Evaluation of the questionnaires' validity in assessing the severity of idiopathic pulmonary fibrosis in correlation with high-resolution computed tomography, lung diffusion, and cardiopulmonary exercise tests

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Introduction Health-related quality-of-life questionnaires need to be incorporated into the evaluations of idiopathic pulmonary fibrosis (IPF) patients to assess their influence.

Aim The aim of the study was to evaluate the validity of generic and specific questionnaires in assessing the severity of IPF in correlation with high-resolution computed tomography (HRCT), diffusion lung capacity for carbon monoxide (DL_{CO}), and cardiopulmonary exercise testing (CPET).

Patients and methods Forty stable IPF patients were prospectively recruited and categorized on the basis of spirometry, DL_{CO}, HRCT, and CPET. The results were correlated with a generic International Physical Activity Questionnaire (IPAQ) and a Specific Saint George Respiratory Questionnaire (SGRQ).

Results IPF patients showed restrictive pattern with impairment of diffusion capacity (forced vital capacity (FVC)= 56±14.8% and DL_{CO}=48.5±20% of predicted value) with a total semiquantitative scoring of HRCT 16.6±8. The mean total score of the SGRQ questionnaire for all studied cases was 56.5+21 and categorical scoring of IPAQ showed that 45, 42.5, and 12.5% of patients were in moderate, severe, and mild categories, respectively. There was a negative correlation between the total score of SGRQ and VO_2max (ml/kg/min) (maximum oxygen consumption) (r=–0.35) and VE' (l/min) (minute ventilation) (r=–0.39) on CPET, as well as with DL_{CO} (r=–0.53), and a positive correlation with HRCT score (r=0.63). There was a highly significant correlation between IPAQ and VO_2max (χ^2=28), VE' (χ^2=14.8) and desaturation percentage variables of CPET, DL_{CO} (r=0.61), and HRCT score (r=–0.68).

Conclusion Correlations between physiological parameters including DL_{CO} and CPET, radiological parameters in the form of HRCT, and health-related quality-of-life assessment using SGRQ and IPAQ were strong and it was possible to distinguish IPF patients with severely impaired lung functions.
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Keywords: cardiopulmonary exercise test, diffusion lung capacity for carbon monoxide, International Physical Activity Questionnaire, interstitial pulmonary fibrosis, Saint George Respiratory Questionnaire

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Introduction

Idiopathic pulmonary fibrosis (IPF) is defined as a specific form of chronic fibrosing interstitial pneumonia limited to the lung and associated with histological appearance of usual interstitial pneumonia on surgical lung biopsy [1]. High-resolution computed tomography (HRCT) of the chest has changed the diagnostic evaluation and commonly shows patchy, predominantly peripheral, subpleural, bibasal reticular abnormalities [2]. Pulmonary function tests are used to quantify disease severity, monitor disease progression, and identify variables most strongly predictive of mortality.

Health-related quality-of-life (HRQL) questionnaires have been applied to quantify average changes in health and the effects on the patient's daily life in several types of chronic lung diseases. Two kinds have been used: generic and disease specific. Both can be used in IPF [3].

Aim

The aim of this study was to evaluate the validity of the generic International Physical Activity Questionnaire (IPAQ) and Specific Saint George Respiratory Questionnaire (SGRQ) in assessing the severity of IPF in correlation with HRCT, diffusion lung capacity for carbon monoxide (DL_{CO}), and cardiopulmonary exercise testing (CPET).

Patients and methods

This prospective study included 40 consecutive stable IPF patients on steroid dose 10 mg or less who were diagnosed according to radioclinical criteria mentioned in American Thoracic Society (ATS) 2011 [4]. The patients were selected from either the outpatient chest clinic or inpatient wards of Ain Shams University hospitals during the period from August 2011 to August 2012. Smokers or ex-smokers, patients with other interstitial lung diseases (ILDs), patients with comorbid disease that precluded exercise (such as severe orthopedic or neurological deficits or history of syncope on exertion or unstable cardiac disease), and patients with cardiac, renal, hepatic diseases, or diabetes mellitus were excluded. All patients gave their formal consent. The protocol was approved the Ethical commiitte of the Ain Shams University.

All patients were subjected to the examinations given below.

Spirometry

Forced expiratory volume in the first second (FEV_1), FVC, FEV_1/FVC ratio, and forced expiratory flow over 25–75% part of FVC ($FEF_{25–75\%}$) were measured using the spirometry system (Masterscreen 2001, version 4.5; Erich Jaeger GmbH, Wurzburg, Germany) according to the guidelines of the ATS [5].

High-resolution computed tomography of the chest

HRCT of the chest was performed on a General Electric multislice 4 multidetector (General Electric) with a scanning time of 5 s so that scans with 1–2 mm collimation were obtained at 10 mm intervals from the lung apices to the bases at full inspiration with breath-holding after deep inspiration and the patient supine. A semiquantitative scoring system (Table 1) was then used to evaluate the correlation between HRCT findings and the clinical severity of disease [6].

Single-breath carbon monoxide diffusing capacity

Single-breath carbon monoxide diffusing capacity (DL_{CO}) was ascertained (Masterscreen 2001, version 4.5; Erich Jaeger GmbH) to evaluate the extent of diffusion impairment severity, which was classified into normal [80–120% of predicted (A grade)], mild [<80 but >60% of predicted (B grade)], moderate [<60 but >40% of predicted (C grade)], and severe [<40% of predicted (D grade)] according to the guidelines of the ATS [5].

Cardiopulmonary exercise testing

CPET was performed using a standardized protocol in accordance with the ATS/American College of Chest Physicians statement [7]. All patients underwent a symptom-limited CPET with an electromagnetically braked cycle ergometer (Ergometrics 900; Erich Jaeger GmbH) using a ramp protocol. Cardiopulmonary data were collected and analyzed with an exercise metabolic unit (Master Screen-CPX; Viasys, Germany). The following parameters were recorded: heart rate (HR), minute ventilation (VE), maximum oxygen consumption (VO_2max), VO_2max/kg, ventilatory equivalent for oxygen (VE/VO_2) and for carbon dioxide (VE/VCO_2), anaerobic threshold (AT), VE/VCO_2 at AT, respiratory rate, oxygen pulse (VO_2/HR), breathing reserve, and HR reserve; these parameters were measured at the highest comparable workload for each patient. The ratio of total dead space to tidal volume (V_d/V_t) was also computed.

Diagnosis of ILD was confirmed by reduced VO_2max, breathing reserve and O_2 pulse, reduced or normal AT, reduced or normal VE', fall in SO_2, and increased V_d/V_t. Then grading was done using VO_2max, predicted VE', and AT to detect the severity of the disease, which was divided into class A (severity: none to mild; VO_2max >20 ml/min/kg; predicted VE' >60 l/min; AT >40–80% from VO_2max), class B (severity: mild to moderate; VO_2max 16–20 ml/min/kg; predicted VE' 50–60 l/min; AT 30–40% from VO_2max), class C (severity: moderate to severe; VO_2max 10–15 ml/min/kg; predicted VE' 40–50 l/min; AT 20–30% from VO_2max), and class D (severity: severe; VO_2max 6–9 ml/min/kg; predicted VE' <40 l/min; AT <20% from VO_2max) [8].

Quality-of-life assessment by two different questionnaires (Saint George Respiratory questionnaire and International Physical Activity Questionnaire)

The Arabic version of the SGRQ (respiratory-specific questionnaire) [9] was used, which consists of three components: symptoms, which measure respiratory symptoms; activities, which measure impairment of mobility or physical activity; and impact, which measures the psychosocial impact of disease. Scores for these components and the summary score are on a

Table 1 Semiquantitative scoring of high-resolution computed tomography [6]

Anatomical regions scored	Grading for each abnormality		Abnormality
	Scores	Percentage disease extent	
Lobes are scored independently	0	0	Ground-glass opacity
Lingula is considered a separate lobe	1	1–25	Mixed ground-glass opacity/reticular fibrosis
6 total lobes	2	26–50	Reticular fibrosis alone
	3	51–75	Honeycombing
	4	>75	

Global score: summation of scores for each abnormality, in all lobes.

100-point scale calculated by an Excel scoring calculator. Higher scores correspond to worse HRQL. The Arabic version of the IPAQ (nonspecific questionnaires) [10] was used, which consists of four generic items (leisure time physical activity, domestic and gardening activities, and work-related physical activity and transport-related physical activity). The questionnaire provided separate scores on walking and on moderate and vigorous activities; categorical scoring was then done (category 1 or mild, category 2 or moderate, and category 3 or severe). Both questionnaires were administered and scored according to the instruction manual before the execution of the CPET and lung function tests.

Statistical analysis

Data were analyzed and tabulated by an IBM computer using statistical program for the social sciences, version 12 (SPSS; SPSS Inc., Chicago, Illinois, USA). Quantitative variables were presented as mean, SD, and range; qualitative variables were presented as number and percentage; the χ^2-test was used to compare qualitative variables; the Spearman correlation was used to rank variables positively or inversely versus each other in the same group; receiver operator characteristic curve was used to find out the best cutoff value of a certain predictor and its validity parameters (sensitivity, specificity, positive predictive value, negative predictive value, and accuracy). *P*-value was considered insignificant if more than 0.05 and significant if up to 0.05.

Results

The population studied consisted of 40 patients. Totally, 20 patients were male and 20 were female, with a mean age of 54±14 (range: 34–81) years. Every study participant underwent spirometry, single-breath carbon monoxide diffusing capacity evaluation, and HRCT of the chest. The mean value of FVC% was 56±14.8. The mean value of DL_{CO}% of predicted was 48.5±20. On the basis of the severity of diffusion impairment, 14 (35%) patients were graded mild (grade B), 15 (37.5%) patients were graded moderate (grade C), and the remaining 11 (27.5%) patients were graded severe (grade D).

The semiquantitative scoring of HRCT revealed a mean total score of 16.6±8 (range: 6–38) for all studied cases. The mean scores of ground-glass opacity, reticular fibrosis, mixed ground-glass opacity, and reticular fibrosis and honeycombing were 0.7±1.5, 7.9±4, 2.5±2, and 5.5±4, respectively.

The mean total score on the SGRQ questionnaire for all studied cases was 56.5±21 (range: 30.6–98.8), in which the mean of symptoms domain, activity domain, and impact domain were 52.4±26, 66.9±18, and 53.3 ±25, respectively. Categorical scoring of IPAQ showed that 18 (45%) patients were of moderate category, 17 (42.5%) patients were of severe category, and five (12.5%) patients were in the mild category.

All patients underwent CPET, except five patients who were oxygen dependent. Out of 35 patients, CEPT was ceased in 26 (74.3%) patients because of dyspnea and in nine (25.7%) patients because of leg pain. Desaturation occurred in 16 (45.7%) patients. All patients reached the AT. The main results of CPET with their grading are shown in Table 2. The mean VO_2max (ml/kg/min), VE' (l/min), and AT (% from VO_2max) were 14±4, 37.9±13, and 35.4±11, respectively.

The correlation between CPET and SGRQ is shown in Table 3. There was an inverse correlation between the total score of SGRQ and both VO_2max (Fig. 1) and VE' on the Spearman correlation test. There was an inverse correlation between VO_2max and both symptom and activity domains of SGRQ. There was a significant inverse correlation between AT and the symptom domain of SGRQ. Further, there was an inverse correlation between VE' and the impact domain of SGRQ. The correlation between CPET

Table 2 Distribution of the studied group as regards cardiopulmonary exercise testing grading[a]

Variables	*n* (%)
VO_2max (ml/kg/min)	
A	3 (8.6)
B	9 (25.7)
C	17 (48.6)
D	6 (17.1)
Mean±SD (range)	14±4 (5–23)
AT (% from VO_2max)	
A	15 (42.9)
B	7 (20)
C	11 (31.4)
D	2 (5.7)
Mean±SD (range)	35.4+11 (16–70)
VE' (l/min)	
A	2 (5.7)
B	6 (16.1)
C	9 (25.7)
D	18 (51.4)
Mean±SD (range)	37.9+13 (15–64)
Desaturation	16 (45.7)

AT, anaerobic threshold; CPET, cardiopulmonary exercise testing; VE', minute ventilation; VO_2max, maximum oxygen consumption.
[a]Grading was according to reference [8].

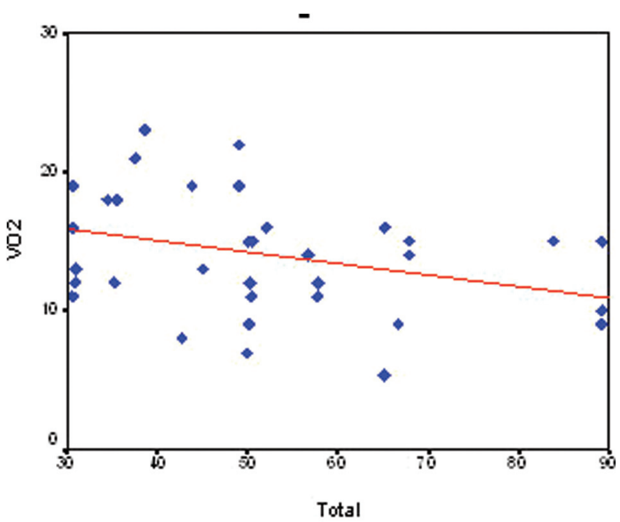
and IPAQ is presented in Table 4. There was a highly significant association between IPAQ and VO_2max, VE', and the desaturation percentage variables of CPET.

The correlation between HRCT and SGRQ is illustrated in Table 5. There was a positive correlation between total score of SGRQ and both honeycombing and reticular fibrosis patterns of HRCT, whereas there was an inverse correlation between the total score of SGRQ and mixed ground-glass opacification/reticular fibrosis pattern of HRCT on Spearman's correlation test. IPAQ showed an inverse correlation versus honeycombing and reticular fibrosis patterns of HRCT and positive correlations with mixed ground-glass opacification/reticular fibrosis and ground-glass opacification patterns of HRCT on the Spearman correlation test (Table 6).

There was an inverse correlation between DL_{CO} and the total score of SGRQ and most domains of SGRQ and a positive correlation between DL_{CO} and IPAQ on the Spearman correlation test (Tables 7 and 8).

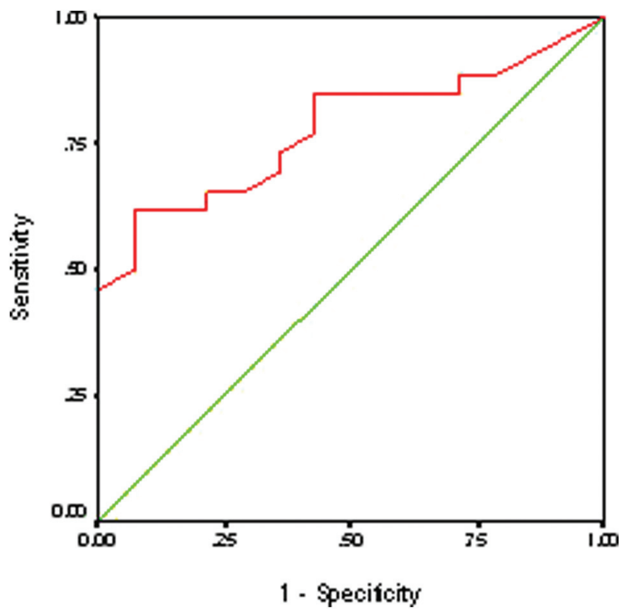
Finally, SGRQ and IPAQ were considered better positive than negative in the prediction of severity of IPF, with an overall sensitivity of 81 and 96%, an overall specificity of 60 and 40%, and an overall accuracy of 65 and 72.5%, respectively (Tables 9 and 10, Fig. 2).

Figure 1



Inverse correlation between total score of the Saint George Respiratory Questionnaire and maximum oxygen consumption

Figure 2



Saint George Respiratory Questionnaire as a better positive than negative predictor of severity

Table 3 Correlation between cardiopulmonary exercise testing and Saint George Respiratory Questionnaire

Variables	SGRQ			
	Domains (*r* values)			
	Symptoms	Activity	Impact	Total
VO_2max (ml/kg/min)	−0.36*	−0.37*	−0.19	−0.35*
Desaturation %	0.11	−0.09	0.08	0.28
AT (% from VO_2max)	−0.43*	0.19	0.23	0.21
VE' (l/min)	0.20	0.18	−0.35*	−0.39*

AT, anaerobic threshold; SGRQ, Saint George Respiratory Questionnaire; VE', minute ventilation; VO_2max, maximum oxygen consumption. *$P<0.05$, significant.

Table 4 Relation between cardiopulmonary exercise testing and International Physical Activity Questionnaire

Variables	IPAQ categories [*n* (%)]			χ^2	*P*
	Severe	Moderate	Mild		
VO_2max (ml/kg/min)					
A	0	0	3 (60)	28	<0.001
B	0	7 (38.9)	2 (40)		
C	9 (75)	8 (44.4)	0		
D	3 (25)	3 (16.7)	0		
Desaturation %	11 (91.7)	5 (27.8)	0	16.7	<0.001
AT (% of VO_2max)					
A	4 (33.3)	8 (44.4)	3 (60)	8.3	>0.05
B	4 (33.3)	1 (5.6)	2 (40)		
C	4 (33.3)	7 (38.9)	0		
D	0	0	0		
VE' (l/min)					
A	0	1 (5.6)	1 (20)	14.8	<0.001
B	0	4 (22.2)	2 (40)		
C	1 (8.3)	7 (38.9)	1 (20)		
D	11 (91.7)	6 (33.3)	1 (20)		

AT, anaerobic threshold; CPET, cardiopulmonary exercise testing; IPAQ, International Physical Activity Questionnaire; VE', minute ventilation; VO_2max, maximum oxygen consumption.

Table 5 Correlation between high-resolution computed tomography and Saint George Respiratory Questionnaire

Variables	SGRQ			
	Domains (*r* values)			
	Symptoms	Activity	Impact	Total
Mixed ground-glass opacity/reticular fibrosis	−0.46*	−0.49**	−0.45**	−0.55**
Ground-glass opacity	−0.20	−0.15	−0.11	0.12
Honeycombing	0.48**	0.70**	0.58**	0.68**
Reticular fibrosis alone	0.49**	0.59**	0.63**	0.61**
Total	0.72**	0.68**	0.55**	0.63**

SGRQ, Saint George Respiratory Questionnaire. *$P<0.05$, significant. **$P>0.05$ is highly significant.

Table 6 Correlation between high-resolution computed tomography and International Physical Activity Questionnaire

Variables	IPAQ	
	r	*P*
Mixed ground-glass opacity/reticular fibrosis	0.46	<0.001
Ground-glass opacity	0.36	<0.05
Honeycombing	−0.56	<0.001
Reticular fibrosis alone	−0.50	<0.001
Total	−0.68	<0.001

IPAQ, International Physical Activity Questionnaire.

Table 7 Correlation between diffusion lung capacity for carbon monoxide and Saint George Respiratory Questionnaire

Variables	DL_{CO}	
	r	*P*
Symptoms	−0.56	<0.001
Activity	−0.60	<0.05
Impact	−0.54	<0.001
Total	−0.53	<0.001

DL_{CO}, single-breath carbon monoxide diffusing capacity.

Table 8 Correlation between diffusion lung capacity for carbon monoxide and International Physical Activity Questionnaire

Variable	IPAQ	
	r	*P.*
DL_{CO}	0.61	<0.001

DL_{CO}, single-breath carbon monoxide diffusing capacity; IPAQ, International Physical Activity Questionnaire.

Table 9 Validity of Saint George Respiratory Questionnaire versus diffusion lung capacity for carbon monoxide

Variables	Value
Best cutoff	45
AUC	0.78
Sensitivity (when >45) (%)	81
Specificity (when <45) (%)	60
PPV (%)	65
NPV (%)	87
Accuracy (%)	65

AUC, area under the curve; NPV, negative predicative value; PPV, positive predicative value.

Table 10 Validity of International Physical Activity questionnaire versus diffusion lung capacity for carbon monoxide

Variables	%
Sensitivity	96
Specificity	40
PPV	71
NPV	80
Accuracy	72.5

NPV, negative predicative value; PPV, positive predicative value.

Discussion

Our results showed that generic (IPAQ) and specific (SGRQ) questionnaires had a good relationship with HRCT, DL_{CO}, and CPET.

Incorporation of HRQL questionnaires into the routine evaluations of IPF patients seems beneficial, as they assess several dimensions (such as the influence of disease on physical, emotional, and social functioning) that are not estimated by traditional methods of clinical assessment [11].

Generic (IPAQ) and specific (SGRQ) questionnaires were used to test their validity in assessing the severity of IPF in correlation with HRCT, DL_{CO}, and CPET. Although both questionnaires are self-administered instruments, we preferred to do the interview ourselves in this study. We made this choice because the patient population seen in our clinic or department has low cultural and social status, and a substantial number of patients and controls had difficulty reading.

The face and content validity of the SGRQ in ILD has been previously tested, and while some authors raised some concerns about its face validity, especially as far as the questions included in the 'symptoms' domain (i.e. those more specific for COPD-related manifestations) were concerned, others had the instrument rate by ILD patients for relevance, obtaining a highly positive feedback [3]. The IPAQ was developed to facilitate surveillance of physical activity based on a global standard and has become the most globally used instrument to assess the quality of life. It has suggested that nonspecific disease questionnaires are sensitive and can be applied to IPF patients [12,13].

This study subjected all patients to spirometry, single-breath carbon monoxide diffusing capacity evaluation, and HRCT of the chest. Our results revealed impaired mean FVC% of predicted (56±14.8) and mean DL_{CO}% of predicted (48.5±20), together with peculiar HRCT findings, all of which were consistent with IPF. It is becoming increasingly accepted that a highly suggestive clinical presentation, including typical HRCT scan findings, can be used in the absence of a lung biopsy specimen to make a likely diagnosis of IPF [14]. Blivet *et al.* [15] agreed with our results, as they showed a restrictive ventilatory impairment in IPF with a mean FVC of 55% and impaired DL_{CO} of 55% of predicted.

The correlations between physiological parameters including DL_{CO} and CPET, radiological parameters in the form of HRCT; and quality-of-life assessment methods using SGRQ and IPAQ questionnaires were highly significant and were able to identify patients with severely impaired lung functions in our study.

Peng *et al.* [16] also showed a significant correlation between total CT scores and each component of the SGRQ, and changes in ground-glass opacity on CT were also correlated with changes in each SGRQ domain, similar to our study results.

CPET as a noninvasive tool is being increasingly used in a wide spectrum of clinical applications on the basis of the assumption that it provides a global assessment of the integrative submaximal and peak exercise responses that are not adequately reflected through the measurement of individual organ system function thus providing fruitful information for clinical decision making [7].

CPET with gas exchange parameters including ventilatory equivalent for O_2 (VE'/VO_2) and ventilatory equivalent for CO_2 (VE'/VCO_2) was used to calculate an AT, which had the potential of noninvasively grading the severity of exercise limitation in patients along with other ventilatory parameters like VE' and metabolic parameters like VO_2max. O_2 pulse acted as a guide for quantifying the pulmonary vascular blood flow and for assessing future responses to therapy even before overt right ventricular failure and pulmonary hypertension became evident at rest with a condition of having normal EF as well as increased levels of V_d/V_t [17].

Correlating exercise capacity [using the 6 min walking test (SMWT)] and other parameters to the quality-of-life questionnaires was done in many studies, all of which showed significance [3,18]. Hence we tried to find a correlation using CPET by means of an electronically braked cycle ergometer using the incremental work rate, and after the completion of the primary assessment for the patients enrolled in the study the two previously mentioned questionnaires were compared with our results, which showed that the IPAQ had a better validity than the SGRQ as regards desaturations occurring with exercise and its ability to discriminate between patients with more severely impaired exercise function and dyspnea as a reason for stopping exercise. As for VO_2max, there was a significantly inverse correlation to SGRQ, especially activity and symptom domains, which signified that the worse the VO_2max, the higher the SGRQ score; in contrast, IPAQ showed highly significant direct correlation. Although the prevalence of leg discomfort as the limiting factor in IPF is unknown, it is likely to be significant. One-third of our patients stopped exercise during CPET because of leg discomfort and not because of mechanical constraint.

Nogueira *et al.* [19] detected a correlation between quality of life and CPET VO_2max and AT in cardiac failure cases by analyzing both a generic Medical Outcomes Short Form 36 (SF-36) questionnaire and a specific Minnesota Living with Heart Failure questionnaire. They observed that the Minnesota Living with Heart Failure questionnaire showed a mild to moderate correlation with VO_2max and AT. Their results matched ours in cases of IPF regarding significance of correlations between VO_2max, AT, and HRQL questionnaires [19].

Chou *et al.* [20] agreed with our results regarding the peak oxygen consumption in patients with rheumatoid arthritis-ILD, which correlated with the results of physical wellness, mental wellness, and environmental health with P values of less than 0.001, 0.01, and 0.04, respectively.

Zimmermann *et al.* [3] showed that generic (SF-36) and specific (SGRQ) questionnaires presented a good relationship with lung function, exercise capacity (using SMWT), and dyspnea. Both instruments revealed a reduction in HRQL (SGRQ=48.4±17.9 and SF-36=55.7±28.4).

Beretta *et al.* [18] showed a good correlation of questionnaires with the SMWT and HRCT scores and other validated measures for perceived breathlessness and FVC. The strongest correlations were found between the SMWT and SGRQ scores, with an almost linear association with the activity score. The study observed that the SGRQ, although not specifically designed for ILD, proved to be a valid respiratory-specific questionnaire for the evaluation of HRQL, strongly correlating with standardized tools [18].

The process of validating a questionnaire designed to measure impaired health is multifactorial. Evidence for the validity of such instruments is built up from a large number of tests of the relationship between the questionnaire and relevant measures of disease activity and its effects on the patient's health and well-being. We have shown that the SGRQ and IPAQ correlated with a number of measures of disease severity and activity relevant to patients with IPF. The pattern of these correlations with the components of the SGRQ and IPAQ suggested that these components were addressing relatively specific areas of impaired health in this population. The results of this direct comparison of SGRQ and IPAQ have confirmed their feasibility for use in patients with more severe IPF. The validity of both quality-of-life questionnaires was supported by the correlations between their total scores and their domain scores. Almost all cross-sectional and longitudinal correlations were highly statistically significant. The overall patterns of correlations were consistent with expectations. Lee *et al.* [21], studying the validity of IPAQ, showed fairly weak evidence to support the use of the IPAQ as either a relative, or as an accurate and absolute, measure of physical activity, although its proven reliability shows it can be used with care in repeated-measures studies, although the true magnitude of the change over time, if any, may not be accurate. This difference between our results and their results may be accounted for by the lack of demographic characteristics in this study, including place of study, targeted population, sample size, male–female ratio, and age, and seemed to be related to differences in validity between the IPAQ and the criterion measure. Our results concurred with those of Beretta *et al.* [22], who showed that SGRQ, although not specifically designed for ILD, proved to be a valid respiratory-specific questionnaire for the evaluation of HRQL in those patients, strongly correlating with standardized tools to measure the patient's lung involvement, its physical tolerance to exertion or perceived breathlessness, and providing additional information to traditional measures of lung involvement. Zimmermann *et al.* [3] showed that a specific rather than a generic questionnaire is a more appropriated and specific instrument to evaluate HRQL in IPF patients and that goes with our results. They also noticed that total SGRQ domains presented a significant correlation with FVC and DL_{CO} as well as with SMWT and rest dyspnea index. Good correlations were also observed between lung function, exercise capacity, and rest dyspnea index and all SGRQ domains, except the symptom domain [3]. Swigris *et al.* [23] agreed that SGRQ was a sensitive instrument for evaluating HRQL in patients with ILD. Patients in their study reported substantially impaired HRQL, especially in domains that measured physical health and level of independence [23]. Tzanakis *et al.* [24] suggested that dyspnea scales and the SGRQ are sensitive tools for assessing HRQL in patients with IPF. Chang and colleagues also showed that generic questionnaires and specific ones are good tools for measuring HRQOL or health status in patients with ILD [13,25].

In the light of our study results, it was concluded that the correlations between physiological parameters including DL_{CO} and CPET, radiological parameters in the form of HRCT, and quality-of-life assessment methods using SGRQ and IPAQ were highly significant and can discriminate IPF patients with severely impaired lung functions.

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Conflicts of interest
There are no conflicts of interest.

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