPD clinical indicators and the London Chest Activity of Daily Living (LCADL) scale, European quality of life (EuroQOL) questionnaires and Charlson comorbidity index.

A total of 837 patients with COPD were analysed (males 84.3%; mean±SD age 68±11 yrs; forced expiratory volume in one second 54.6±17.7% of the predicted value). A strong correlation was found between COPDSS and dyspnoea level and a moderate correlation between COPDSS and exacerbation number. The COPDSS discriminated between patients with varying degrees of dyspnoea (area under receiver operating characteristic (ROC) curve 0.837), and according to number of exacerbations in the last year (area under ROC curve 0.773). Higher COPDSS scores were significantly associated with lower EuroQOL scores, lower EuroQOL visual analogue scale scores and higher LCADL scores.

The present results indicate that the chronic obstructive pulmonary disease severity score is a useful and reliable tool for assessing the severity of chronic obstructive pulmonary disease in primary care.

KEYWORDS: Chronic obstructive pulmonary disease, outcome assessment, primary care, questionnaires

Chronic obstructive pulmonary disease (COPD) is a major cause of disability and mortality, and may affect 7–12% of the adult population [1]. The prevalence of COPD in the adult population aged 40–69 yrs in Spain is 9.1% [2], being a major problem for the public healthcare system, in both primary care (PC) and hospitals. The financial burden involved has increased steadily due to the ageing of the population, as well as the ever-increasing prevalence of the disease [3].

The demonstration of airflow obstruction by forced spirometry is mandatory for the diagnosis of COPD, but it is increasingly recognised that COPD is a complex disease, and other readily obtained variables add significant prognostic value in the evaluation of a patient with COPD. The body mass index, airflow obstruction, dyspnoea and exercise capacity (BODE) index, which is composed of four variables, has been demonstrated to predict mortality better than forced expiratory volume in one second (FEV_1) alone [4]. However, spirometry is underused for the diagnosis and follow-up of patients with COPD in PC centres [5], and other assessment measures, such as the 6-min walking test, necessary for the BODE index, are also difficult to perform in this setting. In this context, the development of simple and reliable standardised questionnaires would not be a substitute for spirometry but may potentially help PC physicians in assessing the severity of COPD patients and may also become a research tool for the evaluation of the impact of therapies or interventions.

EISNER *et al.* [6] developed and validated a simple and specific scale for scoring the severity of COPD, the COPD severity score (COPDSS), used as study outcome or adjust for disease severity of patients with COPD. The validity of this scale was demonstrated in a population of 383 US adults with self-reported physician-diagnosed COPD. Internal consistency reliability was established using standard psychometric techniques and concurrent validity was examined by analysing the association between COPDSS and pulmonary function, the physical component of health-related quality of life (HRQoL) using the

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12-item short-form health survey (SF-12) and physical health status using a question adapted from the National Health Interview Survey (NHIS).

In the present study, the analysis of the properties of the COPDSS were extended by validating its use in PC. A large population of COPD patients were analysed and the concurrent validity of the questionnaire assessed by evaluating its association with lung function, frequency of exacerbations, HRQoL measured by the European quality of life five-dimension (EuroQOL-5D) questionnnaire, the UK Medical Research Council (MRC) dyspnoea score and activities of daily living measured using the London Chest Activity of Daily Living (LCADL) scale.

METHOD

Study design

The present study was a cross-sectional multicentric study with the aim of evaluating the validity of a new severity scoring questionnaire for COPD, the COPDSS, for application in PC centres. General practitioners (GPs) were randomly selected from the database of the sponsoring company, which included 13,848 practising GPs throughout Spain, ~60% of the GPs registered in the country. Participating GPs were requested to include the first five consecutive unselected COPD patients who fulfilled the inclusion and exclusion criteria of the study. All tests and questionnaires were administered by GPs in a face-to-face interview.

The COPDSS includes questions that comprise five overall aspects of COPD severity: respiratory symptoms, systemic corticosteroid use, other COPD medication use, previous hospitalisation or intubation for respiratory disease, and home oxygen use. Each item was assigned an *a priori* weight based on clinical aspects of the disease and its expected contribution to overall COPD severity. Missing values for medication use and other questions were defined as zero. The possible total score ranged 0–35, with higher scores reflecting more-severe COPD. The questionnaire was developed and validated in a sample of 383 US adults with self-reported physician-diagnosed COPD [6]. Since the COPDSS consists of a checklist of items about symptoms and treatment with only yes/no answers (see Appendix), a direct Spanish translation, which can be considered conceptually equivalent to the original version, was obtained. Translation and use of the questionnaire in the present study were performed with permission from the original authors.

The concurrent validity of the COPDSS was assessed by evaluating its association with lung function, clinical characteristics of COPD, frequency of exacerbations, HRQoL measured using the EuroQOL-5D questionnaire, MRC dyspnoea score and activities of daily living measured using the LCADL scale.

Population

Inclusion criteria were ambulatory COPD patients aged $\geqslant$40 yrs who were current or ex-smokers with a smoking history of $\geqslant$10 pack-yrs. The diagnosis of COPD had to be confirmed by a spirometric test, either performed at the clinic visit or reported within the previous 12 months, showing a post-bronchodilator FEV_1/forced vital capacity (FVC) of $<$70%. Each patient had to present in a stable condition with no worsening of symptoms over a 3-month period prior to inclusion in the study. Participants were excluded if they had been diagnosed with asthma or a chronic respiratory disease other than COPD, or if diagnosed with dementia or serious mental illness that would prevent them understanding the questionnaires. The study protocol was approved by a central reference ethics committee, the committee of the Hospital Clinic in Barcelona (Spain). All of the patients had to provide written informed consent in order to participate in the study.

Measurements

The sociodemographic characteristics obtained were sex, age and educational level. Other variables collected were COPD-related symptoms, time since diagnosis (in years), and number of exacerbations and hospitalisations during the previous year, based on self-reporting by the patient and review of clinical records.

The specific questionnaires used in the present study were as follows. 1) The MRC dyspnoea scale [7]. 2) Evaluation of the activities of daily living was performed using the Spanish version of the LCADL scale [8, 9]. This tool has demonstrated good correlations with other questionnaires, such as the St George's Respiratory Questionnaire activity subscale or the Nottingham Extended Activities of Daily Living questionnaire [10], but with the advantage of being focused on limitations to the activity with only 15 items. Each item was scored from 0 (''I wouldn't do it anyway'') to 5 (''someone else does this for me (or helps)''), with the highest LCADL score reflecting greater disability. 3) The overall burden of comorbid diseases was assessed using the Charlson comorbidity score [11]. 4) The evaluation of patient HRQoL was performed using the Spanish version of the self-administered EuroQOL-5D [12, 13], which is a generic questionnaire used to assess HRQoL in a variety of chronic diseases, including COPD. The EuroQOL-5D comprises a descriptive system and a visual analogue scale (VAS) that asks the respondent to consider and rate their health ''today''. The VAS score is anchored at 100 (best imaginable health) and 0 (worst imaginable health). The descriptive system enables the respondent to classify their health according to three levels in five dimensions: mobility, self-care, usual activities, pain/discomfort, and anxiety/depression. The data may be used to represent a profile of health status or converted into a single summary index (EuroQOL-5D index) by applying scores from a valuation set [12]. Higher EuroQOL-5D scores represent more favourable health status.

Statistical analyses

Data are presented as mean$\pm$SD for quantitative data and percentages for qualitative data. Means were obtained for all of the variables used for validity, and Spearman's correlation coefficients were used to examine the association between the COPDSS and the corresponding variables. For significantly associated variables, patients were grouped into different categories according to ranged values and total COPDSSs were calculated for each group. The differences in COPSS between these study groups were compared using one-way ANOVA. For qualitative measurements, this association was assessed using Spearman's rank correlation.

Receiver operating characteristic (ROC) curves were used to define the appropriate cut-off values of the different COPD clinical indicators in relation to the COPDSS, and sensitivity and

specificity were determined for each variable. The area under the curve (AUC) of the ROC curve was calculated, and a value of >0.80 was considered to represent good discrimination [14].

Multiple linear regression analysis was performed in order to examine the relationship between potential predictive factors and the COPDSS. Previously, bivariate analysis had been carried out for each variable (sex, age, respiratory symptoms, COPD exacerbations, MRC dyspnoea score, EuroQOL-5D score, LCADL score and FEV1) using an unpaired t-test to explore the independent relation between each potential predictor and the COPDSS. Variables that significantly correlated with the COPDSS were subsequently included in a multivariate model, performed using backward Wald criteria, to eliminate the possibility of mutual confounding. All tests were two-tailed and the level of significance was set at 0.05.

RESULTS

Characteristics of COPD patients

It was necessary to contact a total of 360 GPs in order to obtain 248 (68%) participants. The main reasons for not participating were lack of time, no interest in research, no interest in COPD or not attending patients with COPD. The total number of patients included was 1,232, but, after checking the selection criteria, 196 (15.9%) patients were excluded from the study, mostly due to the lack of spirometric data (n=115) or incomplete or inconsistent data regarding smoking habits (n=69). Of the remaining 1,037 patients, 827 (79.7%) had recently undergone spirometry with a post-bronchodilator FEV1/FVC of <70% and constituted the COPD population of the present study.

The characteristics of the 827 patients with COPD included in the present study are described in table 1. Most of the subjects were male (86.5%) and had given up smoking (75.1%). The mean±SD duration of COPD was 10.3±7.7 yrs, and, during the last 12 months, the patients reported 2.2±1.9 exacerbations and 0.5±0.99 hospital admissions due to COPD. Overall, 44.4% showed dyspnoea of grade 2 or higher.

Regarding the questionnaires used in the present study, the COPDSS was 10.1±5.54, the EuroQOL-5D utility score was 0.64±0.23 and the VAS score 55.81±16.83. The patient population declared walking for 1.27±1.01 h·day^{-1} and the total LCADL score was 21.55±13.03 (table 2).

Concurrent validity: association between pulmonary function and COPD clinical history and severity score

The COPDSS showed a positive linear relationship with the degree of dyspnoea and the number of previous exacerbations (fig. 1). The COPDSS was significantly different among patients grouped according to number of exacerbations (p<0.001) or degree of dyspnoea (p<0.001) (fig. 2). However, some of the correlations found were very weak, with only the greater degree of dyspnoea (r=0.605; p<0.001) and higher number of previous exacerbations (r=0.569; p<0.001) having an r of >0.5. The correlations between COPDSS and spirometric parameters were significant but weak (r<-0.25 for all) (table 3).

Among the clinical variables, only BMI did not correlate significantly with COPDSS (table 3). When patients were classified according to the BMI threshold in the BODE index of 21 kg·m^{-2} [4], differences in COPDSS were also nonsignificant (p=0.78), although only 47 individuals exhibited a BMI of <21.

TABLE 1 Demographic and clinical characteristics of participating chronic obstructive pulmonary disease (COPD) patients

Subjects n	827
Sociodemographic characteristics	
Age yrs	69±10
BMI kg·m^{-2}	27.7±4.2
Male sex %	86.5
Cigarette smoking	
Current %	21.6
Former %	75.1
History pack-yrs	47.0±28.0
Education %	
Less than primary school	42.3
Finished primary school	37.1
Finished secondary school	12.2
University and/or college	7.1
COPD clinical characteristics	
Time since COPD diagnosis yrs	10.3±7.7
COPD exacerbations in last year	2.2±1.9
Hospitalisations due to COPD in last year	0.5±0.99
FVC mL	2749±851
% pred	68±20
FEV1 mL	1521±555
% pred	54.6±17.7
FEV1/FVC %	56.9±10.1
MRC dyspnoea grade %	
0	8.3
1	46.7
2	24.9
3	15.6
4	3.9
GOLD COPD severity classification %	
I: mild (FEV1 ⩾80%)	4.1
II: moderate (50% ⩽FEV1<80%)	53.8
III: severe (30% ⩽FEV1<50%)	31.9
IV: very severe (FEV1<30%)	8.0

Data are presented as mean±SD unless otherwise indicated. Percentages may not add up to 100 due to missing data (one patient with no specified sex, 37 with no specified smoking habits, 12 with no specified educational level and five with no specified UK Medical Research Council (MRC) dyspnoea grade). BMI: body mass index; FEV1: forced expiratory volume in one second; FVC: forced vital capacity; GOLD: Global Initiative for Chronic Obstructive Lung Disease; % pred: percentage of the predicted value.

Concurrent validity: association between health-related quality of life, activities of daily living and COPD severity score

Analysis of correlation between the COPDSS and the various psychometric tools demonstrated that higher COPDSSs correlated significantly with poorer EuroQOL-5D utility (r=-0.553; p<0.001) and with a reduced EuroQOL-5D VAS score (r=-0.505; p<0.001) (table 3).

A higher COPDSS also correlated significantly with a higher (worse) LCADL score (r=0.465; p<0.001). The domestic

TABLE 2 Outcome measurements in the study population

Total COPDSS	10.1±5.54
HRQoL	
EuroQOL-5D index	0.64±0.23
EuroQOL VAS score	55.81±16.83
Comorbidity	
Charlson comorbidity index score	1.73±1.64
Activity	
Walking time h·day^{-1}	1.27±1.01
LCADL score	
Total	21.55±13.03
Self-care	6.35±3.59
Domestic	6.37±1.75
Physical	4.56±2.25
Leisure	4.29±2.25

Data are presented as mean±SD. COPDSS: chronic obstructive pulmonary disease severity score; HRQoL: health-related quality of life; EuroQOL-5D: European quality of life (EuroQOL) five-dimension; VAS: visual analogue scale; LCADL: London Chest Activity of Daily Living.

domain of the LCADL scale did not correlate with the COPDSS ($p=0.084$) and showed a very low score, probably reflecting the higher percentage of males, not usually dedicated to domestic tasks, in the present sample.

Discriminative power of COPD severity score

The sensitivity and specificity of the COPDSS were calculated at various cut-off points. ROC curves showed that the COPDSS has good discriminative capability, with an AUC of 0.837 for MRC dyspnoea grade. The best cut-off value was 12.5 for COPDSS, with a sensitivity of 71.1% and specificity of 81.1% for discriminating between patients with dyspnoea grades of 0–2 and 3–4 (fig. 1).

For exacerbation frequency, a cut-off value of 8.5 for COPDSS was optimal, with a sensitivity of 69.6% and specificity of 71.1% for discriminating between patients with 0–1 or ⩾2 exacerbations in the previous year. The AUC was 0.773 for discriminating between patients with 0–1 exacerbations and ⩾2 exacerbations in the last year (fig. 1). Finally, the COPDSS showed poor discriminative power for patients with an FEV1 <50% and ⩾50% of the predicted value (ROC curve AUC 0.628). The ROC curve indicated that 8.5 was the best cut-off for COPDSS, with a sensitivity of 62.3% and specificity of 56.2% (fig. 1). The percentage predicted FEV1 was the variable that showed the poorest sensitivity; therefore, the statistical power of the present results was calculated relative to this variable. The 95% confidence interval for sensitivity was 57.0–67.0%, thus giving a precision of ±5% in the most unfavourable situation.

Multiple regression analysis

On bivariate analysis, mean COPDSSs were compared among the population divided according to various characteristics (sex, smoking in current and former smokers, percentage predicted FEV1 of <50 and ⩾50, presence and absence of respiratory symptoms, number of COPD exacerbations in the last year of 0–1 and ⩾2, and MRC grades of 0–2 and 3–4). In all cases, COPDSSs were significantly different in the various subgroups of patients (table 4).

Forward stepwise variable selection was performed for variables that were significant at a p-value of <0.1 on bivariate analysis. A multiple linear regression model was constructed with the variables remaining in the model. COPDSS was significantly influenced by percentage predicted FEV1, number of exacerbations in the previous year, MRC dyspnoea grade and comorbidity (table 5).

DISCUSSION

The present results in a large unselected population of patients with COPD in PC show that use of the COPDSS is feasible and provide useful information regarding the severity of patients in a stable state. The COPDSS correlates significantly with the scores of a generic HRQoL questionnaire (EuroQOL-5D) and a validated questionnaire of physical activity (LCADL) and

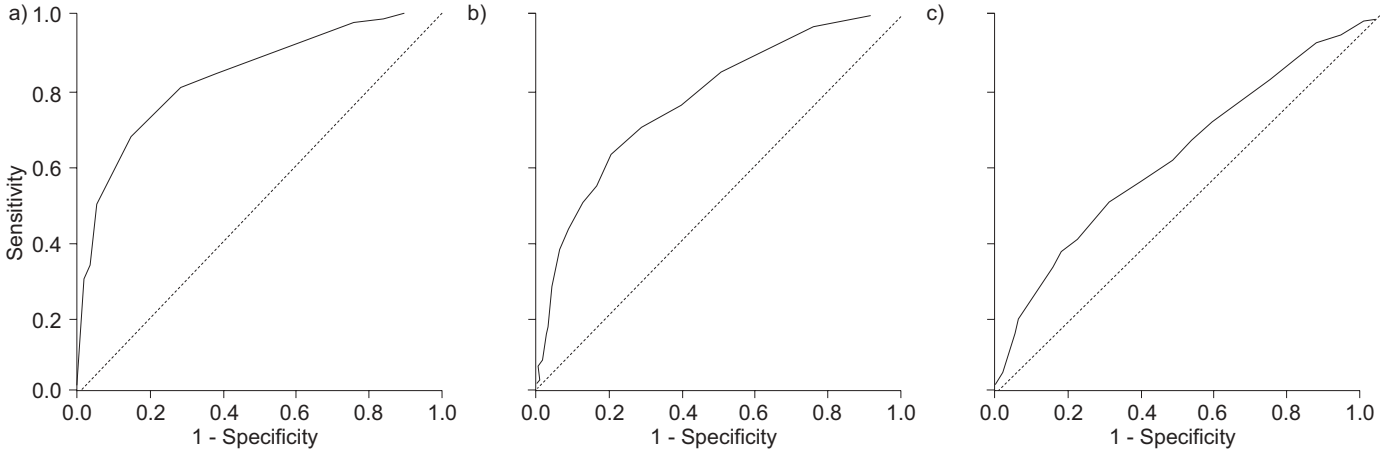

FIGURE 1. Receiver operating characteristic curves for the chronic obstructive pulmonary disease (COPD) severity score (COPDSS) as a predictor of the main clinical indicators of COPD. Discriminative power of COPDSS for: a) UK Medical Research Council dyspnoea grade (ranked 0–2 and 3–4); b) exacerbations in last year (ranked 0–1 and ⩾2); and c) lung function (forced expiratory volume in one second ranked <50% and ⩾50% of the predicted value). ·····: line of no discrimination. a) area under the curve (AUC) 0.837; cut-off 12.5; sensitivity 71.1%; and specificity: 81.1%; b) AUC 0.773; cut-off 8.5; sensitivity 69.6%; and specificity 71.1%; and c) AUC 0.628; cut-off 9.5; sensitivity 62.3%; and specificity 56.2%.

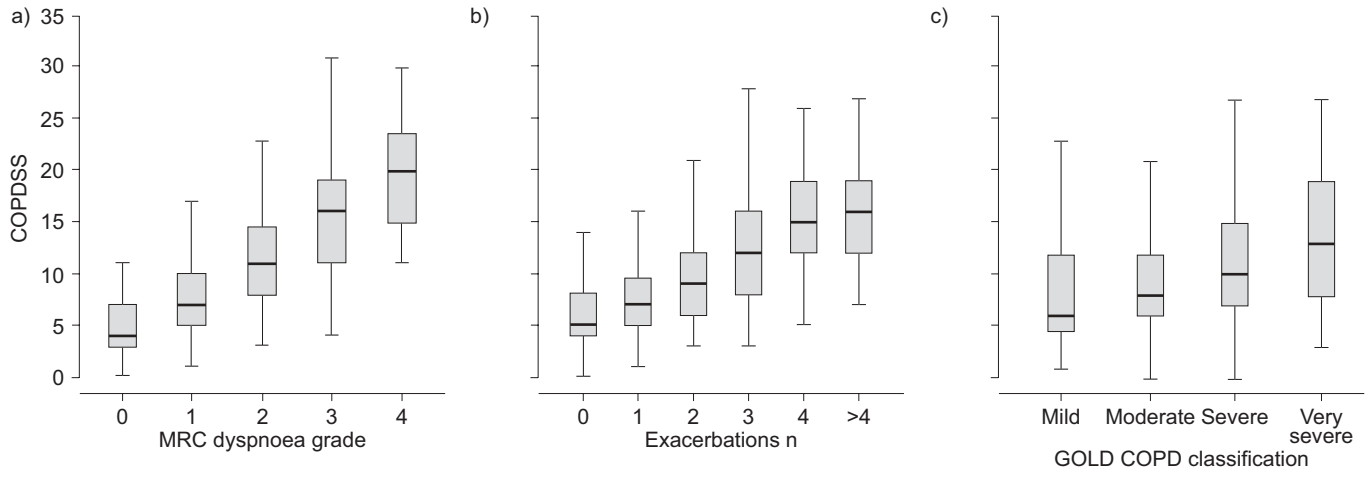

FIGURE 2. Boxplot showing chronic obstructive pulmonary disease (COPD) severity score (COPDSS) of patients grouped according to: a) UK Medical Research Council (MRC) dyspnoea grade; b) number of exacerbations in the previous year; and c) severity of COPD according to Global Initiative for Chronic Obstructive Lung Disease (GOLD) guidelines. Boxes represent mean±SD; vertical bars represent ranges. Increases in MRC dyspnoea grade and number of exacerbations resulted in an increase in COPDSS ($p<0.001$ for both; one-way ANOVA).

significantly, but weakly, with the percentage predicted FEV1. The variables independently and significantly associated with COPDSS were percentage predicted FEV1, number of exacerbations in the previous year, degree of baseline dyspnoea and comorbidity measured by the Charlson index. It is important to realise that only 13.5% of the present study population were female, reflecting the epidemiology of COPD in Spain [2], and that scores for males and females were different, meaning that generalisation of the present results to females must be undertaken with caution.

The COPDSS was developed and validated by EISNER *et al.* [6], and its validity was demonstrated in a population of 383 US adults with self-reported physician-diagnosed COPD. Internal consistency reliability was established using standard psychometric techniques, and concurrent validity was examined by analysing the association between COPDSS and pulmonary function, the physical component of HRQoL using the SF-12 and physical health status using a question adapted from the NHIS. However, spirometric data were available for only 49 patients in their study [6]. The present study has extended these findings by analysing a large group of 827 patients with spirometrically diagnosed COPD in PC in a different country and using various tools to examine the performance of the questionnaire. Interestingly, the mean±SD score of the present population was higher (worse) than that observed in the previous cohort (10.1±5.5 *versus* 7.3±6.5), despite having exactly the same mean FEV1 (54.6% pred in both studies, although data were only available for 13% of the patients in the former study). Other characteristics may have accounted for the differences in scores between the two studies. The present population was older (mean age 69 *versus* 64 yrs) and 19% of the population in the previous study were never smokers, compared with 0% in the present study. These differences could explain, at least in part, the higher COPDSSs of the current study. Unfortunately, other important variables, such as the number of previous exacerbations or comorbid conditions, were not available for comparison in the previous work [6].

The COPDSS correlated significantly with the degree of baseline dyspnoea, and a cut-off of 12.5 provides a sensitivity of 71.1% and specificity of 81.1% for discriminating between mild-to-moderate (grade 0–2) and severe-to-very severe (grade 3–4) dyspnoea. The level of dyspnoea discriminates very well between different degrees of severity of COPD [15] and correlates very strongly with measurements of health status [16]. Similar discriminative properties of the COPDSS were observed with the number of exacerbations in the previous year, with a cut-off of 8.5 being able to discriminate between patients with 0–1 and those with ≥ 2 episodes with a sensitivity of 69.6% and specificity of 71.1%. Exacerbations have been demonstrated to have a persistent impact upon HRQoL in patients with COPD [17, 18], including those in PC [19]. Interestingly, the most significant impairment in HRQoL occurred between 1 and 2 exacerbations·yr^{-1} [19]. Therefore, this threshold was used to divide the present population into two groups according to the frequency of exacerbations. In contrast, correlation of the COPDSS with the severity of COPD measured spirometrically (percentage predicted FEV1) was weak, with an r of only -0.241 ($p<0.001$), similar to that observed with time walked per day ($r=-0.224$; $p=0.001$). Indeed, on multiple regression analysis, only four variables were significantly associated with the COPDSS, being, in order of importance, the degree of dyspnoea, Charlson comorbidity index, number of exacerbations in the previous year and impairment in percentage predicted FEV1.

The concurrent validity of the COPDSS was also measured by evaluating its association with health status and daily living activities. The COPDSS correlated with the EuroQOL-5D index ($r=-0.553$; $p<0.001$) and VAS score ($r=-0.505$; $p<0.001$), with this correlation being similar in magnitude to that observed in the previous study with the physical component of the SF-12 ($r=-0.58$; $p<0.001$) [6]. The EuroQOL-5D VAS and index scores can assess COPD impact upon HRQoL, and these scores have been demonstrated to discriminate between patient groups of known severity [20]. Regarding level of activity, the COPDSS

TABLE 3 Correlation between chronic obstructive pulmonary disease (COPD) severity score, lung function parameters and clinical characteristics of COPD

	Spearman's correlation coefficient	p-value
Age	0.195	<0.001
BMI	0.009	0.798
Smoking history pack-yrs	0.182	<0.001
COPD evolution yrs	0.323	<0.001
Exacerbations in previous year	0.569	<0.001
MRC dyspnoea grade	0.605	<0.001
Charlson comorbidity index	0.314	<0.001
Spirometry		
FVC mL	-0.217	<0.001
FVC % pred	-0.200	<0.001
FEV_1 mL	-0.243	<0.001
FEV_1 % pred	-0.241	<0.001
FEV_1/FVC	-0.114	0.002
HRQoL		
EuroQOL-5D index		
Total	-0.553	<0.001
Mobility	-0.471	<0.001
Self-care	-0.495	<0.001
Usual activities	-0.547	<0.001
Pain/discomfort	-0.325	<0.001
Anxiety/depression	-0.251	<0.001
EuroQOL VAS score	-0.505	<0.001
Activity		
Walking time $h \cdot day^{-1}$	-0.224	<0.001
LCADL score		
Self-care	0.536	<0.001
Domestic	0.064	0.084
Physical	0.624	<0.001
Leisure	0.585	<0.001

BMI: body mass index; MRC: UK Medical Research Council; FEV_1: forced expiratory volume in one second; FVC: forced vital capacity; HRQoL: health-related quality of life; EuroQOL-5D: European quality of life (EuroQOL) five-dimension; VAS: visual analogue scale; LCADL: London Chest Activity of Daily Living; % pred: percentage of the predicted value.

TABLE 4 Bivariate analysis of chronic obstructive pulmonary disease (COPD) severity score (COPDSS) among patients categorised according to various parameters

	COPDSS sum	p-value#
Sex		
Male	10.33±5.57	0.001
Female	8.88±5.30	
Cigarette smoking		
Current	8.85±4.62	<0.001
Former	10.62±5.74	
Symptom: dyspnoea		
Yes	11.77±5.55	<0.001
No	7.80±4.63	
Symptom: daily cough		
Yes	11.10±5.57	<0.001
No	7.85±4.79	
Symptom: daily expectoration		
Yes	10.95±5.64	<0.001
No	8.27±4.87	
COPD exacerbations		
0–1	7.24±4.05	<0.001
⩾2	12.18±5.55	
MRC dyspnoea grade		
0–2	8.69±4.34	<0.001
3–4	16.08±5.97	
FEV_1		
⩾50% pred	9.02±4.87	<0.001
<50% pred	11.64±6.03	

Data are presented as mean± SD (n=827). MRC: UK Medical Research Council; FEV_1: forced expiratory volume in one second; % pred: percentage of the predicted value. #: unpaired t-test.

correlated with the LCADL score. This correlation is of particular interest since the level of physical activity is, in general, a prognostic marker in chronic diseases [21], particularly COPD [22]. Interestingly, there is a link between frequent exacerbations, a reduction in physical activities [23] and an increasing risk of hospital admission and death [22, 24]. In this respect, the COPDSS captures the impact of exacerbations and correlates well with the level of physical activities, suggesting that the COPDSS may have prognostic value in COPD, as has been presented in a preliminary study [25]. Nonetheless, these properties of the questionnaire must be demonstrated in large longitudinal studies.

Spirometry is the gold standard for the diagnosis of COPD, but its implementation in PC is difficult. In a recent study in PC among 251 GPs who collected information on 2,130 patients, only 32% provided post-bronchodilator values, and 43% of the FEV_1 provided were considered implausible [26]. It is accepted that the quality of spirometry in PC may improve with adequate training [27], but the lack of time and incentives of the GPs make the large-scale implementation of this technique unrealistic in many countries [5, 28]. A recent survey in 839 practices in Spain showed that up to 41% did not perform spirometry regularly, and among the most frequent causes for not doing so were lack of training in 35% of cases, lack of dedicated staff in 21% and lack of time in 20% [29]. In this context, a severity score, such as the COPDSS should never replace spirometry in the diagnosis and staging of COPD, and no data exists from a non-COPD group for comparison. Nonetheless, this score may be a great help in the follow-up of COPD patients in the PC setting and may potentially be used as a research tool, as well as to adjust for disease severity [30]. The use of the COPDSS may be complementary to that of other questionnaires in PC addressed at helping in the diagnosis of the disease [31] or to assess the clinical control of patients with COPD [32]. The implementation of the COPDSS in PC is feasible because it takes an average of 4–6 min to be answered and

TABLE 5 Linear regression coefficient analysis with chronic obstructive pulmonary disease severity score total score as a dependent outcome variable[#]

	Regression coefficient (95% CI)	p-value
FEV1 % pred	-0.024 (-0.040– -0.009)	0.002
Number of exacerbations	0.946 (0.0793–1.099)	<0.001
MRC dyspnoea grade	2.703 (2.391–3.016)	<0.001
Charlson index	0.391 (0.222–0.561)	<0.001
Constant	4.447 (3.331–5.584)	<0.001

CI: confidence interval; FEV1: forced expiratory volume in one second; % pred: percentage of the predicted value; MRC: UK Medical Research Council. [#]: n=827.

scored. Administration of the COPDSS every 6 months could provide a simple evaluation of the evolution of COPD, and could be integrated into comprehensive programmes of COPD management in PC.

APPENDIX

COPDSS items, comprising five aspects of COPD severity, and their possible scores are shown in table 6.

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TABLE 6 Chronic obstructive pulmonary disease (COPD) severity score (COPDSS) items and possible scores

	Score
Respiratory symptoms (maximum 7 points)	
Dyspnoea on exertion (currently)	
None	0
Hurrying on level ground or walking uphill	1
Walking with peers on level ground	2
Walking at own pace on level ground	3
Dyspnoea during the past 14 days/nights	
None	0
1–2 days/nights	1
3–6 days/nights	2
7–13 days/nights	3
Every day/night	4
Systemic corticosteroid use (maximum 5 points)	
Ever used	1
Long-term use in the past year[#]	3
Used in past 2 weeks	1
Other medication[¶] (maximum 10 points)	
Metered-dose inhaler in past 2 weeks	
Short-acting β_2-agonists	1
Long-acting β_2-agonists	1
Inhaled corticosteroids	1
Ipratropium bromide/tiotropium bromide	1
Nebulisers in past 2 weeks	
Short-acting β_2-agonists	1
Ipratropium bromide	1
Oral medication in past 2 weeks	
Theophylline	1
β_2-agonists	1
Antibiotics for lung condition in past 12 months	
1/2 courses	1
$\geqslant$3 courses	2
Hospitalisation/intubation/oxygen use (maximum 13 points)	
Hospitalised for COPD in past 5 yrs	3
Intubated for COPD in past 5 yrs	5
Home oxygen, current day/night use	5

[#]: at least three times weekly for $\geqslant$3 months during the past 2 yrs; [¶]: combined medications were counted under both categories.

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REFERENCES

1 Buist AS, McBurnie MA, Vollmer WM, *et al.* International variation in the prevalence of COPD (the BOLD Study): a population-based prevalence study. *Lancet* 2007; 370: 741–750.
2 Sobradillo V, Miravitlles M, Gabriel R, *et al.* Geographic variation in prevalence and underdiagnosis of COPD – results of the IBERPOC multicentre epidemiological study. *Chest* 2000; 118: 981–989.
3 Chapman KR, Mannino DM, Soriano JB, *et al.* Epidemiology and costs of chronic obstructive pulmonary disease. *Eur Respir J* 2006; 27: 188–207.
4 Celli BR, Cote C, Marin JM, *et al.* The body-mass index, airflow obstruction, dyspnea, and exercise capacity index in chronic obstructive pulmonary disease. *N Engl J Med* 2004; 350: 1005–1012.
5 Derom E, van Weel C, Liistro G, *et al.* Primary care spirometry. *Eur Respir J* 2008; 31: 197–203.
6 Eisner MD, Trupin L, Katz PP, *et al.* Development and validation of a survey-based COPD severity score. *Chest* 2005; 127: 1890–1897.
7 Bestall JC, Paul EA, Garrod R, Garnham R, Jones PW, Wedzicha JA. Usefulness of the Medical Research Council (MRC) dyspnoea scale as a measure of disability in patients with chronic obstructive pulmonary disease. *Thorax* 1999; 54: 581–586.
8 Garrod R, Bestall JC, Paul EA, Wedzicha JA, Jones PW. Development and validation of a standardized measure of activity of daily living in patients with severe COPD: the London Chest Activity of Daily Living scale (LCADL). *Respir Med* 2000; 94: 589–596.
9 Vilaró J, Gimeno E, Sánchez Férez N, *et al.* Actividades de la vida diaria en pacientes con enfermedad pulmonar obstructiva crónica: validación de la traducción española y análisis comparativo de 2 cuestionarios. [Daily living activity in chronic obstructive pulmonary disease: validation of the Spanish version and comparative analysis of 2 questionnaires.] *Med Clin (Barc)* 2007; 129: 326–332.
10 Garrod R, Paul EA, Wedzicha JA. An evaluation of the reliability and sensitivity of the London Chest Activity of Daily Living scale (LCADL). *Respir Med* 2002; 96: 725–730.
11 Charlson ME, Szatrowski TP, Peterson J, Gold J. Validation of a combined comorbidity index. *J Clin Epidemiol* 1994; 47: 1245–1251.
12 The EuroQol Group, EuroQol – a new facility for measurement of health-related quality of life. *Health Policy* 1990; 16: 199–208.
13 Badia X, Roset M, Montserrat S, Herdman M, Segura A. The Spanish version of EuroQol: a description and its applications. European Quality of Life scale. *Med Clin (Barc)* 1999; 112: Suppl. 1, 79–85.
14 Zweig MH, Campbell G. Receiver-operating characteristic (ROC) plots: a fundamental evaluation tool in clinical medicine. *Clin Chem* 1993; 39: 561–577.
15 Hajiro T, Nishimura K, Tsukino M, Ikeda A, Oga T, Izumi T. A comparison of the level of dyspnea *vs* disease severity in indicating the health-related quality of life of patients with COPD. *Chest* 1999; 116: 1632–1637.
16 Ferrer M, Alonso J, Morera J, *et al.* Chronic obstructive pulmonary disease stage and health-related quality of life. *Ann Intern Med* 1997; 127: 1072–1079.
17 Seemungal TAR, Donaldson GC, Paul EA, Bestall JC, Jeffries DJ, Wedzicha JA. Effect of exacerbation on quality of life in patients with chronic obstructive pulmonary disease. *Am J Respir Crit Care Med* 1998; 157: 1418–1422.
18 Miravitlles M, Ferrer M, Pont A, *et al.* Effect of exacerbations on quality of life in patients with chronic obstructive pulmonary disease: a 2 year follow up study. *Thorax* 2004; 59: 387–395.

19 Llor C, Molina J, Naberan K, *et al.* Exacerbations worsen the quality of life of chronic obstructive pulmonary disease patients in primary healthcare. *Int J Clin Pract* 2008; 62: 585–592.

20 Rutten-van Mölken M, Oostenbrink JB, Tashkin DP, Burkhart D, Monz BU. Does quality of life of COPD patients as measured by the generic EuroQol five-dimension questionnaire differentiate between COPD severity stages? *Chest* 2006; 130: 1117–1128.

21 Warburton DER, Nicol CW, Bredin SSD. Health benefits of physical activity: the evidence. *Can Med Assoc J* 2006; 174: 801–809.

22 Garcia-Aymerich J, Lange P, Benet M, Schnohr P, Antó JM. Regular physical activity reduces hospital admission and mortality in chronic obstructive pulmonary disease: a population based cohort study. *Thorax* 2006; 61: 772–778.

23 Donaldson GC, Wilkinson TMA, Hurst JR, Perera WR, Wedzicha JA. Exacerbations and time spent outdoors in chronic obstructive pulmonary disease. *Am J Respir Crit Care Med* 2005; 171: 446–452.

24 Soler-Cataluña JJ, Martinez-García MA, Roman Sánchez P, Salcedo E, Navarro M, Ochando R. Severe acute exacerbations and mortality in patients with chronic obstructive pulmonary disease. *Thorax* 2005; 60: 925–931.

25 Eisner MD, Katz P, Iribarren C, Yelin B, Blanc P. Measurement of COPD severity: further validation of a survey-based instrument. *Eur Respir J* 2007; 30: 629S.

26 Miravitlles M, de la Roza C, Naberan K, Lamban M, Gobartt E, Martín A. Use of spirometry and patterns of prescribing in COPD in primary care. *Respir Med* 2007; 101: 1753–1760.

27 Schermer TR, Jacobs JE, Chavannes NH, *et al.* Validity of spirometric testing in a general practice population of patients with chronic obstructive pulmonary disease (COPD). *Thorax* 2003; 58: 861–866.

28 Lusuardi M, De Benedetto F, Paggiaro P, *et al.* A randomized controlled trial on office spirometry in asthma and COPD in standard general practice. *Chest* 2006; 129: 844–852.

29 Naberan K, de la Roza C, Lamban M, Gobartt E, Martín A, Miravitlles M. Use of spirometry in the diagnosis and treatment of chronic obstructive pulmonary disease in primary care. *Arch Bronconeumol* 2006; 42: 638–644.

30 Katz PP, Eisner MD, Yelin EH, *et al.* Functioning and psychological status among individuals with COPD. *Qual Life Res* 2005; 14: 1835–1843.

31 Müllerova H, Wedzicha J, Soriano JB, Vestbo J. Validation of a chronic obstructive pulmonary disease screening questionnaire for population surveys. *Respir Med* 2004; 98: 78–83.

32 Van der Molen T, Willemse BWM, Schokker S, ten Hacken NHT, Postma DS, Juniper EF. Development, validity and responsiveness of the clinical COPD questionnaire. *Health Qual Life Outcomes* 2003; 1: 13–22.