



# The benefits of pulmonary rehabilitation in patients with COVID-19

Zhen-feng He<sup>1</sup>, Nan-shan Zhong<sup>1,2</sup> and Wei-jie Guan<sup>1,2</sup>

<sup>1</sup>State Key Laboratory of Respiratory Disease, National Clinical Research Center for Respiratory Disease, Guangzhou Institute of Respiratory Health, First Affiliated Hospital of Guangzhou Medical University, Guangzhou Medical University, Guangzhou, China. <sup>2</sup>Both authors contributed equally to the work.

**Correspondence:** Wei-jie Guan, State Key Laboratory of Respiratory Disease, National Clinical Research Center for Respiratory Disease, Guangzhou Institute of Respiratory Disease, First Affiliated Hospital of Guangzhou Medical University, 151 Yanjiang Road, Guangzhou, Guangdong, China.  
E-mail: battery203@163.com



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**This editorial reviews the evidence supporting benefits of pulmonary rehabilitation in #COVID19 patients, as well as some unanswered research questions** <https://bit.ly/39JY3SU>

**Cite this article as:** He Z-f, Zhong N-s, Guan W-j. The benefits of pulmonary rehabilitation in patients with COVID-19. *ERJ Open Res* 2021; 7: 00212-2021 [<https://doi.org/10.1183/23120541.00212-2021>].

As of 10 March 2021, coronavirus disease 2019 (COVID-19) has resulted in more than 0.1 billion laboratory-confirmed cases and more than 2.5 million deaths globally [1]. Both the economic impact and disease burden of COVID-19 far exceeded those of severe acute respiratory syndrome and Middle East Respiratory Syndrome. The number of patients who have recovered from COVID-19 is increasing [2] despite an escalation of total number of cases worldwide.

The clinical manifestations of COVID-19 were heterogeneous, ranging from asymptomatic or mild diseases that did not require any specific medical treatment (accounting for ~80% of patients) to the critical illness which rapidly progressed to death (accounting for ~3% of patients) [3]. In many patients, COVID-19 was typically characterised by cough, dyspnoea and fever on hospital admission. Other symptoms such as fatigue, muscle weakness and dysgeusia have also been reported [4]. Unfortunately, a considerable proportion of patients had residual symptoms (including cough, fatigue, muscle weakness and mental symptoms) on discharge from hospital, and some of these symptoms persisted for at least a median of 6 months of follow-up [5]. Furthermore, the severity of COVID-19 correlated with the likelihood of having residual symptoms and abnormal lung function [5–7]. These findings were in line with the results from the long-term follow-up study among patients with severe acute respiratory syndrome which demonstrated that approximately 40% of these survivors still experienced chronic fatigue for a mean of 41.3 months [8].

Given the growing number of patients recovering from COVID-19 and the notable long-lasting adverse consequences, it is crucial for clinicians to explore novel approaches to help patients ameliorate the residual symptoms. Pulmonary rehabilitation (PR), which includes (but is not limited to) exercise training, education, and behavioural changes, might have a role in accelerating the improvement in the physical and psychological condition of patients with COVID-19 after discharge from hospital [9]. Indeed, several studies have also documented the therapeutic benefits of PR on improving the quality of life (QoL), respiratory function and psychological parameters of patients with COPD, asthma and lung cancer after thoracic surgery [10–12].

In the context of the global management of the aftermath of COVID-19, there remains a lack of evidence to verify the safety and efficacy of PR on patients discharged from hospital, although some expert



consensus and guidelines have been published by the World Health Organization [13], Chinese Medical Association of Rehabilitation [14], and European Respiratory Society/American Thoracic Society [15]. These documents recommended early bedside in-hospital rehabilitation and regular daily activities after hospital discharge among patients with COVID-19 [15]. However, in light of the paucity of studies, no specific recommendations have been made regarding the optimal mode, intensity, duration and course of PR. It was believed that the implementation of a comprehensive PR programme would be superior to no PR programme in accelerating the recovery of COVID-19 [15].

In this issue of *ERJ Open Research*, GLOECKL *et al.* [16] evaluated the efficacy, feasibility and safety of an integrated PR programme in COVID-19 patients with different grading of disease severity. The study prospectively evaluated the improvement of exercise capacity, lung function, QoL and psychological impairment among 50 patients (24 with mild/moderate COVID-19 and 26 with severe/critical illness of COVID-19) after a 3-week supervised PR programme, which was similar to that intended for patients with lung fibrosis, in a rehabilitation centre. The medium duration between the first positive PCR assay and PR administration was 178 days and 61 days for the mild/moderate group and the severe/critical illness group, respectively. At the end of follow-up, there was a significant improvement in the 6-min walking distance (6 MWD), forced vital capacity, forced expiratory volume in 1 s, and short-form 36 questionnaire (SF-36) total score in both groups. Importantly, the severe/critical illness group benefited significantly from the improvement in the mental health component of SF-36. No adverse event was recorded during the PR. Moreover, a numerically but not significantly lower number of patients reported pre-existing symptoms such as dyspnoea, fatigue or cough after PR. Therefore, PR was deemed effective and safe to improve exercise performance, lung function and QoL in COVID-19 patients with different grading of disease severity.

The study by GLOECKL *et al.* [16] has added to the accumulating evidence regarding the role PR plays in accelerating the recovery of COVID-19. Several studies have reported certain benefits associated with the intervention of a short course of PR. For instance, both lower limb strength and cardiopulmonary endurance could be improved significantly after a supervised 2-week out-patient PR programme *via* the telehealth platform (65% of the 44 patients achieved the clinically meaningful difference) or home-based exercise programme (88% of the 25 patients achieved the clinically meaningful difference) [17]. A 28-day course of PR also markedly increased the 6 MWD in 21 patients with COVID-19 who were discharged from the intensive care unit [18]. In a prospective clinical trial that recruited 72 elderly patients with COVID-19 who were randomly assigned to receive either a 6-week PR programme or usual care alone, PR resulted in a marked improvement in the lung function, QoL and anxiety, but not depression [19]. Furthermore, a 20-day in-patient cardiopulmonary rehabilitation programme for 28 patients with COVID-19 in a general ward significantly improved the 6 MWD by a mean of 130 m as well as the health status [20]. Therefore, most studies found that PR consistently accelerated the recovery of physical function but the impact on mental health remains elusive. Indeed, the adverse impact of an epidemic outbreak such as COVID-19 and severe acute respiratory syndrome on mental health might persist longer than that on the physical health [5, 8]. Despite the lack of a control group, findings of the study by GLOECKL *et al.* [16] have also shed light on the positive role of PR in accelerating the recovery of mental health which has been an important neglected issue.

However, there remain some unanswered research questions. In light of the self-limited nature of COVID-19 among most of the patients, the improvement in 6 MWD might have been confounded by the rate of the natural recovery of COVID-19. DAHER *et al.* [21] recruited a cohort of patients with severe COVID-19 who did not receive a PR programme, and reported a median of 380 m on the 6 MWD after ~56 days of discharge from hospital which was significantly lower than the median of 468 m reported by GLOECKL *et al.* [16]. It was likely that the improvements in patients recovering from severe COVID-19 might be attributed to the addition of a PR programme. In addition, the PR programme varied considerably from one to other, which precluded any direct comparison of the efficacy across different study designs. However, the heterogeneity of COVID-19 also indicated the need to implement an individualised PR programme [22]. PR should ideally integrate respiratory muscle training, cough exercise, diaphragmatic training, stretching exercise and home exercise, with the assessment of respiratory function, exercise endurance, strength training, QoL and psychological health [19]. The typical duration of the PR programme should persist for at least 6–8 weeks [15]. Furthermore, the implementation of the PR programmes should be adapted to the local situations, taking into account the patient's preference and culture. Table 1 demonstrates the proposed interim instructions from the World Health Organization and European Respiratory Society/American Thoracic Society on PR practice in the hospital and post-hospital phase in COVID-19 patients based on empirical evidence.

Despite the growing understanding on the role of PR, the generalisability of PR remains to be tested by well-designed randomised controlled trials in larger settings. We keenly await more solid evidence which

TABLE 1 Interim instructions on pulmonary rehabilitation practice in the acute, sub-acute and long-term phase in coronavirus disease 2019 patients

Phase of care	Pulmonary rehabilitation instruction	Typical delivery setting
<b>Acute</b>	In the acute phase, severe patients receiving ventilatory support should receive pulmonary rehabilitation to maintain and improve basic respiratory function	Intensive care units
<b>Sub-acute</b>	In the early recovery period, hospitalised patients should receive pulmonary rehabilitation which aims to promote independence with activities of daily living, and to provide with the psychosocial support	General wards
<b>Long-term</b>	After hospital discharge, patients should receive pulmonary rehabilitation to recover from physical, psychological and respiratory impairments in the first 6–8 weeks	Rehabilitation centres, outpatient programmes, in-home services, telehealth

will facilitate the implementation of PR in routine clinical practice, which aims to promote the physical and mental health in long-term follow-up for COVID-19 patients.

Acknowledgement: We thank Shan-shan Zha (Shenzhen People's Hospital) and Li-li Guan (Guangzhou Institute for Respiratory Health) for their valuable suggestions.

Author contributions: Zhen-feng He and Wei-jie Guan drafted the manuscript; Wei-jie Guan and Nan-shan Zhong critically revised the manuscript. All authors have approved the final submission.

Conflict of interest: None declared.

Support statement: This work was supported by the Guangzhou Institute for Respiratory Health Open Project (funded by China Evergrande Group) project numbers 2020GIRHHMS09 and 2020GIRHHMS19 (to W-j. Guan), the Zhongnanshan Medical Foundation of Guangdong Province (to W-j. Guan) and the Penghua Care Fund to the Medical Pioneers against Covid-19 of Shenzhen Social Commonwealth Foundation (to W-j. Guan). Funding information for this article has been deposited with the Crossref Funder Registry.

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