Internal Consistency and Validity of the Spanish Version of the St. George' Respiratory Questionnaire for Use in Patients With Clinically Stable Bronchiectasis

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OBJECTIVE: To analyze the reliability and validity of the St. George's Respiratory Questionnaire (SGRQ) for use in patients with clinically stable bronchiectasis.

MATERIAL AND METHODS: The SGRQ (50 items on 3 scales—symptoms, activity, and impact) was administered to 102 patients (mean [SD] age, 69.5 [8.7] years; 63% men) with clinically stable bronchiectasis. Disease severity was classified according parameters such as airflow obstruction (forced expiratory volume in 1 second), colonization by *Pseudomonas aeruginosa*, extent of bronchiectasis, symptoms, daily quantity of sputum, and number of exacerbations. Internal consistency (Cronbach's alpha and correlation between items and between item and scale), concurrent validity (correlation between items and clinical variables), predictive validity (correlation between items and severity), and construct validity (factorial analysis of main components) were assessed.

RESULTS: The internal consistency of the SGRQ was excellent (Cronbach's alpha between 0.81 and 0.87 for the different scales, and 0.90 for the overall score). Concurrent validity was high, as correlations between items and clinical variables were significant and followed the expected distribution. The SGRQ differentiated between degrees of disease severity, regardless of the clinical variable used. The factorial analysis showed a construct of 4 factors that were only moderately similar to the original structure of the questionnaire, due mainly to inclusion of a small number of questions with conditioned response and others with low discriminatory capacity.

CONCLUSIONS: The SGRQ shows excellent concurrent and predictive internal consistency and validity, though restructuring of the original construct would be advisable before use in patients with stable bronchiectasis.

Key words: *Health-related quality of life. Bronchiectasis. St. George's Questionnaire. Internal consistency. Validity.*

Consistencia interna y validez de la versión española del St. George's Respiratory Questionnaire para su uso en pacientes afectados de bronquiectasias clínicamente estables

OBJETIVO: Analizar la fiabilidad y validez del St. George's Respiratory Questionnaire (SGRQ) para su uso en pacientes afectados de bronquiectasias estables.

MATERIAL Y MÉTODOS: El SGRQ (50 ítems en 3 escalas: síntomas, actividad e impacto) se administró a 102 pacientes (edad media ± desviación estándar de 69,5 ± 8,7 años; 63% varones) con bronquiectasias clínicamente estables. Se clasificó la gravedad según diferentes parámetros: obstrucción al flujo respiratorio (volumen espiratorio forzado en el primer segundo), colonización por *Pseudomonas aeruginosa*, extensión de las bronquiectasias, síntomas, cantidad de esputo diario y número de agudizaciones. Se calcularon la consistencia interna (alfa de Cronbach y correlación ítem-ítem e ítems-escala), la validez concurrente (correlación ítems-variables medidas), la validez predictiva (correlación ítems-parámetros de gravedad) y la validez de constructo (análisis factorial de componentes principales).

RESULTADOS: La consistencia interna del SGRQ fue excelente (alfa de Cronbach entre 0,81 y 0,87 para las distintas escalas, y 0,90 para la puntuación total). La validez concurrente fue elevada, ya que las correlaciones ítems-variables medidas fueron significativas y se distribuyeron de la forma prevista. El SGRQ permitió diferenciar adecuadamente los distintos grados de gravedad de la enfermedad independientemente de los parámetros utilizados. El análisis factorial mostró un constructo de 4 factores que se asemejaba tan solo de forma moderada a la estructura original del cuestionario, sobre todo por la inclusión de preguntas con bajo porcentaje de respuestas obligadas y otras con bajo poder discriminatorio.

CONCLUSIONES: El SGRQ presenta una excelente consistencia interna y validez tanto concurrente como predictiva, si bien sería recomendable una reestructuración previa del constructo original para su uso en pacientes con bronquiectasias estables.

Palabras clave: *Calidad de vida relacionada con la salud. Bronquiectasias. Cuestionario St. George's. Consistencia interna. Validez.*

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Introduction

Bronchiectasis is defined as abnormal airway dilatation caused by continuous infection–inflammation–repair cycles, which progressively weaken the local defense systems. This in turn increases susceptibility to further infection and a negative feedback loop is formed.[1] Unlike chronic obstructive pulmonary disease (COPD) and asthma, bronchiectasis receives little attention, probably because physicians believe that the disease can be controlled with existing drugs. It has therefore come to be known as an "orphan" disease.[2] Recent studies have, however, shown a greater incidence of bronchiectasis than expected, even in developed countries, and have highlighted the need for early diagnosis given the nature of the treatment strategies.[3,4] Clinically, bronchiectasis is characterized by a chronic overproduction of sputum—sometimes purulent—as a result of repeated infections. Deterioration of lung function is accelerated in such patients and they ultimately develop incapacitating dyspnea associated with progressive loss of health-related quality of life (HRQL).[5,6]

In recent years, several measurement tools—both generic and specific—have been developed to provide a multidimensional quantification of the impact on HRQL of different airway diseases.[7] The St. George's Respiratory Questionnaire (SGRQ), a specific questionnaire designed by Jones et al[8] in 1992 for use in patients with chronic airway limitation, has been translated and adapted for use in various languages and cultures. Its intrinsic qualities for measuring HRQL in such patients have been shown to be excellent.[9-11] Wilson et al[12] in London in 1997 and Chan et al[13] in Hong Kong in 2002 validated the SGRQ in English and Chinese, respectively, for use in patients with noncystic fibrosis bronchiectasis, and currently, it is the only validated questionnaire for measuring HRQL in these languages for such patients.

We were unable to determine from the scientific literature whether the HRQL has sufficient internal consistency and construct validity for reliable use in Spanish-speaking patients with clinically stable bronchiectasis. Our objective was therefore to analyze the reliability and validity of the SGRQ for measuring HRQL in such patients.

Material and Methods

Study Population

All patients diagnosed with clinically stable diffuse cylindrical bronchiectasis (with involvement of more than 1 lung lobe) or cystic bronchiectasis (whether localized or diffuse) in our hospital from 1993 to 2003 were included in the study (n=132). Patients were defined as clinically stable if no changes with respect to baseline clinical characteristics had occurred that required an increase in current medication or rescue medication in the last 4 weeks. We excluded patients with traction bronchiectasis (n=11), those with bronchiectasis associated with severe pulmonary emphysema (n=4), patients who had undergone surgery for bronchiectasis (n=2), and those who were unable to complete the questionnaire even with assistance because of deterioration in their mental or physical state (n=11). Likewise, patients who refused to participate in the study were also excluded (n=2).

Diagnosis of Bronchiectasis

Bronchiectasis was diagnosed in all patients by chest high-resolution computed tomography (HR-CT) with 1-mm collimation every 10 mm during deep inspiration, in accordance with the criteria described by Naidich et al.[14] Chest HR-CT was repeated if the previous scan had been done more than 24 months before the start of the study to ensure an up-to-date assessment of the extent of bronchiectasis. The extent of bronchiectasis was defined according to a modification of the scale described by Bhalla et al.[15] Each lung lobe was assigned a score as follows (with the lingula and middle lobe assessed independently): 0 if it did not have bronchiectasis, 1 if it had cylindrical bronchiectasis in a single lung segment, 2 if it had cylindrical bronchiectasis in more than 1 lung segment, and 3 if it had cystic bronchiectasis. The maximum score was thus 18 points. All chest HR-CT scans were assessed independently by a radiologist and a clinician with extensive experience in the study of this type of patient.

Various possible etiologies of bronchiectasis were considered. One was posttuberculous origin in patients with a history of tuberculosis at the same site as bronchiectasis—also considered when indirect indications of previous tuberculosis were observed in the chest HR-CT (regions of apical fibrosis, granulomas, or lymph node calcification) along with a positive Mantoux test, provided no other cause was apparent and that the onset of bronchiectasis occurred after the onset of tuberculosis. The second was postinfectious origin when evidence of one or more nontuberculous pulmonary infections at the current location of the bronchiectasis was detected or the patient had a history of necrotizing pneumonia if the signs of bronchiectasis had started after infection. This etiology was also considered in patients with primary immunodeficiency provided bronchiectasis could not be explained by other causes. The third was allergic bronchopulmonary aspergillosis, when the sites of bronchiectasis were mainly central and the patient also presented asthma requiring aggressive medication and was positive for precipitins, skin tests, or specific E immunoglobulin, or had sputum culture positive for *Aspergillus fumigatus*. A patient with pulmonary aspergillosis was only included if his or her accompanying asthma was stable throughout the study period. The remaining etiologies considered were collagenosis, inflammatory diseases, congenital diseases, and others, diagnosed at the discretion of the clinician with the necessary complementary tests. If a consistent diagnosis of cause was not reached after all the appropriate complementary tests, the bronchiectasis was classified as idiopathic.

Study Protocol

In addition to the battery of complementary tests aimed at identifying the possible cause of bronchiectasis, information was collected on a set of variables to classify the patients by increasing disease severity. Cough and wheezing in the month prior to the start of the study while the patient was stable were reported as dichotomous variables, with presence of cough and wheezing on more than half the days taken as the cutoff. The

presence of dyspnea was quantified with the Medical Research Council scale, incorporating the modifications of the American Thoracic Society,[16] and using the 5 groups that represent the different degrees of dyspnea on this scale for classification of severity. Forced respiratory volume in 1 second (FEV_1) was measured, expressed as both an absolute value in mL (with a cutoff of 1000 mL to establish 2 groups of severity) and as a percentage of the predicted value (4 groups of severity—less than 35%, between 36% and 50%, between 51% and 70%, and greater than 70% of predicted), before and 15 minutes after administration of 200 μg of salbutamol. Daily sputum production was also recorded. All patients collected the sputum produced over 24 hours in appropriately graduated containers for 3 consecutive days after qualified personnel had instructed the patients on how to collect sputum correctly. The final value recorded for total daily sputum production was the arithmetic mean for all 3 days and 2 groups of severity were established with a cutoff of 20 mL/day. Chronic colonization by *Pseudomonas aeruginosa* was determined by taking sputum stains and cultures from 3 valid sputum samples, separated by at least 15 days. All sputum samples were collected during the 3 months prior to administration of the HRQL questionnaire and always when the patient was clinically stable. Sputum samples were valid if they had at least 10 epithelial cells and more than 25 leukocytes per field. Chronic colonization was considered present if more than 10^5 colony forming units/mL of *P aeruginosa* were counted in at least 2 of the 3 valid sputum samples. The number of exacerbations in the last 6 months was reported, and 2 groups of severity defined with a cutoff of 2 prior exacerbations. The extent of bronchiectasis was determined according to the scale described by Bhalla et al.[15] Two groups of severity were established with a cutoff at 4 points.

Measurement of Quality of Life

HRQL was quantified using the SGRQ, a specific questionnaire for patients with respiratory disease. The questionnaire contains 50 items structured in 3 components. The symptoms component refers to the frequency and severity of cough, wheezing, expectoration, or exacerbations of the patient. It has 8 items: 7 questions with multiple responses and an eighth question with 2 possible responses. The activity component refers to restrictions in the activity of the patient due to dyspnea. It consists of 16 items with 2 possible responses structured into 2 questions (Questions 11 and 15). The impact component summarizes the effect on the mental state and the work and social activities of the patient as a result of the way the patient perceives the disease. It consists of 26 items structured into 8 questions, 3 of which have multiple responses. Questions 6, 8, 10, and 14 (7 items) are optional, depending on the response given to the previous question or the particular situation of the patient. The score for each component is a weighted total of all items of the component, and the overall score is a weighted total of all items. Scores for components and the overall score can range from 0 (best possible score) to 100 (worst possible score). The questionnaire was designed to be self-administered in around 10 minutes, although administration during a personal interview does not seem to significantly affect the responses.[17] In the present study, the questionnaires were given to the patients, and only in the event that a patient requested help was the questionnaire administered in a personal interview, taking care not to influence the responses to the questions.

Statistical Analysis

Quantitative variables were presented as means (SD) and qualitative variables as absolute values and percentages of the total. The commercial statistical package SPSS-PC 11.5 (Chicago, IL, USA) was used. For comparison of 2 means, the Student *t* test was used, whereas comparisons of more than 2 means were performed by an analysis of variance, applying the Bonferroni correction or the corresponding nonparametric tests for nonnormal distributions of variables under comparison. (Normal distributions were confirmed using the Kolmogorov-Smirnov test.) The χ^2 test was used for comparison of 2 dichotomous variables. The kappa coefficient for reliability was calculated to investigate agreement between the radiological diagnoses of bronchiectasis by 2 different observers. Values greater than 0.8 were considered excellent.[18] For the study of the internal consistency or reliability of the questionnaire, defined as the degree of homogeneity in the responses to the different items of each component, the correlation (Spearman coefficient) between each item and the component to which it belonged was calculated. Cronbach's alpha coefficient for the overall score on the questionnaire and for each of the 3 components was calculated, and the changes in this coefficient after exclusion of each of the items from the questionnaire were also investigated. In accordance with Nunnany,[19] an alpha value greater than 0.7 was considered sufficient to use the questionnaire for comparing groups of patients, whereas for the comparison between individuals, an alpha value above 0.9 was needed.[20]

The validity of the questionnaire was analyzed in several ways. The construct validity determines whether the items of the questionnaire are structured in a similar way to the original questionnaire. To study this, a factor analysis of the principle components of the correlation matrix was performed with either varimax (orthogonal) or oblimin (oblique) rotation, depending on the degree of correlation between them. The Bartlett sphericity test, the determinant of the correlation matrix, and the Kaiser-Meyer-Olkin (KMO) test (with values above 0.5 considered acceptable) were used to determine whether a factor analysis was applicable. If indeed such an analysis was applicable, each item was only included in a given factor provided minimal loading of 0.4 was reached and its eigenvalue was greater than 1. The number of factors was determined with no structural restrictions and then a reduced number of factors were extracted by analyzing the scree plot. In contrast, concurrent validity, which aims to study whether the questionnaire relates acceptably to what it is measuring, was investigated by calculating the Spearman correlation coefficients for each component of the questionnaire with the clinical variables that it is expected to measure. These clinical variables were quantified with other measurement methods. Finally, the predictive validity of the questionnaire was investigated by analyzing its capacity to discriminate between different degrees of severity of the disease as measured by the variables described earlier.

For all these calculations, statistical significance was set at $P<.05$.

Results

Patient Characteristics

The mean age of the 102 patients finally included in the study was 69.5 (8.7) years and 63% were men. The most common types of disease were idiopathic,

reported in 45 patients (44%); postinfectious in 32 (31%); posttuberculous in 17 (16.6%); allergic pulmonary aspergillosis in 4 (3.9%); rheumatoid arthritis in 1 patient; immotile cilia syndrome in 1 patient; postmeasles in 1 patient, and there was 1 patient with collagenosis. The kappa index for diagnosis of bronchiectasis by chest HR-CT with independent evaluation by 2 observers was 0.81. Table 1 summarizes the main characteristics of the patients with regard to symptoms, spirometry, microbiological tests, extent of bronchiectasis, and course of disease.

Internal Consistency

Table 2 shows the results of the analysis of the questionnaire with regard to its general description and internal consistency. The Spearman correlation coefficient between different items on the questionnaire varied according to component. For the symptoms component, coefficients ranged from 0.25 to 0.64 and were always significant, for the activity component, coefficients lay between 0.23 and 0.78 and were significant for most values, and for the impact component, coefficients ranged from 0.2 to 0.58 and were significant for most values. Cronbach's alpha was 0.90 for overall score on the questionnaire and—by individual component—0.75 for symptoms, 0.87 for activity, and 0.81 for impact. Questions 6 and 8, belonging to the symptoms component, and Questions 10 and 14, belonging to the impact component, were answered by less than half the patients because the responses to these questions were conditioned by other responses. Therefore, the correlation between these items and the remaining items of their corresponding components was not significant. When these items were excluded from the analysis, the alpha value for the symptoms component increased to 0.81, whereas the alpha value for the impact component remained almost unchanged.

TABLE 1
Baseline Data on Extent of Bronchiectasis, Symptoms, Spirometry, Microbiological Tests, and Clinical Course of Patients Included in the Study*

Variables	
Chest HR-CT score†	4.46 (2.2)
Dyspnea (MRC scale, 0-4)†	1.91 (0.88)
Cough (more than half the days)‡	42 (41.1)
Wheezing (more than half the days)‡	32 (31.3)
Daily sputum production, mL†	20.9 (19.8)
FEV_1 post-BD, mL†	1501 (539)
FEV_1 post-BD, %†	60.4 (18.8)
Colonization by *Pseudomonas aeruginosa*‡	20 (19.6)
Exacerbations (previous 6 months)†	2.22 (2.32)

*HR-CT indicates high resolution computed tomography; MRC, Medical Research Council; FEV_1, forced expiratory volume in 1 second; post-BD, after bronchodilatation.
†Data are expressed as means (SD).
‡Data are expressed as number of patients (%).

Construct Validity

The value of the determinant of the item correlation matrix was 7.33×10^{-14}, the Bartlett sphericity test was significant ($P<.0001$), and the KMO test returned a value of 0.645. The correlation matrix could therefore be studied by factor analysis. Factor analysis with no structural restrictions revealed 13 independent factors that could explain 98% of the variance but, despite detailed analysis, we were unable to find a meaningful construct. Analysis of the scree plot showed a reduced number of 4 factors that explained 36.8% of the variance. We used orthogonal (varimax) rotation, given the level of correlation between these factors (Table 3). All items were fed into the analysis, even those belonging to questions with a conditioned response. The first factor comprised 16 items that explained 19.9% of the variance. One item did not attain sufficient loading to be considered significant. The structure of this factor was similar to the activity component of the original questionnaire and contained 11 of the 16 times of this component. This factor also included 3 items from the impact component that clearly referred to the physical activity of the patient (physical effort and bending over). The second factor comprised 14 items, whose loading did not exceed 0.40 in 2 cases (corresponding to Questions 6 and 8 on the symptoms component), and explained a further 6.6% of the variance already explained by the first factor. It included all the items of the original symptoms

TABLE 2
General Description and Internal Consistency of the Results of the St. George's Respiratory Questionnaire*

Statistics	Symptoms	Activity	Impact	Overall
Mean score (SD)	45.4 (19.5)	54 (23.6)	39.6 (19.3)	45.8 (17.6)
Missing data, %†	4.5	2	7.9	4.8
Range observed	0-93.1	6.3-100	3.2-100	2.6-100
Ceiling effect	0	3	1	1
Floor effect	1	0	0	0
Item-component correlation†	0.25-0.64	0.23-0.78	0.2-0.58	
Cronbach's alpha†	0.81	0.87	0.81	0.90
Cronbach's alpha with exclusion of items	0.73-0.82	0.85-0.88	0.80-0.82	

*Missing data indicates percentage of items not answered for each component and for the overall score; ceiling effect, number of patients with maximum score (100 points) on each component or for the overall score on the questionnaire; floor effect, number of patients with minimum score (0 points) on each component or for the overall score on the questionnaire.
†Does not include questions with possibility of conditioned response (Questions 6, 8, 10, and 14).

TABLE 3
Matrix of the 4 Factors Calculated by Factor Analysis of Main Components with Varimax Rotation (Only Items With Loading Greater Than 0.30 Are Tabulated)*

Items	Factors			
	1	2	3	4
A15.1	**0.761**	0.305		
A15.2	**0.721**	0.304		
A15.4	**0.716**			
A15.3	**0.703**		0.322	
A11.3	**0.700**			
A11.2	**0.688**			
A15.5	**0.655**		0.424	
A11.4	**0.643**			0.306
I13.8	**0.504**		0.316	
A15.6	**0.496**		0.361	
A11.1	**0.459**			
A11.5	**0.448**		0.395	
I12.4	**0.404**			
I9	**0.403**		0.350	0.321
I13.7	**0.403**			
I12.3	0.313			
S1		**0.789**		
S2		**0.652**		
S4	0.345	**0.632**		
I16.2		**0.548**		
I16.4		**0.539**		
I16.3		**0.533**		
S3	0.473	**0.513**		
S5		**0.508**		
S7		**0.507**		
I12.1		**0.427**		
I12.5		**0.412**		
I14.4		**0.408**		
S8				
S6				
A15.7			**0.711**	
A15.8			**0.688**	
A15.9			**0.614**	
I16.1			**0.607**	
I10			**0.465**	
I17	0.351		**0.450**	
I13.6			**0.439**	
I16.5			**0.418**	–0.315
I14.1			0.338	
A11.7				**0.608**
I13.4				**0.594**
I14.3				**0.487**
I14.2				**0.483**
I12.6	0.445			**0.467**
I13.3			0.309	**0.460**
I13.1				**0.450**
I13.2				**0.438**
I12.2				**0.419**
A11.6				**0.414**
I13.5				**0.407**

*A indicates item corresponding to the activity component (items of Questions 11 and 15); S, item corresponding to symptom component (items of Questions 1 to 8); I, item corresponding to impact component (items of Questions 9, 10, 12, 13, 14, 16 and 17). Values in boldface correspond to items included in each factor.

component of the SGRQ, and also 2 items of the impact component that referred to the impact of symptoms on the patient (cough and pain) and a further 4 from the same component, apparently unrelated to the remaining items. The third factor, comprising 9 significant items and 1 nonsignificant item, explained a further 5.8% of the variance. It was made up principally of items of the impact component (6 items) and 3 items of the activity component. All the items of this factor referred to questions that most of the patients answered the same way and so provided little discrimination. The fourth factor comprised 11 items—all with significant loading—that explained a further 4.5% of the variance already explained by the 3 previous factors. Nine of these items belonged to the impact component of the original questionnaire and 2 to the activity component, and also referred to activities with little discrimination. The items with insufficient loading to be included in any of the factors analyzed were those answered by a lower percentage of the patients. All factors obtained correlated significantly with the corresponding components and with the overall score on the original questionnaire.

TABLE 4
Spearman Correlation of Scores for Components and Overall Score on the Questionnaire With Variables That Reflect Severity of Bronchiectasis*

Variable	Symptoms	Activity	Impact	Overall
Dyspnea, MRC	0.49†	0.62†,‡	0.54†,‡	0.65†
FEV_1 post-BD, mL	0.42†	0.61†,‡	0.51†,‡	0.59†
FEV_1 post-BD, %	0.45†	0.56†,‡	0.58†,‡	0.59†
Cough	0.48†,‡	0.08	0.22§	0.32§
Daily sputum production	0.53†,‡	0.27§	0.37§	0.47†
Wheezing	0.36†,‡	0.26§	0.18	0.29§
Exacerbations	0.23‡,§	0.18	0.12	0.2§
Chest HR-CT score	0.18	0.34§	0.29§	0.33§
Colonization by *Pseudomonas aeruginosa*	0.41†,‡	0.26§	0.26§	0.35§

*HR-CT indicates high resolution computed tomography; MRC, Medical Research Council scale; FEV_1, forced expiratory volume in 1 second; post-BD, after bronchodilatation
†P<.001.
‡Correlations expected to be highest given the nature of the questions of each component.
§P<.01.

Concurrent Validity

Table 4 shows the correlation (Spearman coefficient) of the 3 components and the overall score with clinical variables that the components make reference to. The symptoms component correlated most with presence of cough (r=0.48; *P*<.001), wheezing (r=0.36; *P*<.001), daily sputum production (r=0.53; *P*<.001), number of exacerbations (r=0.23; *P*<.01), and presence of *P aeruginosa* (r=0.41; *P*<.001), whereas the components for activity and impact correlated most with dyspnea (r=0.62 and r=0.54, respectively; *P*<.001), and lung function parameters (r=0.61 and r=0.51, respectively; *P*<.001, for FEV_1 in mL after bronchodilatation).

Predictive Value

As shown in Table 5, the overall score on the questionnaire differed significantly on comparison between the 2 groups of severity as measured by: score for extent of bronchiectasis (*P*=.006), daily sputum

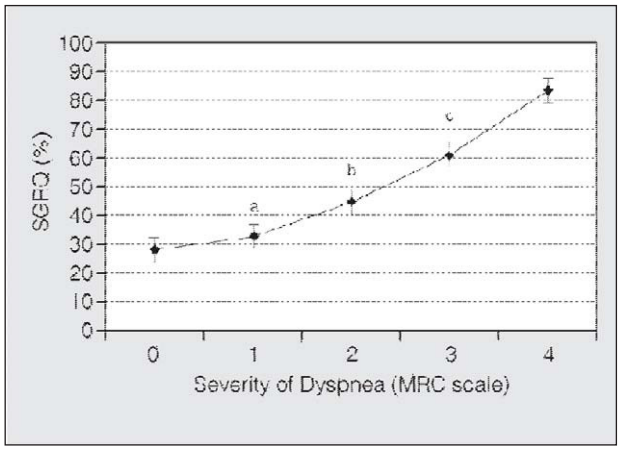

Figure 1. Discriminatory power of overall score on the St. George's Respiratory Questionnaire (SGRQ) versus severity of dyspnea as measured with the Medical Research Council (MRC) scale.
[a]*P* <.02 (grade 1 vs 2); [b]*P*<.001 (grade 2 vs 3); [c]*P*<.001 (grade 3 vs 4).

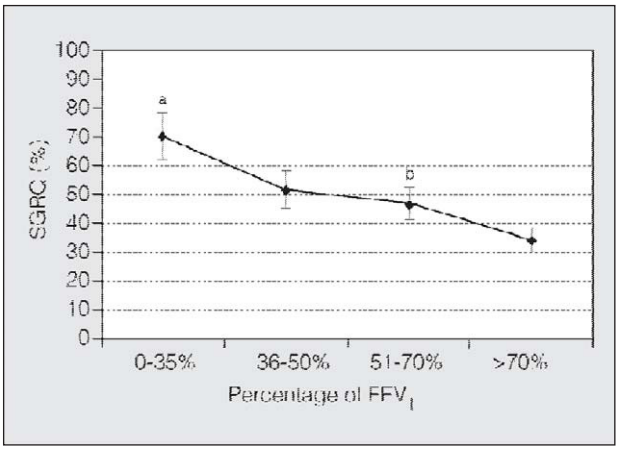

Figure. 2. Discriminatory power of overall score on the St. George's Respiratory Questionnaire (SGRQ) versus intervals of severity of airway obstruction expressed as percentage of theoretical forced expiratory volume in 1 second (FEV_1) after bronchodilatation.
[a]*P*<.003 (0%-35% vs 36%-50%); [b]*P*<.01 (51%-70% vs >70%).

production (*P*=.002), chronic colonization by *P aeruginosa* (*P*=.003), number of exacerbations (*P*=.002), and FEV_1 after bronchodilatation (*P*=.0001). Figure 1 shows the deterioration in HRQL as the severity of dyspnea increased (Medical Research Council scale). In Figure 2, the relationship between overall score on the questionnaire and the severity of the airway obstruction is presented by intervals of theoretical percentage of FEV_1. The figure shows that HRQL decreased as FEV_1 decreased. The differences between values of HRQL for percentage of FEV_1 in the range of 36% to 70% and percentages below 35% and above 70% were statistically significant (*P*=.003 and *P*=.01, respectively).

Discussion

According to our study, the SGRQ for use in patients with stable bronchiectasis showed excellent internal consistency, concurrent validity, and value for predicting severity. However, there are some structural failings in the construct validity in that the structure was only moderately similar to the original questionnaire.

The SGRQ, designed by Jones et al[8] en 1992 for use in patients with chronic airflow limitation, has been translated into different languages, including Spanish, and adapted to different cultures while retaining, at least for the analyses performed, excellent psychometric properties.[9-11] In view of its widespread use, some authors have applied the questionnaire to patients with other respiratory diseases such as COPD,[7] asthma,[21] and bronchiectasis. Recently, Wilson et al[12] and Chan et al[13] have analyzed the validity of the English and Chinese versions of the SGRQ, respectively, for use in patients with bronchiectasis. In both cases, solid internal consistency was reported (Cronbach's alpha: 0.89-0.92), although the alpha value for the symptoms component in the study by Chan et al[13] was 0.59, probably because 2 questions had a conditioned response. The concurrent validity and value for predicting severity were acceptable in both studies, but a detailed analysis of the construct validity by factor analysis to determine whether the structure of items was similar to the original was not performed in either study. Moreover, Wilson et al[12] found strong correlations that had discriminatory power between different degrees of severity of bronchiectasis and dyspnea, number of exacerbations in the last year, and other symptoms, but a weak correlation with lung function variables (r=0.07-0.36). Chan et al,[13] in contrast, found a stronger correlation with FEV_1 (r=0,48) and daily sputum production (r=0.40), but they

TABLE 5
Discriminatory Power of the St. George's Respiratory Questionnaire With Respect to the Different Degrees of Severity of Bronchiectasis*

Variable	Cutoff	Graeter Severity	Lower Severity	*P*
Chest HR-CT Score	4	52.9 (19.5)	42 (15.5)	.006
Presence of *Pseudomonas aeruginosa*	Yes/No	58.2 (19.8)	42.7 (15.8)	.003
Exacerbations	2	55.3 (19.4)	41.9 (15.3)	.002
Post-BD FEV_1, absolute value (mL)	1000	60.4 (17.6)	41.8 (15.5)	.0001
Sputum production, mL	30	56.3 (19.9)	43.1 (16.1)	.002

*HR-CT indicates high-resolution computed tomography (used to determine extent of bronchiectasis); FEV_1, forced expiratory volume in 1 second; post-BD, after bronchodilatation. Severity data are expressed as means (SD).

did not perform a detailed study of the discriminatory power of the questionnaire for differing disease severity.

In general, our results are similar to those found by the British and Chinese studies. The internal consistency of the questionnaire was high—0.90 for overall score and greater than 0.80 for the different components. As expected, the items with conditioned response, and therefore with a lower response rate, produced a lower alpha value for the corresponding components. We therefore eliminated these from the analysis on the grounds that data loss was inevitable, and average values or other summary statistics could not be used to replace lost data. In any case, even when such responses were included in the symptoms component, the value for alpha was 0.75, above the minimum required value of 0.70 according to Nunnany.[19]

The study of the construct by factor analysis showed that the 4 factors chosen after analysis of the scree plot were only moderately similar to the construct of the original questionnaire in 3 components. Overall, these 4 factors explained 36.8% of the variance. The items that made up the first factor were structured in a very similar way to the activity component, grouping 11 of the 16 items of Questions 11 and 15. The structure of the second factor included all items of the symptoms component, whereas the 26 items of the impact component were less evenly distributed among the 4 factors, with most items in the third and, above all, the fourth factor. This uneven distribution might be explained by the nature of the content of the impact component, whose questions take different approaches to analyze the influence of the disease on the patient. These approaches include the impact on the patients of activity limitations due to the disease (information shared with the activity component), the impact of the symptoms themselves (information shared with the symptoms component), and other forms of impact such as social, work, or personal. Thus, in addition to the aforementioned items, the first factor also included a further 3 items referring to activity even though they belonged to the impact component in the original questionnaire. These items referred to how important the patient found shortness of breath when performing certain activities such as bending down or exercising. Likewise, 3 items in the second factor, which encompassed the entire symptoms component, referred to the impact on the patient of cough and other symptoms. Most of the items of the impact component were found in the fourth factor. The third factor contained fewer items and included those with lower discriminatory power—whether because fewer patients answered them because the response was conditioned or because, given the nature of the questions, almost all patients gave the same response. For example, patients with diffuse bronchiectasis and a mean age of nearly 70 years predictably responded that they were unable to participate in sports or intense activities. Finally, 4 items did not reach the minimum level of loading required (0.40) in any of the factors. These items corresponded to those that were most often unanswered and usually referred to personal questions about the disease and the relationship of the patient with those close to him or her such as family and friends, and patients may feel uncomfortable answering such questions. Only Rutten-van Mölken et al,[22] in a study conducted in patients with moderate-to-severe COPD, have carried out a factor analysis of the SGRQ, and their conclusions were similar to those of the present study. In the analysis of these authors, with no structural restrictions, 18 factors were obtained that were difficult to interpret. These factors explained 73% of the variance, whereas restricting the structure to 3 factors managed to only explain 28% of the total variance, and so a dimensional structure similar to the original questionnaire was not confirmed. In effect, according to our analysis, the structure of the SGRQ fell short of being appropriate for use in patients with bronchiectasis. This could be due to a number of factors, such as: inclusion of items with little discriminatory power that therefore did not reach a minimum level of correlation with other items; presence of questions with conditioned responses; the heterogeneous nature of the wide-ranging content of the impact component, which included analyses already used by the symptoms and activity components; the inherent characteristics of our population, whose social and cultural profile was that of a rural area and so the comprehension of some questions may have been limited; and, finally, the application of the questionnaire to patients with a disease other than COPD or asthma, namely bronchiectasis, thus limiting how much of the total variance could be explained by the proposed model.

The SGRQ in our study did, however, provide excellent correlation with variables that, in theory, define the impact of the disease on the patient. As expected, there was strong correlation between the symptoms component and the presence of cough, wheezing, number of exacerbations, sputum production, and presence of *P aeruginosa,* but only weak correlation of this component with lung function variables. The activity and impact components essentially correlated with dyspnea and FEV_1. It is noteworthy that the overall score on the questionnaire correlated more strongly with the lung function variables, particularly both the percentage and absolute FEV_1 (correlation coefficient of approximately 0.6 for both), than in the studies of Wilson et al[12] and Chan et al.[13] In contrast, the correlation was similar for dyspnea, daily sputum production, number of exacerbations, score for extent of bronchiectasis, and chronic colonization by *P aeruginosa*. This latter variable is a factor known to determine severity of bronchiectasis in patients.[23,24] Moreover, the SGRQ showed excellent power for discriminating the severity of bronchiectasis as defined by different variables, in particular, severity of dyspnea and deterioration of lung function parameters.

Taken as a whole, our results suggest that the psychometric characteristics of the SGRQ are good enough to make it appropriate for use in patients with clinically stable bronchiectasis in light of the strong correlation between the variables that essentially define this disease and its severity. Nevertheless, the construct should be reorganized to ensure that the final structure was more applicable to patients with bronchiectasis. Finally, it would be desirable to conduct studies that confirm that this instrument is sufficiently sensitive to clinical changes to complete its validation.

REFERENCES

1. Barker AF. Bronchiectasis. N Engl J Med. 2002;346:1383-93.
2. Barker AF, Bardana EJ. Bronchiectasis: update of an orphan disease. Am Rev Respir Dis. 1988;137:969-78.
3. O'Brien CO, Guest PJ, Hill SL, Stockley RA. Physiological and radiological characterisation of patients diagnosed with chronic obstructive pulmonary disease in primary care. Thorax. 2000;55: 635-42.
4. Heaney LG, Conway E, Nelly C, Johnston BT, English C, Stevenson M, et al. Predictors of therapy resistant asthma: outcome of a systematic evaluation protocol. Thorax. 2003;58:561-6.
5. Hernández C, Abreu J, Jiménez A, Fernández R, Martín C. Función pulmonar y calidad de vida en relación con la colonización bronquial en adultos con bronquiectasias no debidas a fibrosis quística. Med Clin (Barc). 2002;118:130-4.
6. Wilson CB, Jones PW, O'eary CJ, Hansell DM, Cole PJ, Wilson R. Effect of sputum bacteriology on the quality of life of patients with bronchiectasis. Eur Respir J. 1997;10:1754-60.
7. Ferrer M, Alonso J. Medición de la calidad de vida en los pacientes con EPOC. Arch Bronconeumol. 2001;37:20-6.
8. Jones PW, Quirk FH, Baveystock CM, et al. A self-complete measure of health status for chronic airflow limitation: the St George's Respiratory Questionnaire. Am J Respir Crit Care Med. 1992;145:1321-7.
9. Engstrom CP, Persson LO, Larsson S, et al. Reliability and validity of a Swedish version of the St George's Respiratory Questionnaire. Eur Respir J. 1998;11:61-6.
10. Ferrer M, Alonso J, Prieto L, Plaza V, Monsó E, Marrades R, et al. Validity and reliability of the St George's Respiratory Questionnaire after adaptation to a different language and culture; the Spanish example. Eur Respir J. 1996;9:1160-6.
11. Barr JT, Schumacher GE, Freeman S, LeMoine M, Bakst AW, Jones PW. American translation, modification, and validation of St George's Respiratory Questionnaire. Clin Ther. 2000;22:1121-45.
12. Wilson CB, Jones PW, O'Leary CJ, et al. Validation of the St George's Respiratory Questionnaire in bronchiectasis. Am J Respir Crit Care Med. 1997;156:536-41.
13. Chan SL, Chan-Yeung MM, Ooi GC, Lam CL, Cheung TF, Law WK, et al. Validation of the Hong Kong Chinese version of the St George's Respiratory Questionnaire in patients with bronchiectasis. Chest. 2002;122:2030-7.
14. Naidich DP, McCauley DI, Khouri NF, Stitik PP, Siegalman SS. Computed tomography of bronchiectasis. J Comput Assist Tomogr. 1982;6:437-44.
15. Bhalla M, Turcios N, Aponte V, Jenking M, Leitman B, McCauley DI, et al. Cystic fibrosis: scoring system with thin-section CT. Radiology. 1991;179:783-8.
16. Brooks SM. Surveillance for respiratory hazards. ATS News. 1982;8:12-6.
17. Badia X, Salamero M, Alonso J, Editors. La medida de la salud. Guía de escalas de medición en español. Barcelona: Edimac; 1999.
18. Brennan P, Silman A. Statistical methods for assessing observer variability in clinical measures. BMJ. 1992;304:1491-4.
19. Nunnany J. Psychometric theory. 2nd ed. New York: McGraw Hill; 1978.
20. McHorney CA, Tarlov AR. Individual-patient monitoring in clinical practice: are available health status surveys adequate? Qual Life Resp. 1995;4:293-307.
21. Sanjuás C, Alonso J, Prieto L, Ferrer M, Broquetas JM, Anto JM. Health-related quality of life in asthma: a comparison between the St George's Respiratory Questionnaire and the Asthma Quality of Life Questionnaire. Qual Life Res. 2002;11:729-38.
22. Rutten-van Mölken M, Roos B, van Noord JA. An empirical comparison of the St George's Respiratory Questionnaire (SGRQ) and the Chronic Respiratory Disease Questionnaire (CRQ) in a clinical trial setting. Thorax. 1999;54:995-1003.
23. Ho P, Chan K, Ip M, Lam W, Ho C, Yuen K, et al. The effect of *Pseudomonas aeruginosa* infection on clinical parameters in steady-state bronchiectasis. Chest. 1998;114:1594-8.
24. Miszkiel KA, Wells AU, Rubens MB, Cole PJ, Hansell DM. Effects of airway infection by Pseudomonas aeruginosa: a computed tomographic study. Thorax. 1997;52:260-4.