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Evaluation of the Post-COVID-19 Functional Status (PCFS) Scale in a cohort of patients recovering from hypoxemic SARS-CoV-2 pneumonia

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ABSTRACT

Introduction COVID-19 sequelae are numerous and multisystemic, and how to evaluate those symptomatic patients is a timely issue. Klok *et al* proposed the Post-COVID-19 Functional Status (PCFS) Scale as an easy tool to evaluate limitations related to persistent symptoms. Our aim was to analyse PCFS Scale ability to detect functional limitations and its correlation with quality of life in a cohort of patients, 2–9 months after hospitalisation for COVID-19 hypoxemic pneumonia.

Methods PCFS Scale was evaluated in 121 patients together with quality of life and dyspnoea questionnaires, pulmonary function tests and CT scans.

Results We observed a high correlation with multiple questionnaires (Short Form-36, Hospital Anxiety and Depression Scale, modified Medical Research Council, end Borg Six-Minute Walk Test), making the PCFS Scale a quick and global tool to evaluate functional limitations related to various persistent symptoms following COVID-19 pneumonia.

Discussion The PCFS Scale seems to be a suitable instrument to screen for patients who will require careful follow-up after COVID-19 hypoxemic pneumonia even in the absence of pulmonary sequelae.

INTRODUCTION

The consequences that result from the COVID-19 pandemic are numerous. A few studies have already highlighted both high frequency and heterogeneity of post COVID-19 symptoms.^{1 2} Indeed, many symptoms have been described up to 6 months after the acute phase of COVID-19,³ including asthenia, muscle weakness, anxiety, depression, sleep disorder and respiratory manifestations. If most of these symptoms are reversible,⁴ some last over time and significantly alter daily life.⁵ If not taken seriously, they could evolve towards a chronic disease with

Key messages

What is already known on this topic

- There is a great number of patients with a wide range of clinical symptoms following COVID-19 pneumonia.
- A simple and reproducible questionnaire could help the clinician to identify the ones that need intervention.

What this study adds

- The Post-COVID-19 Functional Status (PCFS) Scale is a global instrument that correlates with quality of life, dyspnoea and mental health.

How this study might affect research, practice or policy

- This study showed that the PCFS Scale is a suitable scale to detect functional limitations related to the various persistent symptoms following COVID-19 pneumonia.

major public health and economic consequences.

Because of the vast number of patients and range of clinical symptoms, a simple and reproducible questionnaire is crucial to identify patients with functional limitations. A year ago, the ‘Post-COVID-19 Functional Status (PCFS) Scale’ was proposed by Klok *et al* as an easy tool to identify people with incomplete recovery.⁶ It focuses on daily-life limitations connected to persistent symptoms. Machado *et al* already described a relationship between the PCFS Scale and two scores that assess health-related quality of life (EuroQoL-5D-5L), daily life and work impairment.⁷ However, it was based on a population of symptomatic patients who volunteered, of



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Table 1 Patient characteristics according to their PCFS Scale Score

PCFS n (%)	0 36 (30)	1 35 (29)	2 35 (29)	3–4* 15 (12)
Age, years, mean±SD	57±12	57±11	59±11	59±13
Women, n (%)	12 (33)	13 (37)	13 (37)	7 (47)
Body mass index, kg/m ² , n (%)				
18–24	6 (17)	11 (31)	8 (23)	3 (20)
25–30	19 (53)	15 (43)	10 (29)	6 (40)
>30	11 (31)	9 (26)	17 (49)	6 (40)
Current or former smokers, n (%)	20 (56)	19 (54)	16 (46)	7 (47)
Comorbidities†, n (%)	20 (56)	20 (57)	23 (47)	7 (47)
Total duration of hospitalisation, days, median (IQR)	11 (7; 15)	9 (6; 16)	13 (7; 29)	14 (9; 25)
ICU stay, n (%)	14 (39)	17 (49)	16 (46)	10 (67)
Duration of ICU stay, days, median (IQR)	10 (5; 19) (n=14)	9 (6; 14) (n=17)	18 (10; 29) (n=16)	5 (2; 17)(n=10)
Mechanical ventilation, n (%)	9 (25)	9 (26)	11 (31)	4 (27)
Mechanical ventilation duration, days, median (IQR)	13 (6; 15) (n=9)	9 (7; 20) (n=9)	18 (9; 24) (n=10)	11 (7; 19) (n=4)
Total duration of oxygen therapy, days, median (IQR)	9 (6; 19)	9 (4; 16)	12 (6; 25)	13 (7; 21)
Corticosteroids, n (%)	19 (53)	21 (60)	17 (49)	9 (60)
Rehabilitation‡, n (%)	8 (22)	8 (23)	11 (31)	6 (40)
Weekly activity duration before COVID-19, min, median (IQR)	60 (0; 120) (n=29)	120 (60; 240) (n=25)	60 (0; 180) (n=26)	120 (0; 180) (n=11)

The PCFS Scale assesses patient-relevant functional limitations: grade 0 reflects the absence of any functional limitation. Upward of grade 1, symptoms, pain or anxiety are present to an increasing degree. This has no effect on activities for patients in grade 1, whereas a lower intensity of the activities is required for those in grade 2. Grade 3 accounts for inability to perform certain activities, forcing patients to structurally modify these. Finally, grade 4 is reserved for those patients with severe functional limitations requiring assistance with activities of daily living.⁶

*Patients in categories # 3 (n=13) and 4 (n=2) were merged.

†History of chronic respiratory disease, chronic cardiac disease, arterial hypertension, diabetes, chronic kidney disease, immunodepression, psychiatric disease and thromboembolic disease.

‡Includes patients who underwent respiratory rehabilitation as well as standard recovery centres following discharge.

ICU, intensive care unit; PCFS, Post-COVID-19 Functional Status.

whom only 5% had been hospitalised during the acute phase of COVID-19. In the present study, we assessed the PCFS Scale in a cohort of patients recovering from hypoxemic COVID-19 pneumonia and analysed its ability to detect functional limitations related to remaining symptoms and its correlation with quality of life using Short Form-36 (SF-36) and mental health and dyspnoea questionnaires.

METHODS

Study design and inclusion criteria

This observational, monocentric prospective study was conducted at Nantes University Hospital, France, between June 2020 and March 2021. Patients aged between 18 and 75 years admitted with hypoxemic COVID-19 pneumonia, confirmed by reverse transcription-PCR or chest CT scan, were routinely proposed a follow-up with a pulmonologist after discharge.

Construct validity and study objectives

The PCFS was translated into French by the authors (online supplemental figure 1) and then back-translated into English by a native English speaker. Multiple self-administered questionnaires were fulfilled: French translation of the PCFS Scale, the modified Medical Research Council (mMRC) Scale, the Multidimensional Dyspnea Profile (MDP), the SF-36 questionnaire and the Hospital Anxiety and Depression Scale (HAD A and D). Patients also underwent physical examination and pulmonary functional tests. When possible, a chest CT scan and a Six-Minute Walk Test (6MWT) were performed (see online supplemental methods).

The main study aim was to evaluate the validity of the French translation of the PCFS Scale to detect limitations secondary to the wide spectrum of symptoms remaining after COVID-19 pneumonia. To achieve that, we analysed its correlation with questionnaires exploring dyspnoea, quality of life and psychiatric state. The secondary aim was to verify whether the PCFS Scale could be suited to

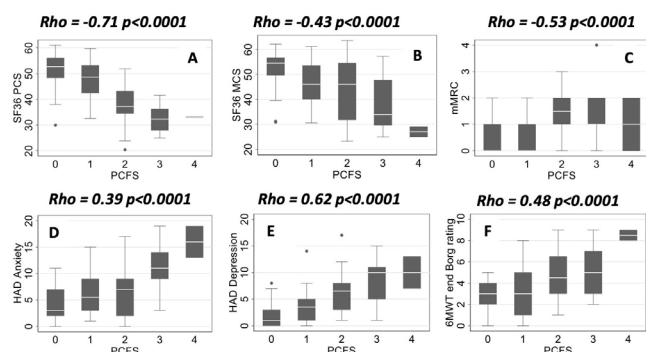


Figure 1 PCFS Scale correlates with SF-36 scores, mMRC dyspnoea scale, HAD Scale and the 6MWT end Borg rating. (A) Correlation between the SF-36 physical composite score and the PCFS scale. (B) Correlation between the SF-36 mental composite score and the PCFS scale. (C) Correlation between the mMRC and the PCFS Scale. (D) Correlation between the HAD A and the PCFS scale. (E) Correlation between the HAD D and the PCFS scale. (F) Correlation between the end 6MWT Borg scale and the PCFS Scale. 6MWT, Six-Minute Walk Test; HAD, Hospital Anxiety and Depression; mMRC, modified Medical Research Council; PCFS, Post-COVID-19 Functional Status; SF-36, Short Form-36.

detect pulmonary sequelae. For this purpose, we analysed PCFS Scale correlation with persistent chest CT scan abnormalities, carbon monoxide transfer factor (TLco) and 6MWT. Three groups of patients were identified according to their follow-up status: (1) ‘no sequelae’ stood for no persistent dyspnoea, no chest CT scan findings and no altered TLco, (2) ‘isolated dyspnoea’ stood for patients with persistent dyspnoea with normal TLco and chest CT scan and (3) ‘pulmonary sequelae’ for chest CT scan and/or TLco abnormalities.

RESULTS

A total of 121 patients were enrolled in the study. At a median time of 125 days (59–284) after hospital admission for severe COVID-19 pneumonia (online supplemental figure 2), only 44 patients (36.4%) had a restored pre-COVID-19 condition (online supplemental table 1). Overall, 106 patients (88%) had a PCFS Scale Score at

0, 1 or 2, indicating no symptom (0) or symptom persistence without (1) or with minor (2) limitation (table 1). Overall, 92% of patients scored the PCFS Scale easy or very easy to fill in (online supplemental table 2).

The PCFS Scale significantly correlated with all SF-36 questionnaire subgroups, including the physical composite score ($\rho=-0.71$; $p<0.0001$, figure 1A) and the mental composite score ($\rho=-0.43$; $p<0.0001$, figure 1B). The PCFS Scale also correlated significantly with the mMRC ($\rho=0.53$; $p<0.0001$) (figure 1C), all subgroups of the MDP (data not shown) and both the HAD anxiety ($\rho=0.39$; $p<0.0001$) and depression scale ($\rho=0.62$; $p<0.0001$) (figure 1D,E). The PCFS Scale also correlated with the 6MWT end Borg dyspnoea rating ($\rho=0.48$; $p<0.0001$) (figure 1F). Significant correlation was neither found between the PCFS Scale and TLco results nor with persistent lung abnormalities on chest CT scan (online supplemental figure 3). However, the PCFS Scale was significantly higher in the ‘isolated dyspnoea’ group, as well as the 6MWT end Borg rating (table 2).

DISCUSSION

In patients having suffered from severe COVID-19 pneumonia, our data showed that the PCFS Scale correlated with SF-36, dyspnoea and mental health questionnaires, making it a global and easy tool to detect functional limitations related to the multiple aspects of post-COVID-19. Indeed, SF-36 is a lengthy questionnaire that can hardly be used in everyday practice. The strong correlation with the physical composite score suggests that the PCFS Scale could be best suited to explore the physical impact of COVID-19.

We observed no correlation between the PCFS Scale and DLCO results or chest CT scan sequelae at reassessment (online supplemental figure 3), which is consistent with the literature suggesting that the symptom burden has no correlation with the initial severity or the existence of residual lung abnormalities.^{8,9} Interestingly, the PCFS Scale Score was significantly higher in the ‘isolated dyspnoea’ group, as well as the 6MWT end Borg rating (table 2), suggesting that the PCFS Scale also reflected deconditioning. Determining a PCFS Scale threshold

Table 2 Comparison of the PCFS Scale and 6MWT end Borg rating according to the type of sequelae

	Type of sequelae			P value
	No pulmonary sequelae, n=27	Isolated dyspnoea, n=41	Pulmonary sequelae, n=53	Between three groups*
PCFS Scale (mean±SD)	0.6±0.8	1.7±1	1.3±1.1	<0.001
6MWT end Borg rating (mean±SD)	2.6±1.2	5.2±2.3	3.4±2.6	0.001

Isolated dyspnoea: patients who described remaining dyspnoea with no chest CT scan or TLco abnormalities. Pulmonary sequelae: patients who had at least a chest CT scan abnormality or TLco impairment, with or without associated dyspnoea (see online supplemental table 3).

*There was a significant difference between the PCFS Scale in the three groups. PCFS Scale and 6MWT end Borg rating results were then compared according to the type of described sequelae. Significant differences were observed between each group ($p<0.05$), except for the mean 6MWT end Borg rating in the no pulmonary sequelae and the pulmonary sequelae groups.

6MWT, Six-Minute Walk Test; PCFS, Post-COVID-19 Functional Status; TLco, carbon monoxide transfer factor.

that coincides with patients' acceptable state could be interesting to target patients requiring careful prolonged medical follow-up after COVID-19.

In our study, we showed acceptable validity of the PCFS Scale according to the COSMIN (Consensus-based Standards for the selection of health Measurement Instruments) group standards¹⁰ by comparing it with other scales. We did not test 'responsiveness' to analyse the PCFS Scale ability to vary with treatment, for instance, physiotherapy. However, we retrospectively analysed the PCFS status before COVID-19 and 85% patients had a PCFS Scale of 0 at that time (data not shown).

In conclusion, the PCFS Scale correlated with quality of life, dyspnoea and mental health. The growing population of patients recovering from COVID-19 with persistent and disabling symptoms calls for specific rehabilitation programmes. The PCFS Scale may be a suitable instrument to search for functional limitations related to the wide range of symptoms following COVID-19 pneumonia. Importantly, these patients with functional limitations, but for some of them without pulmonary sequelae, will require careful follow-up, including deconditioning identification and treatment.

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Contributors NB, EE and PL contributed to the study design, patient enrolment, data analysis and writing of the report. MK and J-BH contributed to the study design and data analysis. TG, CL, DH-L, LM, A-LC, SD, CB, AC and F-XB contributed to patient enrolment and follow-up. AN, DC and RL contributed to chest CT scan acquisition and analysis. PL was the author responsible for the overall content as the guarantor.

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Competing interests None declared.

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Data availability statement Data are available upon reasonable request. The data are deidentified participant data, they are available from MK and data reuse will be allowed limited to academic research and to non-commercial use only, after evaluation of research project.

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