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Validation and reproducibility of the lung function questionnaire (LFQ) for the diagnosis of COPD in Colombia

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Abstract

English:

Introduction: *The development of clinical prediction scales and their use can reduce under-diagnosis and increase early detection of chronic obstructive pulmonary disease (COPD). The performance of clinical prediction scales in Colombia is unknown. The objective of this study is to evaluate the validity and reproducibility of the lung function questionnaire (LFQ) in Colombia.*

Method: *A cross-sectional study was performed, with analysis of diagnostic validity and reliability in people over 40 years of age who underwent a spirometry test. The LFQ questionnaire was applied. To assess reproducibility, the test was carried out at two time points: first at the initial consultation; and then 1 day to 1 week after the previous application. Spirometry was performed immediately after the initial questionnaire, meeting the American Thoracic Society criteria.*

Results: *Among the 1996 subjects included in the analysis, the average age was 65 years (SD: 11.97 years), prevalence of COPD was 21.3%, the intra-class correlation coefficient between the two time points was 0.844 (95% CI: 0.863–0.901) (p < 0.001), and kappa was 0.797 for the dichotomous outcome ≤18 COPD risk points (p < 0.001), validity analysis using the area under the receiver operating characteristic curve for the population evaluated was 0.715 (95% CI: 0.685–0.745); the dichotomous outcome of the questionnaire ≤18 points was as follows: sensitivity – 91.18% (95% CI: 88.0–94.3); specificity – 32.41% (95% CI: 29.8–35.0); positive predictive value – 26.7% (95% CI: 24.1–29.3); negative predictive value – 93.15% (95% CI: 90.7–95.6); likelihood ratio (LR) +: 1.34 (95% CI: 1.28–1.42), LR– 0.27 (95% CI: 0.19–0.39); number needed to diagnose: 4; number needed to misdiagnose: 2 (p < 0.001).*

Conclusion: *The LFQ questionnaire has good performance for the diagnosis of COPD, especially in populations without previous respiratory symptoms or usual risk factors, optimising the use of spirometry to increase its detection.*

Keywords

chronic obstructive pulmonary disease • spirometry • interview and questionnaires • validity and reproducibility

Validarea și reproductibilitatea Lung Function Questionnaire (LFQ) pentru diagnosticul BPOC în Colombia

Rezumat

Romanian:

Introducere: *Dezvoltarea scalelor de predicție clinică și utilizarea lor poate reduce subdiagnosticul și crește detectarea precoce a BPOC. Nu se cunoaște valoate scalelor clinice de predicție în Colombia. Obiectivul acestui studiu este de a evalua validitatea și reproductibilitatea chestionarului de funcție pulmonară (LFQ) în Colombia.*

Materiale și metodă: *Analiza transversală a testului diagnostic și a confidenței la populația peste 40 de ani care se prezintă pentru o spirometrie, la care a fost aplicat LFQ. Pentru a evalua reproductibilitatea, chestionarul a fost aplicat la două momente: la consultația inițială și 1-7 zile după prima aplicare. Spirometria a fost efectuată imediat după chestionarul inițial, îndeplinind criteriile ATS.*

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Rezultate: *1996 subiecți, cu vârsta medie 65 de ani (ds 11,97), cu o prevalență a BPOC de 21,3%, coeficientul de corelație între cele două momente de 0,844 (IC95: 0,863-0,901) (p < 0,001) și Kappa pentru rezultatul dihotomic mai mic sau egal cu 18 puncte de risc pentru BPOC de 0,797 (p < 0,001), analiza validității prin aria de sub curba caracteristicilor operaționale pentru populația evaluată a fost de 0,715 (95% CI: 0,685-0,745). Sensibilitatea 91,18% (95% CI: 88-94,3), specificitatea 32,41% (95% CI: 29,8-35), valoarea predictivă pozitivă 26.7% (95% CI: 24,1-29,3), valoarea predictivă negativă 93,15% (95% CI 90,7-95,6), LR+: 1,34 (95% CI: 1,28-1,42), LR-: 0,27 (95% CI: 0,19-0,39), număr necesar pentru diagnostic: 4, număr necesar pentru nondiagnostic: 2 (p < 0,001).*

Concluzii: *chestionarul LFQ are rezultate bune pentru diagnosticul BPOC, mai ales la populația cu simptome respiratorii anterioare și factorii de risc obișnuiți, optimizând utilizarea spirometriei pentru a crește detecția bolii.*

Cuvinte-cheie

Bronhopneumopatie obstructivă cronică • spirometrie • interviu și chestionar • validitate • reproductibilitate

Introduction

Chronic obstructive pulmonary disease (COPD) is a highly frequent condition that requires early preventive and diagnostic measures so that proper management and treatment can be implemented (1). However, despite the high prevalence of COPD, ranging from 4% to 12.16% worldwide (2-4), and the fact that the initial diagnosis of the disease can be done based on a simple clinical approach, the under-diagnosis of this condition is high and can vary from 15% to 81% in different populations (5-7), affecting the proper management of patients and increasing the economic costs of the disease (5). To address this problem, in recent years, different strategies have emerged for trying to reduce the misdiagnosis: among them are the search for cases through conventional spirometry, the use of portable spirometers, peak expiratory flow measurement (PEF), use of standardised questionnaires and a combination of them. These strategies have shown an increase in the diagnosis of COPD but with variable validity and cost-effectiveness results (8-10).

The use of targeted questionnaires remains a promising strategy, since they can be implemented in different scenarios and populations, without requiring specialised equipment or personnel to use them (10,11). Among the different questionnaires currently used for the diagnosis of COPD are the Lung Function Questionnaire (LFQ), a self-administered questionnaire based on five main questions derived from the Third National Health and Nutrition Examination Survey (NHANES III) (12), and the Likert scale questionnaire, which has shown, in initial validation studies, an area under the receiver operating characteristic (ROC) curve ranging from 0.652 to 0.720, sensitivity from 73.2% to 82.6% and specificity from 47.8% to 58.2% in a primary care population in the United States, with validation studies recommended in different populations (13,14).

The early recognition of subjects with COPD through questionnaires and, in this case, through the LFQ questionnaire can optimise the use of health resources, optimise the use of spirometry and implement early management measures, such as strategies to stop smoking and exposure to other risk factors (15). On the other hand, improving the follow-up and management of underdiagnosed patients could decrease exacerbations and thus improve exercise capacity and prognosis in these patients (16). However, in our environment, the reproducibility and validity of this questionnaire for fixed airflow obstruction is unknown. This study aims to determine the diagnostic performance value of this questionnaire in our environment.

Method

A cross-sectional study was performed, with analysis of reproducibility and diagnostic validity of the use of LFQ in a population of subjects over 40 years of age who underwent a spirometry pre- and post-beta-2-agonist administration in the Pulmonary Function Laboratory of the University of La Sabana Clinic in Chia, Colombia. The period of recruitment was between January 2015 and June 2019. The data collection was carried out in two visits. During the first visit, the data obtained included identification variables, sex, height, weight, race, education level, presence of respiratory symptoms, age at onset of respiratory symptoms, history of smoking, year package index, exposure to wood smoke, passive smoking and prior history of COPD and asthma. The LFQ questionnaire was administered, and the pre- and post-beta-2-agonist spirometry was performed, measuring the forced vital capacity (FVC), forced expiratory volume in the first second (FEV1) and the FEV1/FVC ratio, as well as the percentage change of FVC and FEV1. In the second visit, which occurred 24 h to 15 days after the first one, the LFQ questionnaire was again completed for the analysis of reproducibility.

The LFQ questionnaire in the Spanish version consists of the following five questions:

1. How often do you have a cough with mucus production?
2. How often do you feel noises in your chest when you breathe?
3. How often are you short of breath during a physical activity?
4. How many years have you smoked?
5. How old are you?

Each question has several response options that score from the highest to the lowest on a 1–5 Likert scale; the cutoff point for discrimination is 18 points, i.e. if a score ≤18 is obtained, the greater is the risk of presenting the disease.

The inclusion criteria were as follows: age over 40 years, scheduled to perform spirometry regardless of medical indication, informed consent signature for voluntary participation in the study, native Spanish language speaker and availability of time to complete the questionnaire. Subjects whose spirometry did not meet the quality criteria according to the guidelines of the American Thoracic Association, subjects submitting incomplete questionnaires, and subjects with some type of disability or limitation for communication and/or understanding of the questionnaire or spirometry technique were excluded (mental retardation, dementia, stroke sequelae, hearing loss, deafness and blindness). To carry out the spirometry tests, the same trained and qualified personnel of the pulmonary function laboratory were used, with prior calibration of the equipment and measurement of the pulmonary function tests according to the validity characteristics and reproducibility. COPD was defined as the presence of fixed airflow obstruction as defined by the American Thoracic Society (ATS) as FEV1/FVC ratio <0.7 after bronchodilator administration.

Convenience sampling was performed by sequentially entering the subjects in the study. The sample size was calculated using the Epidat 4.0 programme using the diagnostic test formula, with calculation of confidence interval with unknown patient condition and taking the proportion of disease (26.7%) in the PUMA study, where the prevalence of COPD in subjects attending medical centres in the country was evaluated (17,18); the expected sensitivity value of 73.2% and expected specificity of 58.2% of the study by Hanania et al (13) were taken, with a minimum of 1129 subjects being required for a precision of 5% and a 95% confidence interval (95% CI). The sample size for the reproducibility analysis was calculated using the formula to determine the intra-class correlation coefficient (ICC). An anticipated ICC = 0.85, precision = 5, confidence level = 95% and two observers were required, requiring a minimum of 475 subjects. The *p* Editions were replaced with a new subject the entrance of the study.

The data was obtained automatically through an electronic collection form, which automatically entered them into an Excel spread sheet for later verification of their values by the research group for the search for transcription and correction errors. Subsequently, the database was analysed using the statistical programme SPSS version 25 (licenced), where an initial description of the study variables was made using the measures of summary of frequencies and percentages for the qualitative and average variables, respectively, and standard deviation for the quantitative variables if their distribution was normal; or medium and interquartile range for quantitative variables with non-normal distribution. Bivariate analysis was performed between the study variables and the presence or absence of COPD using the chi-square test for qualitative variables and Student's *t*-test or Mann–Whitney *U*-test for quantitative variables according to their distribution; 2×2 tables were constructed for diagnostic test analysis and calculation of sensitivity, specificity, positive predictive value, negative predictive value, positive likelihood ratio, negative likelihood ratio with the dichotomous outcome of the questionnaire ≤18 and the presence or absence of non-reversible airflow obstruction by spirometry. The construction of the ROC curve with the quantitative result of the questionnaire and the presence or absence of COPD by spirometry, the number needed to diagnose (NND) and the number needed for misdiagnosis (NNMD) were also calculated for the general population and divided by groups of respiratory symptoms, history of smoking and exposure to wood smoke. The result was considered a significant if the *p*-value was <0.05.

The research protocol follows the international ethical guidelines of the Declaration of Helsinki and the national ethical considerations of Resolution 8430 of 1993 and the Data Protection Law 1581 of 2012. It was presented and approved by the research committee of the University of La Sabana and by the ethics committee of the Clinic of the University of La Sabana.

Results

A total of 1996 potentially eligible patients were admitted during the study period. A total of 397 subjects did not meet inclusion criteria, and thus, 1599 subjects were taken to the final analysis. Figure 1 shows the flowchart for inclusion of the subjects in the study. Regarding the general characteristics of the population, the average age was 65 years (SD: 11.97 years), male sex comprised 44%, mixed race comprised 86% and the prevalence of COPD was 21.3%. The general characteristics of the studied population and their lung function are shown in Tables 1 and 2.

LFQ results and COPD diagnosis

The answers to all the questions that assess cough with expectoration, wheezing, dyspnoea, age of presentation and years of cigarette consumption had significant differences between COPD and non-COPD subjects. The running time

Table 1. General characteristics of the population

	Total population, *n* = 1599	Without COPD, *n* = 1259	With COPD, *n* = 340	*p*-value
Age, in years, *n* (SD)	65.3 (11.9)	64 (11.88)	70 (11.03)	<0.001
Male sex, *n* (%)	702 (49.9)	518 (41.1)	184 (54.1)	<0.001
Race, *n* (%)				
White	196 (12.2)	153 (12.1)	43 (12.5)	0.354
Half-blood	1381 (86.4)	1086 (86.2)	295 (86.7)	
Black	4 (3)	3 (2.3)	1 (0.2)	
Other	3 (1)	2 (0.2)	1 (0.2)	
Educational level, *n* (SD)				
None	20 (1.2)	15 (1.2)	5 (1.4)	<0.001
Primary	604 (37.7)	425 (33.7)	179 (52.6)	
High school	427 (26.7)	356 (28.2)	71 (20.8)	
Technologist	12 (0.77)	11 (0.9)	1 (0.2)	
Technical	121 (9.3)	29 (9.6)	150 (8.5)	
Master´s degree	5 (0.3)	2 (0.1)	3 (0.8)	
Doctorate	4 (0.2)	4 (0.3)	0 (0)	
Years of study, *n* (SD)	9.3 (5.6)	9.8 (5.56)	7.5 (5.51)	<0.001
Respiratory symptoms, *n* (%)	1360 (85)	1046 (83)	314 (90)	<0.001
Age at onset of symptoms, *n* (SD)	57.3 (17.21)	57 (16.11)	57.5 (20.05)	0.856
Smoking, *n* (%)	733 (45)	553 (43)	180 (52)	0.003
IPA, *n* (%)	15.2 (23.26)	12.8 (21.25)	22.6 (27.43)	<0.001
Passive smoker, *n* (%)	266 (16)	206 (16.2)	60 (17.6)	0.982
Exposure to wood smoke, *n* (%)	937 (58)	702 (55.8)	235 (69.1)	<0.001
Prior diagnosis of COPD, *n* (%)	409 (25)	246 (19.5)	163 (47.9)	<0.001
Prior diagnosis of asthma, *n* (%)	215 (13)	149 (11.8))	66 (19.4)	<0.001

IPA, index package/year.

Table 2. General lung function characteristics of the population

	Total population, *n* = 1559	Without COPD, *n* = 1259	With COPD, *n* = 340	*p*-value
Weight, kg, *n* (SD)	70.6 (13.74)	71.4 (13.86)	67.7 (12.86)	<0.001
Height, cm, *n* (SD)	159.6 (9.25)	159.6 (9.29)	159.7 (9.10)	0.954
Pulmonary function, L (SD)				
FVC reference	3.1 (0.81)	3.1 (0.82)	3.0 (0.8)	0.014
FVC pre-B2	2.9 (0.98)	3.0 (0.99)	2.7 (0.92)	<0.001
FVC pre-B2, % predicted	94.7 (21.33)	96.3 (20.76)	88.8 (22.36)	<0.001
FVC post-B2	3.0 (0.97)	3.1 (0.97)	2.9 (0.97)	0.001
FVC post-B2, % predicted	98.1 (21.02)	98.7 (20.48)	95.8 (22.77)	0.031
FVC, % change	4.2 (7.97)	2.9 (6.75)	9.1 (9.98)	0.001
FEV1 reference	2.4 (0.67)	2.5 (0.67)	2.3 (0.64)	<0.001
FEV1 pre-B2, best	2.2 (0.82)	2.4 (0.77)	1.5 (0.61)	<0.001
FEV1 pre-B2, % predicted	90.6 (25.02)	97.0 (21.69)	66.6 (21.81)	<0.001
FEV1 post-B2, best	2.3 (0.82)	2.5 (0.78)	1.7 (0.64)	<0.001
FEV1 post-B2, % predicted	96.4 (9.96)	102.2 (21.31)	74.9 (22.40)	<0.001
FEV1, % change	7.9 (9.96)	6.0 (7.26)	14.9 (14.5)	<0.001
FEV/FVC reference	78.2 (4.78)	78.9 (3.16)	75.7 (7.90)	<0.001
FEV/FVC pre-B2%, best	74.6 (12.79)	79.4 (7.83)	56.7 (11.73)	<0.001
FEV/FVC pre-B2, % predicted	94.9 (11.45)	100.7 (9.17)	73.7 (73.66)	<0.001
FEV/FVC post-B2%, best	76.8 (12.4)	81.7 (6.86)	58.6 (11.32)	<0.001
FEV/FVC post-B2, % predicted	98.0 (15.41)	103.7 (9.01)	76.5 (15.37)	<0.001

B2, beta-2-agonist; COPD, chronic obstructive pulmonary disease; FVC, forced vital capacity; FEV, forced expiratory volume.

Table 3. Results of the LFQ questionnaire in the general population and in patients with and without COPD

	Total population, *n* = 1599	**Without COPD, *n* = 1259**	**With COPD, *n* = 340**	***p*-value**
How often do you have a cough with mucus?				
Never, *n* (SD)	348 (21.76)	298 (23.6)	50 (14.7)	<0.001
Rarely, *n* (SD)	591 (36.96)	481 (38.2)	110 (32.3)	
Sometimes, *n* (SD)	351 (21.95)	274 (21.7)	77 (22.64)	
Frequently, *n* (SD)	208 (13)	141 (11.1)	67 (19.7)	
Very often, *n* (SD)	101 (6.3)	65 (5.16)	36 (10.58)	
How often do you fee sounds in your chest (gasps, whistles or vibrations) when you breathe?				
Never, *n* (SD)	664 (41.5)	583 (46.3)	81 (23.82)	<0.001
Rarely, *n* (SD)	310 (19.38)	253 (20.1)	57 (16.76)	
Sometimes, *n* (SD)	366 (22.88)	260 (20.6)	106 (31.1)	
Frequently, *n* (SD)	169 (10.56)	111 (8.81)	58 (17.05)	
Very often, *n* (SD)	90 (5.62)	52 (4.13)	38 (11.17)	
How often are you short of breath during a physical activity (when climbing stairs or climbing a slope without resting)?				
Never, *n* (SD)	324 (21.6)	272 (21.6)	52 (15.29)	<0.001
Rarely, *n* (SD)	228 (14.25)	188 (14.9)	40 (11.76)	
Sometimes, *n* (SD)	361 (22.57)	304 (24.1)	57 (17.76)	
Frequently, *n* (SD)	378 (23.63)	291 (23.1)	87 (25.58)	
Very often, *n* (SD)	308 (19.26	203 (16.2)	104 (30.5)	
How many years have you smoked?				
I have never smoked, *n* (SD)	872 (54.5)	710 (56.39)	162 (47.6)	<0.001
≤10 years, *n* (SD)	244 (15.25)	210 (16.67)	34 (10)	
11–20 years, *n* (SD)	149 (9.31)	119 (9.45)	30 (8.82)	
21–30 years, *n* (SD)	107 (6.69)	76 (6.03)	31 (9.11)	
>30 years, *n* (SD)	227 (14.19)	144 (11.43)	83 (24.41)	
How old are you?				
<40 years, *n* (SD)	15 (0.93)	15 (1.19)	0 (0)	<0.001
40–49 years, *n* (SD)	197 (12.32)	176 (13.97)	21 (6.17)	
50–59 years, *n* (SD)	320 (20.01)	285 (822.63)	35 (10.29)	
60–69 years, *n* (SD)	483 (30.2)	387 (30.73)	96 (28.23)	
≥70 years, *n* (SD)	584 (36.52)	396 (31.45)	188 (55.29	
Total LFQ score, *n* (SD)	16.2 (3.52)	16.8 (3.34)	14.1 (3.35)	<0.001
LFQ development time, *n* (SD)	0.9 (0.82)	0.9 (0.87)	0.8 (0.64)	0.323
LFQ score ≤18, *n* (SD)	1161 (0.72)	851 (9.67)	310 (0.91)	<0.001
LFQ score ≤18 without respiratory symptoms, *n* (SD)	100 (0.41)	79 (0.37)	21 (0.80)	<0.001
LFQ score ≤18 with respiratory symptoms, *n* (SD)	1061 (0.78)	772 (0.73)	289 (0.92)	<0.001
LFQ score ≤18 without smoking, *n* (SD)	537 (0.62)	401 (0.56)	136 (0.85)	<0.001
LFQ score ≤18 with smoking, *n* (SD)	624 (0.85)	450 (0.81)	174 (0.96)	<0.001
LFQ score ≤18 no exposure to wood smoke, *n* (SD)	445 (0.67)	353 (0.63)	92 (0.87)	<0.001
LFQ score ≤18 exposure to wood smoke, *n* (SD)	716 (0.76)	498 (0.70)	218 (0.92)	<0.001
LFQ score ≤18 no smoker in the house, *n* (SD)	838 (0.75)	595 (0.65)	243 (0.91)	<0.001
LFQ score ≤18 with smoker in the house, *n* (SD)	201 (0.75)	147 (0.71)	54 (0.9)	0.003
LFQ score ≤18 no smoking or exposure to wood smoke, *n* (SD)	182 (055)	150 (0.52)	32 (0.76)	0.004
LFQ score ≤18 with smoking and exposure to wood smoke, *n* (SD)	361 (0.90)	247 (0.87)	114 (0.97)	0.002

LFQ, lung function questionnaire.

of this questionnaire was an average of 1 minute, and the dichotomous classification with a cutoff point ≤18 for COPD risk discriminates with statistically significant p (<0.05) in the analysed subgroups of exposure to risk factors and presence or absence of clinical symptoms. The results of the different questions and their respective answers, as well as the dichotomous score among the general population and among patients with and without COPD, are shown in Table 3.

When performing the statistical tests to find differences between the scores of the LFQ questionnaire at the two different time points, no difference was observed between the averages of the questionnaire scores. In addition,

Pearson's and Spearman's correlation coefficients showed a very good correlation, and the assessment of the correlation and concordance through the ICC was excellent. For the dichotomous outcome, the kappa concordance coefficient was also very good; a correlation and concordance between the score and the degree of obstruction evaluated by spirometry was not found. The results of the correlation and concordance analysis between the questionnaires and spirometry are found in Table 4.

Validity analysis of the LFQ questionnaire

In the general population and the different groups analysed, the LFQ questionnaire shows high sensitivity (>76.19%) and low specificity (<62.91%); these values vary depending on the population evaluated. The best relationship between the number needed to diagnose (NND) and the number needed to misdiagnose (NNDM) is among subjects without exposure to smoking or wood smoke. In subjects who did not report respiratory symptoms, this relationship remains, but it is less prominent. The area under the ROC curve shows good performance in the general population, being higher in the population that did not report respiratory symptoms. The results of sensitivity, specificity, positive and negative predictive values, positive and negative likelihood ratios, accuracy and Youden's indices, the numbers needed to diagnose, the numbers needed to misdiagnose and the areas under the ROC curve are shown in Tables 5 and 6.

Discussion

This is the first study where the use of a clinical questionnaire for the diagnosis of COPD in our region has been evaluated. Taking into account the high frequency of patients with misdiagnosed COPD worldwide, it is important to evaluate potential tools easy to implement in the search for subjects with the disease. The evaluation of the LFQ questionnaire showed excellent ICC reproducibility: 0.884 (95% CI: 0.863–0.901) and good validity for the recognition of patients with COPD, defined as a FEV1/FVC post-bronchodilator ratio <0.7. The values obtained are similar to those obtained in American populations, where the AUC was 0.718 (95% CI: 0.673–0.763) for the sum of the total score, and in our study, we obtained a value of 0.715 (95% CI: 0.685–0.745). For the cutoff point of ≤18 for the diagnosis of obstruction, we found sensitivity in our population to be greater (91.2% vs 82.6%) and lower specificity (32.4% vs 47.8%), compared to the original validation study of Hanania et al (13,19).

The prevalence of COPD (21.3%) is higher in our study than that reported in the community, namely 14.3% in Latin America (20) and 8.9% in Colombia (21). This increase in prevalence is explained by the sampling of subjects among people who attended care centres, not among an unselected population. However, our prevalence is similar to that reported in the PUMA study (20.6%), which was carried out at the first-level care centres in Latin America (18). This prevalence increases as the positive predictive value is known. However, the use of the questionnaire increases the possibility of detecting cases of the disease regardless of the study population; the sub-diagnosis of the disease occurs both in the community and in hospitals. In our study, only 47.9% of the subjects with the disease had a previous diagnosis of COPD, showing that the recognition percentage can increase significantly with the use of this questionnaire. On the other hand, characteristics in our population regarding male sex, low educational level and history of exposure to wood smoke could also be taken into account for the early suspicion and diagnosis of the disease (22).

In the group analysis, the highest performance of AUC was found in subjects without prior evidence of respiratory symptoms, with an area of 0.798 (95% CI: 0.706–0.889) and where the NND = 2 in relation to the NNDM = 3. However, the best relationship between the NND and the NNDM is 4–14, found in subjects in whom there is fixed obstruction to the air flow and who have not been exposed to cigarette or wood smoke. Conversely, in subjects with chronic respiratory symptoms and in whom there is a clear risk factor, the use of this questionnaire has regular performance. The use of questionnaires in search of COPD in subjects with risk factors or attending medical centres is still valuable (23) and increases the diagnosis of the disease. However, its performance may be greater as a screening tool in the general population (24). In this manner, the spirometry resource could be optimised; subjects with a negative questionnaire result would not require additional evaluations, and in those with the positive questionnaire result, the conventional spirometry evaluation

Table 4. Results of the correlation analysis and concordance using LFQ questionnaire

	Correlation coefficient	95% CI	*p*-value
t-tests for related samples			0.793
Pearson's correlation coefficient	0.884		<0.001
Spearman's correlation coefficient	0.881		<0.001
ICC	0.884	0.863–0.901	<0.001
Cronbach´s alpha	0.938		
Kappa correlation coefficient	0.797		<0.001
ICC FEV1 pre, L, vs LFQ	0.165	0.117–0.212	<0.001
ICC FEV1 post, L, vs LFQ	0.158	0.110–0.206	<0.001
ICC FEV1/FVC pre, L, vs LFQ	0.179	0.131–0.226	<0.001
ICC FEV1/FVC post, L, vs LFQ	0.183	0.135–0.230	<0.001

ICC, intra-class correlation coefficient; FEV1, forced expiratory volume in the first second; FVC, forced vital capacity.

Table 5. Validity analysis of the LFQ questionnaire with diagnosis of COPD

	S	95% CI	E	95% CI	VPP	95% CI	VPN	95% CI	LR+	95% CI	LR–	95% CI	Index of accuracy	Youden's index	NND	NNMD
Total population	91.18	88.0–94.3	32.41	29.8–35.0	26.70	24.1–29.3	93.15	90.7–95.6	1.34	1.28–1.42	0.27	0.19–0.39	0.44	0.23	4	2
Without symptoms	80.77	63.7–97.8	62.91	56.2–69.6	21.00	12.5–29.5	96.40	92.9–99.9	2.17	1.69–2.81	0.3	0.14–0.68	0.64	0.43	2	3
With symptoms	92.04	88.9–95.2	26.20	23.5–28.9	27.24	24.5–29.9	91.64	88.3–94.9	1.24	1.19–1.31	0.3	0.21–0.45	0.41	0.18	5	2
No smoking	85.00	79.2–90.9	43.20	39.5–46.9	25.33	21.6–29.1	92.71	89.7–95.7	1.49	1.37–1.64	0.34	0.24–0.51	0.5	0.28	4	2
Smoking	96.67	93.7–99.6	18.63	15.3–21.9	27.88	24.3–31.5	94.50	89.8–99.2	1.18	1.13–1.25	0.17	0.08–0.40	0.37	0.15	7	2
No exposure to wood smoke	87.62	80.8–94.4	36.62	32.5–40.7	20.67	16.8–24.6	94.01	90.6–97.4	1.38	1.26–1.52	0.33	0.20–0.57	0.44	0.24	4	2
Exposure to wood smoke	92.77	89.2–96.3	29.06	25.6–32.5	30.45	27.0–33.9	92.31	88.6–96.1	1.3	1.23–1.39	0.24	0.16–0.40	0.45	0.21	5	2
Without smoker in the home	91.35	87.8–94.9	34.62	31.5–37.8	29.00	25.9–32.1	93.20	90.4–96.0	1.39	1.32–1.48	0.24	0.17–0.37	0.47	0.25	4	2
With smoker in the home	90.00	81.6–98.4	28.64	22.2–36.0	26.87	20.5–33.2	90.77	82.9–98.6	1.26	1.12–1.42	0.34	0.16–0.77	0.42	0.18	5	2
Without smoking and without exposure to wood smoke	76.19	62.1–90.3	47.74	41.8–53.7	17.58	11.8–23.4	93.20	88.8–97.6	1.45	1.19–1.78	0.49	0.29–0.87	0.92	0.23	4	14
With smoking and exposure to wood smoke	97.44	94.1 – 100	12.72	8.7–16.8	31.58	26.7–36.5	92.31	82.7–100	1.11	1.06–1.18	0.2	0.06–0.64	0.37	0.1	10	2
Without symptoms	80.77	63.7–97.8	62.91	56.2–69.6	21.00	12.5–29.5	96.40	92.9–99.9	2.17	1.69–2.81	0.3	0.14–0.68	0.64	0.43	2	3
No exposure to wood smoke	87.62	80.8–94.4	36.62	32.5–40.7	20.67	16.8–24.6	94.01	90.6–97.4	1.38	1.26–1.52	0.33	0.20–0.57	0.44	0.24	4	2

Table 6. AUC of the LFQ questionnaire for COPD diagnosis

	AUC	95% CI	*p*-value
Total population of the study	0.715	0.685–0.745	<0.001
Population without evidence of respiratory symptoms	0.798	0.706–0.889	<0.001
Population with respiratory symptoms	0.694	0.661–0.727	<0.001
Population without a history of smoking	0.713	0.670–0.757	<0.001
Population with a history of smoking	0.706	0.664–0.748	<0.001
Population without a history of exposure to wood smoke	0.715	0.661–0.770	<0.001
Population with a history of exposure to wood smoke	0.705	0.668–0.742	<0.001
Population without a history of smoking at home	0.73	0.697–0.763	<0.001
Population with a history of smoking at home	0.653	0.581–0.773	<0.001
Population without smoking and without exposure to wood smoke	0.671	0.581–0.760	<0.001
Population with smoking and exposure to wood smoke	0.674	0.617–0.730	<0.001

AUC, area under the receiver operating characteristic curve.

would be directed towards complete evaluation and thus the cost-effectiveness of spirometry in these scenarios is improved (12).

The correlation of the clinical history and respiratory symptoms to the limitation of air flow is variable. Two different observers had good agreement in determining the history of smoking with kappa of 0.95; however, it decreased with the evaluation of other clinical findings. Reproducibility for the determination of wheezing had a kappa of 0.61, dyspnoea had kappa of 0.44–0.48 and cough showed a kappa of 0.46 (25). In this sense, the reproducibility of the LFQ questionnaire is very good, with an ICC of 0.884 for the quantitative score and 0.777 for the dichotomous outcome. The medical history remains a useful tool in the recognition of subjects with COPD or at risk for it (26); however, isolated information regarding symptoms has low sensitivity, history of cigarette consumption has sensitivity of 40%, expectoration 20%, wheezing 51%, dyspnoea 33% and coughing 51%. The use of a questionnaire that integrates the symptomatic characteristics increases the instrument's sensitivity, an important characteristic in an instrument to search for cases without increasing costs or additional resources.

Nowadays, there are questionnaires such as the CDQ (27), COPD-PS (28) and IT BE COPD, among others (29), which have also been evaluated for the diagnosis of COPD, whose performance is similar to the LFQ questionnaire; however, it is not known exactly whether one is better than the others or whether they can be used interchangeably with each other, which could still be the subject of future research. However, it seems that the use of such tools could be one of the alternatives to address the problem of misdiagnosis of the disease by focusing adequately on the use of pulmonary function tests so that a balance in cost-effectiveness is achieved in the procedures for early diagnosis of the disease (30). On the other hand, studies should be conducted on the use of additional alternatives, such as portable devices or cost-efficiency biomarkers, for easy implementation as additional alternatives that may be available in the future.

In summary, this questionnaire, which evaluates five clinical symptomatology items along with additional risk factors, has good reproducibility and validity for the detection of patients with COPD. Its validity is similar to previous validation studies in other populations, ir meets the characteristics of a screening method (high sensitivity) and it can be used in our region easily and economically. Among the possible weaknesses of the study we can consider the type of population evaluated, namely that it assesses a hospital population and thus may increase the risk of disease bias. However, patients without previous symptoms were evaluated, in whom the questionnaire showed greater capacity for discrimination, a situation similar to that found in other questionnaire validation studies, where, based on a specific score, the spirometry study is recommended for air flow confirmation.

Conclusion

The LFQ questionnaire has good reproducibility and validity for the detection of subjects with COPD, and its use can optimise the use of conventional spirometry to confirm the diagnosis of airflow obstruction.

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