Original article

Impact of physical therapy on functional outcomes in post-COVID-19 patients

Impacto da fisioterapia na funcionalidade de pacientes pós-COVID-19

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ABSTRACT | BACKGROUND: After coronavirus disease (COVID-19), nearly 65% of patients recovered previous health condition within 14-21 days after onset of symptoms. However, 10% persisted with symptoms and functional impairment for more than 12 weeks. **METHODS:** Between March 2021 and May 2022, we identified the effect of physical therapy in 26 symptomatic post-COVID-19 patients aged ≥18 years enrolled in a quasi-experimental study, with confirmed diagnosis of COVID-19 undergoing treatment for motor and respiratory symptoms in the post-COVID-19 multidisciplinary service at Fundação José Silveira (José Silveira Foundation) in Bahia, Brazil. General reported complaints, data of vital signs and functional tests (Timed-Up-and-Go, sit-to-stand and 2-min step-in-place tests) were collected before and after 10 physical therapy sessions. We evaluated physical parameters such as: cough, dyspnea, fatigue, sleep disorders, intercostal and supraclavicular retractions, maximum inspiratory pressure, maximum expiratory pressure, pulmonary auscultation, peak expiratory flow, peak cough, apnea test, thoracic mobility and expansibility. **RESULTS:** After 10 physical therapy sessions, a significant improvement was observed in global muscle strength ($p<0.001$), handgrip strength ($p=0.004$), Timed-Up-and-Go test ($p=0.002$), sit-to-stand test ($p=0.006$), 2-min step-in-place test ($p=0.006$), fatigue scale ($p=0.025$) and apnea test ($p=0.001$). In addition, reported complaints of dry cough ($p=0.008$), dyspnea on exertion ($p=0.002$) and fatigue ($p=0.006$) were reduced. **CONCLUSIONS:** Post-COVID-19 patients evaluated after 10 sessions of respiratory and motor physical therapy significantly decreased symptoms and recovered functional parameters, supporting the implementation of structured rehabilitation programs in similar healthcare settings to optimize functional gains, quality of life and work capacity after infections or hospitalizations.

KEYWORDS: Post-Acute COVID-19 Syndrome. Rehabilitation. Functional Status. Quasi-Experimental Study. Adult.

RESUMO | CONTEXTO: Após a doença pelo coronavírus (COVID-19), cerca de 65% dos pacientes recuperaram sua condição de saúde prévia dentro de 14 a 21 dias após o início dos sintomas. No entanto, 10% permaneceram com sintomas e comprometimento funcional por mais de 12 semanas. **MÉTODOS:** Entre março de 2021 e maio de 2022, identificamos o efeito da fisioterapia em 26 pacientes pós-COVID-19 sintomáticos, com idade ≥18 anos, incluídos em um estudo quase-experimental, com diagnóstico confirmado de COVID-19, em tratamento para sintomas motores e respiratórios no serviço multidisciplinar pós-COVID-19 da Fundação José Silveira, em Salvador (Bahia, Brasil). Queixas gerais relatadas, dados de sinais vitais e testes funcionais (*Timed-Up-and-Go*, teste sentar-levantar-30s, e teste de marcha estacionária-2min) foram coletados antes e após 10 sessões de fisioterapia. Avaliamos parâmetros físicos como: tosse, dispneia, fadiga, distúrbios do sono, retrações intercostais e supraclaviculares, pressão inspiratória máxima, pressão expiratória máxima, ausculta pulmonar, pico de fluxo expiratório, pico de tosse, teste de apneia, mobilidade e expansibilidade torácica. **RESULTADOS:** Após 10 sessões de fisioterapia, observou-se melhora significativa na força muscular global ($p<0,001$), força de preensão manual ($p=0,004$), teste Timed-Up-and-Go ($p=0,002$), teste sentar-levantar-30s ($p=0,006$), teste de marcha estacionária-2min ($p=0,006$), escala de fadiga ($p=0,025$) e teste de apneia ($p=0,001$). Além disso, houve redução nas queixas de tosse seca ($p=0,008$), dispneia aos esforços ($p=0,002$) e fadiga ($p=0,006$). **CONCLUSÕES:** Pacientes pós-COVID-19 sintomáticos avaliados após 10 sessões de fisioterapia respiratória e motora apresentaram redução significativa dos sintomas e recuperação dos parâmetros funcionais, embasando a necessidade de implementação de programas estruturados de reabilitação em serviços de saúde similares, a fim de otimizar ganhos funcionais, qualidade de vida e capacidade laboral após infecções ou hospitalizações.

PALAVRAS-CHAVE: Síndrome Pós-Aguda da COVID-19. Reabilitação. Estado Funcional. Estudo Quase-Experimental. Adulto.

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1. Introduction

The coronavirus disease (COVID-19) pandemic caused by the new coronavirus SARS-CoV-2 represented a global emergency, with varied clinical presentations, from asymptomatic or oligosymptomatic conditions, which facilitate transmission, to severe and critical cases, requiring hospitalization and mechanical ventilation[1]. The most common acute symptoms are cough, fever and fatigue, but they can be accompanied by sputum production, dyspnea, headache, hemoptysis and lymphopenia[2], as well as dizziness, anosmia and dysgeusia[3]. Gastrointestinal symptoms may also be present, the most frequently reported being diarrhea, nausea, vomiting and abdominal discomfort. Liver changes have been demonstrated by biochemical tests[4].

In general, patients who had mild or moderate forms of the disease recover completely. Nevertheless, individuals who had severe or critical forms of the disease may have impairment of several systems[5]. Studies show that about half of post-COVID-19 patients had severe impairment of functionality in activities of daily living after discharge[6], and that only 65% of patients who tested positive returned to their previous health status after 14-21 days[7]. About a quarter of infected individuals have symptoms that persist for at least four weeks, but 1 in 10 remain symptomatic after 12 weeks, which has been characterized as "long COVID"[8]. Based on the UK COVID Symptom Study, around 10% of patients who tested positive for SARS-CoV-2 persist with complaints for more than three weeks and a smaller proportion for months[7].

Greenhalgh et al.[7] define post-acute COVID-19 as a condition that extends beyond three weeks after the first symptoms and chronic beyond 12 weeks; and suggest that a positive test is not necessary for diagnosis, since many individuals have not been tested and false negatives are common. The occurrence and severity of chronic COVID do not seem to be correlated with the symptoms of the acute phase of the infection, however, growing evidence indicates that it is a common and debilitating condition[8]. A recent cross-sectional study conducted in socioeconomically vulnerable neighborhoods of two Brazilian cities (Salvador-BA and Rio de Janeiro-RJ), using the post-COVID functional status scale, indicated that the prevalence of limitations in post-COVID-19 patients was 34.6% (26.7% reporting negligible/slight limitation and 7.9% reporting moderate/severe limitations)[9]. Furthermore, the sociodemographic factors associated with moderate/severe functional status of post-COVID-19 patients were: living in households with fewer rooms, female gender, older age, self-reported diabetes mellitus, respiratory diseases, having contracted COVID-19 two or more times, not having had a medical appointment in the last 12 months, difficulty accessing COVID-19 testing, and experience discrimination in health services[9].

The most important sequelae of the severe form of COVID-19 are respiratory, cognitive, central and peripheral nervous system, deconditioning, myopathy and neuropathy related to critical condition, dysphagia, joint stiffness and pain, in addition to psychiatric conditions[5]. Patients intubated for prolonged periods and those who needed tracheostomy during hospitalization present significant impairment of voice and swallowing[10]. Weakness of the inspiratory muscles and proteolysis of the diaphragm can occur after long periods of mechanical ventilation[11].

The complexity of chronic COVID must be recognized when developing healthcare policies, considering its impacts on work, social life and mental health, as well as economic consequences for patients, families and society[8]. It is necessary to implement services with multidisciplinary approaches associated with research that enable greater understanding of these clinical conditions, with efforts to restore the functionality of these individuals and their full return to society with quality of life.

Several studies recommend rehabilitation and provide evidence of benefits of physical therapy for post-COVID-19 patients[12-17]. However, few studies address the impact of structured physical therapy programs specifically in low- and middle-income countries. This gap highlights the importance of this study, which will shed some light on these populations. General international recommendations to implement rehabilitation were made even before empirical evidence was available, due to the urgency of the pandemic, encouraging patients to do low-/moderate-intensity physical exercise at home in the first 6–8 weeks after hospital discharge[17].

In a systematic review published in 2022[13], it was concluded that rehabilitation was able to improve dyspnea, anxiety, kinesiophobia, muscle strength, walking capacity, performance in the sit-to-stand test and quality of life. Early rehabilitation is important, but many patients experience a decrease in saturation at minimal effort, which impacts the rehabilitation process[18]. Therefore, individualized planning and prescription of low to moderate intensity exercises are recommended[13,19], along with constant reassessment of functional impairment and the need for the use of oxygen, prioritizing patient safety[17]. However, to date, reviews worldwide remain with unmet expectations regarding optimal physical therapy protocols, mainly due to heterogeneity of population, sample size and variability of outcome measures[12-16,20].

This manuscript aims to identify the effect of physical therapy intervention in symptomatic post-COVID-19 after 10 sessions of physiotherapy care provided at the Instituto Bahiano de Reabilitação — IBR (Rehabilitation Institute of Bahia).

2. Materials and methods

2.1 Ethics statement

All regulatory documents were approved by the Research Ethics Committee of Maternidade Climério de Oliveira — MCO (Climério de Oliveira Maternity Center) (CAAE 46564421.5.0000.5543). This study was conducted in accordance with Resolution 466/12 of the Code of Ethics for Research involving Human Beings of the National Health Council and the principles of the Declaration of Helsinki.

2.2 Study design

This is a quasi-experimental study of patients referred by a physician to the multidisciplinary post-COVID-19 service at the Instituto Bahiano de Reabilitação (IBR) of Fundação José Silveira — FJS (José Silveira Foundation), Bahia, Brazil, for the treatment of post-COVID-19 respiratory and/or motor impairments. 26 post-COVID-19 patients admitted to the aforementioned sector were included: patients aged ≥ 18 years, typical clinical presentation of COVID-19, laboratory tests confirming the disease through the RT-PCR test, with disease progression of at least 21 days, re-evaluation after 10 sessions of physical therapy. None of the patients who met the aforementioned criteria were excluded. Patients with difficulty understanding the instruments of this study were excluded, based on clinical evaluation of the ability to understand the informed consent form.

Patients were monitored during regular assessments. The service was structured during the COVID-19 pandemic in response to the volume of patients presenting with sequelae of COVID-19 or "long COVID". It was inaugurated in March 2021 and was conceived as a multidisciplinary care approach, with the participation of pulmonologists, general practitioners, physiotherapists, speech therapists, occupational therapists, psychologists and nutritionists. Outpatients who arrived at the service with a recommendation from their attending physician were also invited to undergo therapy. Data was recorded using electronic and physical forms specific to each service. For this study, the primary outcome was the presence of persistent symptoms (symptoms identified at the first assessment and persistent at the last assessment). Secondary outcomes were the variations in functional parameters through the baseline and the last assessment.

Clinical parameters were evaluated: age, weight, height, main complaint, history of hospitalization, use of O_2 and mechanical ventilation, percentage of pulmonary impairment and presence of comorbidities. The evaluation of the physical therapy service monitored changes in motor skills such as muscle strength and tone, contractures, pain, balance and movement impairments, gait and sensitivity alterations, in addition to tracking alterations of the respiratory system. Patients were evaluated to monitor: cough, dyspnea, fatigue, sleep disorders, intercostal and supraclavicular retractions, maximal inspiratory pressure (MIP), maximal expiratory pressure (MEP), pulmonary auscultation, peak expiratory flow (PEF — peak flow), cough peak, apnea test, thoracic mobility and expansibility.

Patients indicated for motor physical therapy continued with assessment of: fatigue using the fatigue pictogram[21]; pain using a visual analogue scale[22]; global muscle strength and handgrip strength (assessed according to the Medical Research Council scale - MRC)[23]; functional mobility using the Timed-Up-and-Go (TUG) test[24,25]; cardiorespiratory endurance using 30-second sit-to-stand (STS) test[26,27] and 2-minute step-in-place (2mSIP) test[28,29]; in addition to pre- and post-test vital signs (heart rate, blood pressure, respiratory rate, O_2 saturation %).

The goals of physical therapy were (i) to optimize respiratory function through breathing exercises, focusing on lung re-expansion to improve the ventilation-perfusion ratio and increase pulmonary capacity; and (ii) to strengthen global musculature due to weakness and atrophy resulting from hospitalization/disuse. The following equipment were used for initial exercises: peak flow meter, Respiron®, treadmill, Swiss ball, and therapy rod; and for resistance exercises, therabands®, ankle weights, and dumbbells. Patients were evaluated in the first session and after 10 sessions of physical therapy treatment and these data were used as a baseline parameter for the evaluation of impairments. We established that 10 sessions of the physical therapy treatment were the optimal volume of sessions to identify effects of treatment and participation in the study; and considering the emerging disease, participants were included using convenience sampling. This duration of treatment is corroborated by recent evidence which indicates that 4-8 weeks of pulmonary rehabilitation is effective[14,15] to improve exercise capacity and reduce fatigue[15]. The physical therapy sessions lasted approximately 45 minutes each. The duration of each exercise and the load applied was based on the patient's perception of fatigue, conducted in an individualized manner, as was the progression of exercises from one session to the other. Individualized rehabilitation programs are strongly suggested in other studies[13,19].

Categorical variables were presented in absolute and relative frequencies and continuous variables in median and interquartile range (IQR). Normal distribution was tested using the Kolmogorov-Smirnov test. Baseline and reassessment data were compared using the Wilcoxon (continues variables) and McNemar tests (categorical variables). P-values < 0.05 were considered statistically significant. All data were tabulated and analyzed using the Statistical Package for Social Sciences SPSS® version 26.0.

3. Results

3.1 Characteristics of the study participants

Between March 2021 and May 2022, the physical therapy service received 63 patients for evaluation with varied symptoms and degrees of impairment. Of these 63 patients, 26 that remained in physical therapy until the 10th session were included in this study. We established that 10 sessions of physical therapy treatment were the necessary volume of session needed to identify effects of treatment, considering that many patients had mild symptoms, had already reported spontaneous improvement of symptoms and did not plan on participating in the rehabilitation protocol for many sessions. Therefore, we included all patients that completed 10 physical therapy sessions, even the ones with a few missing data, due to the flexibilization of methodological rigor required in pandemic times, as seen in other studies as well[13].

In this group of 26 patients, the median age was 54 years, 57.7% were male, the median of body mass index (BMI) was 27.7 kg/m2 and 34.6% reported practicing physical activity regularly before COVID-19 (Table 1). Participants presented a median of 82.5 days post-infection at the time of admission. Most patients (61.5%) had not been hospitalized due to COVID-19, and of the ones who were hospitalized, 19.2% used mechanical ventilation and 11.5% used an oxygen catheter. In 80.8% of patients imaging did not show pulmonary impairment, only 7.7% of patients presented with reduced chest expansibility and none of them presented with reduced chest mobility (Table 1).

Table 1. Baseline characteristics of 26 post-COVID-19 patients who completed 10 physical therapy sessions

Characteristics	N	n (%)
Male sex – n (%)	26	15 (57.7)
Age (years) – median (IQR)	26	54 (42.3-59.8)
Weight (kg) – median (IQR)	25	76.8 (69.9-86.7)
Height (cm) – median (IQR)	25	167 (158-175)
BMI (kg/m2) – median (IQR)	25	27.7 (24.3-32.1)
Evaluation time after testing positive (days) – median (IQR)	20	82.5 (43.8-173)
Time for re-evaluation (days) – median (IQR)	24	47 (36-69.8)
Hospitalization – n (%)	26	10 (38.5)
O_2 catheter – n (%)	26	3 (11.5)
Mechanical ventilation – n (%)	26	5 (19.2)
Pulmonary impairment – n (%)	26	5 (19.2)
Thoracic mobility impairment – n (%)	26	0 (0)
Thoracic expansibility impairment – n (%)	26	2 (7.69)
Supraclavicular retraction – n (%)	26	1 (3.85)
Intercostal retraction – n (%)	26	0 (0)
Physical activity before COVID-19– n (%)	26	9 (34.6)
Main complaint:	25	
Fatigue – n (%)		7 (28)
Dyspnea – n (%)		5 (20)
Body pain – n (%)		10 (40)
Persistent cough – n (%)		2 (8)

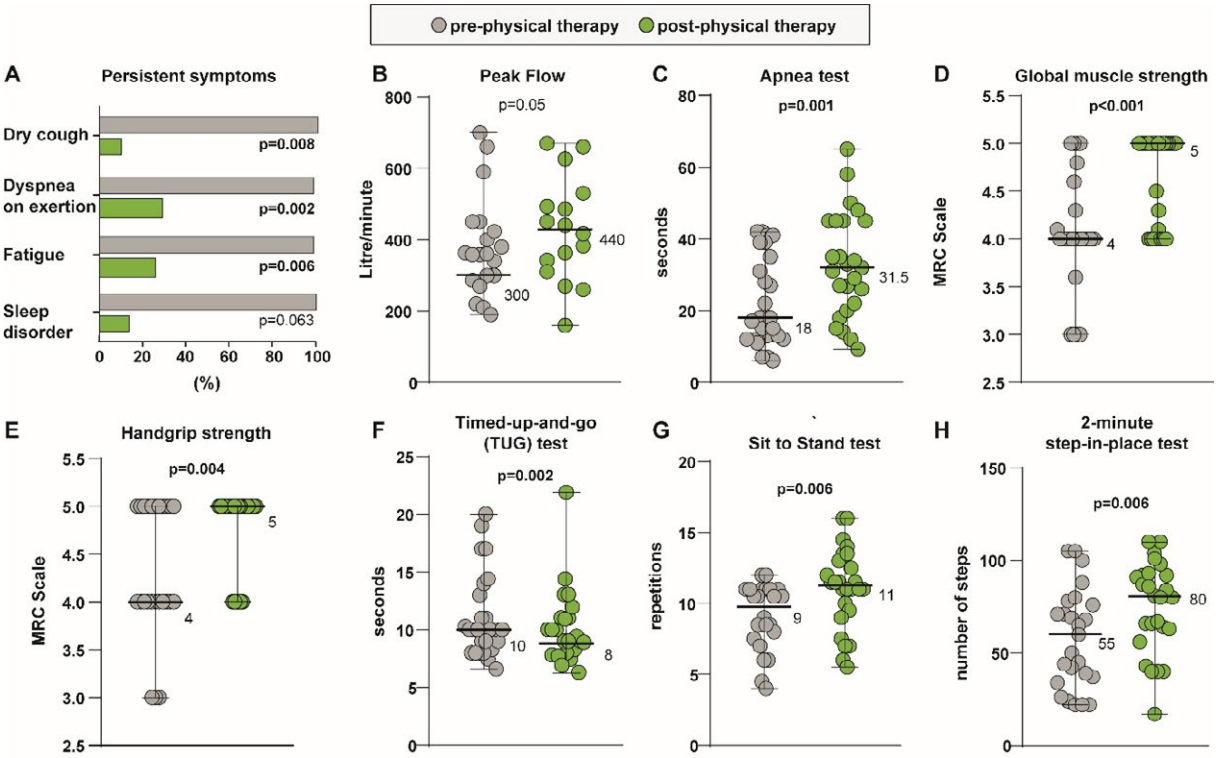
Source: the authors (2025).
Data represents no. (%), except for age, weight, height, BMI, evaluation time after testing positive, time for re-evaluation.
Abbreviations: BMI - body mass index, IQR - interquartile range.
The number of patients is different for some variables due to missing data.

The most frequently reported symptoms were fatigue (61.5%), body pain (such as myalgia and arthralgia) (40%), dyspnea at rest (7.7%), dyspnea on exertion (57.7%), persistent dry cough (38.5%), persistent productive cough (7.7%), sleep disorders (23.8%). The main complaints reported by patients were fatigue (28%), dyspnea (20%), pain (40%) and persistent cough (8%) (Table 1).

3.2 Impact of physical therapy on functional outcomes among study participants

Patients were reevaluated after 10 sessions of physical therapy, comprising a median period of 47 days after the initial assessment (Table 1). When comparing the results before and after physical therapy, a significant reduction in complaints of dry cough (p=0.008), dyspnea on exertion (p=0.002) and fatigue (p=0.006) was noted (Figure 1A). No variations were observed in peak flow measurements (Figure 1B). Furthermore, significant improvements were observed in functional assessments, such as the apnea test (18 to 31.5 seconds; p=0.001) (Figure 1C), global muscle strength (4 to 5; p=0.000) (Figure 1D), handgrip strength (4 to 5; p=0.004) (Figure 1E), in the TUG test (10 to 8; p=0.002) (Figure 1F), in the STS test (9 to 11; p=0.006) (Figure 1G) and in the 2mSIP test (55 to 80; p=0.006) (Figure 1H). On the fatigue scale, the median remained 2, but there was a significant improvement (p=0.025). No significant improvement was observed for vital signs BP, HR, RR and O_2 saturation (%).

Figure 1. Comparative test pre-physical therapy and post-physical therapy describing reported symptoms and functional test results



Source: the authors (2025).
In panel A, Persistent symptoms are shown in percentages and in panels B, C, D, E, F, G and H are presented in medians and interquartile range (IQR). Persistent symptoms were assessed using McNemar test. Peak Flow, apnea test, global muscle strength, handgrip strength, Timed-Up-and-Go, Sit-to-stand and 2-min step-in-place tests were evaluated using Wilcoxon test.
Abreviation: MRC - Medical Research Council.

4. Discussion

In this study, we observed the effects of physical therapy on a group of patients with mild to moderate symptoms in the post-COVID-19 period who sought assistance at the FJS post-COVID-19 multidisciplinary service. Despite the milder symptoms, when compared to the range of severe post-COVID-19 symptoms reported in the literature, it was possible to quantify significant improvement in patients in a short period of time using individualized therapeutic approaches, functional tests and simple infrastructure, which can be easily implemented. This is an important contribution especially for implementation of rehabilitation protocols in emerging countries. A systematic review with meta-analysis of randomized controlled trials published this year included 37 studies, of which five were conducted in Brazil, and of the five, only one was conducted in an outpatient service similar to our scenario. The other four studies were conducted in some form of tele-rehabilitation[14].

It is important to highlight that other viral conditions and hospitalization for other reasons can lead to similar conditions that will also require physical therapy for complete recovery, which broadens the scope of our findings. Post-COVID-19 patients, as well as other critically ill patients, may experience dyspnea and fatigue at rest and during activities of daily living (ADLs), peripheral muscle dysfunction, and exercise intolerance, in addition to post-traumatic stress disorder, anxiety and depression[30]. Prolonged hospitalizations can cause pulmonary, cardiovascular, muscular and cognitive impairments, as well as psychological consequences such as anxiety and depression[30,31]. Prolonged hospitalization and intensive care lead to muscle weakness acquired in the ICU, which makes recovery difficult[30,32].

In this sample of post-COVID-19 patients, the most frequently reported symptoms were fatigue, body pain, dyspnea at rest, dyspnea on exertion, persistent dry cough, persistent productive cough, sleep disorders.

The main complaints reported by patients were fatigue, dyspnea, pain and persistent cough. In a systematic review with meta-analysis, it was identified that post-COVID-19 symptoms are present in 60% of patients infected by SARS-CoV-2, and as in the present study, fatigue and dyspnea were observed as the most prevalent symptoms[33]. Reduced exercise tolerance is also common in post-COVID-19 patients[34]. Prolonged symptoms resulted in a significant negative impact on functional and work activities[35], highlighting the need for monitored rehabilitation of these patients. Physical therapy can improve functional capacity, reduce deconditioning after prolonged periods in the ICU and facilitate return to work[34]. Continuous aerobic and resistance training has been shown to be effective in the recovery of exercise tolerance and quality of life and reducing the perception of fatigue in post-COVID-19 patients[34].

The effects observed in our service after 10 sessions of physical therapy were: improvement in complaints of fatigue, dyspnea on exertion and dry cough, as well as functional improvement observed in the apnea, muscle strength, TUG, STS, 2mSIP and fatigue scale tests. As described above, physical therapy protocols were specifically designed for each patient, with the objectives of optimizing respiratory function and global muscle strength. Through resistance exercises, we aim to promote improvement in muscle strength, helping to improve functional capacity, independence in ADLs, preventing adjacent diseases and a sedentary lifestyle[36].

Reports in the literature corroborate our positive results after physical therapy intervention. In a randomized controlled clinical trial using inspiratory muscle training, improvements in complaints of dyspnea, respiratory muscle strength and aerobic performance were observed[37]. In a study that used concurrent training with or without inspiratory muscle training, significant improvement in muscle strength of the lower limbs, dyspnea and fatigue were observed. This intervention proved to be more effective than just training inspiratory muscles or just following recommendations without follow-up[38].

Functional improvements were also observed using 2mSIP test and STS test both after face-to-face and virtual physical therapy intervention[39]. Another study that identified functional improvement observed that the STS test outcomes significantly correlated with mental health outcomes and work capacity[40].

Just as we observed significant functional gains through the 2mSIP and STS tests, we also observed significant improvements in the TUG test scores. Furthermore, it was observed that patients who had critical COVID-19 performed worse on the TUG test or similar to the performance of adults around 20 years older[41]. Our results and findings in the literature reinforce the importance of using these tools as quantifiable evolution parameters of patients in this scenario.

A necessary alternative during the pandemic period was the implementation of telerehabilitation services, through which it was possible to reach a greater number of patients, who could have otherwise been deprived of assistance. A telerehabilitation protocol lasting eight weeks also observed improvements comparable to what we observed, with reported improvements in quality of life, respiratory muscle strength and lower limb muscle strength, despite not having achieved effective results in terms of exercise tolerance, pulmonary function and psychological condition[42].

The literature shows us that different approaches in different groups of patients obtained different results, but all were able to promote improvements in some aspects of the patient's health[12-16]. We emphasize here that, even in the face of a lack of experience and lack of resources, when caught by surprise in the pandemic scenario, services around the world were able to adapt, learn quickly and provide effective care for the enormous demand of patients during the active disease and in the post-COVID-19 period. It is important to disseminate diverse findings, even if sometimes flawed and incomplete, for the continuous learning of therapeutic and evaluative approaches in contexts of viral infections and prolonged hospitalization.

This study had limitations regarding the variability of clinical conditions of patients that sought this service (an important factor in the COVID-19 pandemic) and the limited number of patients, which may compromise the precision of our results. We observed a large number of patients who discontinued treatment after just a few sessions. Of the 63 patients who sought the service, 26 continued treatment until the 10th session. The main reasons identified for discontinuing physical therapy were: less severity of symptoms and rapid improvement, difficulties in locomotion and transportation to physical therapy,

financial difficulties, fear of reinfection when leaving home and/or using public transportation during the pandemic. Other studies report similar reasons for low adherence[31].

The selection criteria for 10 physical therapy sessions before re-evaluation was a safety measure to ensure we were considering the effect of treatment and not spontaneous improvements of mild symptoms; however, this posed as a selection bias, as it reduced our sample size and possibly underestimated the results (many patients improved and were released before completing 10 sessions). Due to the need for individualized sessions, according to each patient's general complaint and the complaint at the time of each session, we also have limitations regarding the control of the intervention protocol used. Nonetheless, individualization of therapy is a necessary measure, especially considering post-COVID-19 patients who are fatigued easily[13,19].

Part of our results are based on self-reported measures (pain, fatigue, perception of symptoms), an information bias which may overestimate our results. At baseline, the patients are worried and seeking help, but once they perceive improvements with physical therapy sessions, they tend to become more optimistic, which may enhance the perception of the actual improvement. Validated instruments, such as the post-COVID functional status (PCFS) scale, validated for Brazilian Portuguese in 2023[43], may be an interesting approach to improve quality of information for future studies. The use of validated instruments, such as the PCFS, which scores functional abilities on a scale of 0-4, is a useful methodological alternative to ensure a more precise evaluation of functional status and mitigate self-report bias.

These limitations have a negative impact on the potential extrapolation of results to other populations. Furthermore, the absence of a control group is an important limitation of quasi-experimental studies. Therefore, future studies including a group without intervention and a more robust methodological approach and well-designed trials, such as randomized controlled trials, with wider range of disease severity and age distribution, remain essential to confirm results and expand applicability.

5. Conclusions

In this quasi-experimental study, we documented the improvement of persistent symptoms and the recovery of functional parameters in initially mild or moderately impaired post-COVID-19 patients, which reinforces the effectiveness of a specialized rehabilitation service to optimize functional gains, quality of life and work capacity after infections or hospitalizations. Continuous learning of therapeutic and evaluative approaches is essential to refine rehabilitation strategies in cases of viral infections, prolonged hospitalization and pandemic scenarios.

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Authors contributions

The authors declared that they have made substantial contributions to the work in terms of the conception or design of the research; the acquisition, analysis or interpretation of data for the work; and the writing or critical review for relevant intellectual content. All authors approved the final version to be published and agreed to take public responsibility for all aspects of the study.

Competing interests

No financial, legal, or political conflicts involving third parties (government, private companies, and foundations, etc.) were declared for any aspect of the submitted work (including but not limited to grants and funding, advisory board participation, study design, manuscript preparation, statistical analysis, etc.).

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