Long-COVID: symptomatic and functional analysis post pulmonary rehabilitation

COVID longo: análise sintomática e funcional pós-reabilitação pulmonar

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ABSTRACT
Objective: to analyze the symptomatic and functional profile of patients with long-term COVID-19 after physiotherapeutic intervention. Methods: This was an analytical-
descriptive, longitudinal, prospective and quantitative study, of both sexes, with diagnostic confirmation of post-COVID-19 patients referred for pulmonary rehabilitation, after spirometry and chest computed tomography. Patients answered a sociodemographic questionnaire and were submitted to the following scales: Medical Research Council (MRC) and Functional Independence Measure (FIM) to measure the degree of dyspnea and functionality of patients. Data collection was performed using Microsoft Excel software version 2010 for descriptive statistics, with data correlation and bivariate analysis, using the R software (R Core Team) version 2019, considering a significance level of 95%, \( p<0.05 \). The research was approved by the Research Ethics Committee under opinion number 4,897,987. Results: The sample consisted of 30 volunteers for COVID-19 after pulmonary rehabilitation, in which the male gender was prevalent (73%), the mean age was 53.4 years and 60% had the disease in its severe form; the first symptoms of the disease were not related to the history of hospitalization; a mild degree of dyspnea (MRC), restrictive disorders on spirometry and changes in cognitive behavior were observed in FIM category 6. Conclusion: It is inferred that the patients had a positive outcome in the long-term functional impact, however, the persistence of some symptoms was still detected. This finding highlights the need for continuous monitoring, as the post-COVID-19 syndrome premise is increasingly strengthened, causing long-term public health disorders.

**Keywords:** signs and symptoms, long COVID-19, rehabilitation, functional capacity.

**RESUMO**
Objetivo: analisar o perfil sintomático e funcional de pacientes com Covid-19 a longo prazo após intervenção fisioterapêutica. Métodos: Foi um estudo analítico-descritivo, longitudinal, prospectivo e quantitativo, de ambos os sexos, com confirmação diagnóstica de pacientes pós-Covid-19 encaminhados para reabilitação pulmonar, após espirometria e tomografia computadorizada torácica. Os pacientes responderam a um questionário sociodemográfico e foram submetidos às seguintes escalas: Conselho de Pesquisa Médica (MRC) e Medida de Independência Funcional (FIM) para medir o grau de dispneia e funcionalidade dos pacientes. A coleta de dados foi realizada utilizando o software Microsoft Excel versão 2010 para estatísticas descritivas, com correlação de dados e análise bivariada, utilizando o software R (R Core Team) versão 2019, considerando um nível de significância de 95%, \( p<0.05 \). A pesquisa foi aprovada pelo Comitê de Ética em Pesquisa sob o parecer número 4.897.987. Resultados: A amostra foi composta por 30 voluntários para a Covid-19 após a reabilitação pulmonar, em que o sexo masculino foi predominante (73%), a idade média foi de 53,4 anos e 60% tinham a doença em sua forma grave; os primeiros sintomas da doença não estavam relacionados com a história de hospitalização; um grau leve de dispneia (MRC), distúrbios restritivos à espirometria e alterações no comportamento cognitivo foram observados na categoria 6 da FIM. Conclusão: Conclui-se que os pacientes tiveram um resultado positivo no impacto funcional a longo prazo, porém, a persistência de alguns sintomas ainda foi detectada. Essa constatação destaca a necessidade de monitoramento contínuo, uma vez que a premissa da síndrome pós-Covid-19 está cada vez mais fortalecida, causando transtornos de saúde pública de longo prazo.

1 INTRODUCTION

Much of the attention in disease surveillance during the COVID-19 pandemic has focused on the number of SARS-CoV-2 infections, hospital admissions, and deaths. Less attention has been paid to quantifying the risk of experiencing symptoms after the acute stage of SARS-CoV-2 infection. However, a second pandemic emerged: post-COVID-19 sequelae and “long haulers”. How millions of people will survive SARS-CoV-2 infection; the number of individuals with sequelae of COVID-19, i.e. long hauler, will increase dramatically over time (Hanson et al., 2022, p. 1604-1615; Fernández-De-Las-Peñas, 2021, p. 55-70).

Symptoms associated with SARS-CoV-2 infection are heterogeneous and affect different systems, such as respiratory (cough, sore throat, rhinorrhea, dyspnea), musculoskeletal (myalgia), gastrointestinal (diarrhea, vomiting) and neurological (headaches, myopathy, ageusia, anosmia). Current evidence suggests the existence of a myriad of symptoms in COVID-19 survivors. However, studies investigating symptoms after SARS-CoV-2 infection are incipient compared to available studies in the acute phase of COVID-19 (Fernández-De-Las-Peñas, 2021, p. 55-70).

Many patients who have survived COVID-19 describe persistent health problems. In October 2021, the World Health Organization (WHO) released a clinical case definition for the post-COVID-19 condition as symptoms present 3 months after SARS-CoV-2 infection lasting at least 2 months and cannot be explained by an alternative diagnosis, the so-called “Long-term COVID”. Different terms are currently used to describe the presence of post-COVID-19 symptoms (e.g., post-COVID-19 syndrome, post-COVID persistent), with “COVID Long” probably being the most commonly used term worldwide (Hanson et al., 2022, p. 1604-1615; Fernández-De-Las-Peñas, 2021, p. 55-70).

As more is learned about the natural history of COVID-19, many patients (millions worldwide) are left with persistent symptoms such as exercise intolerance,
dyspnoea and weakness that may represent persistent dysfunction of the heart, lungs, peripheral tissues and their microcirculation, leading to deteriorating quality of life. It is believed that there is a knowledge gap related to the prevention and early treatment of long-term health problems post-COVID-19 (Morrow et al., 2022, p. 660; Boutou et al., 2021, p. 838).

Considering the explosive number of COVID-19 cases, we sought to analyze the symptomatic and functional profile of patients with long-term COVID-19 after physical therapy intervention. Although a growing body of evidence indicates that a carefully designed pulmonary rehabilitation program may be beneficial for patients with long-term dyspnoea, fatigue, and exercise limitation, we believe that there is persistence of some signs and/or symptoms that characterize sequelae of COVID long (Boutou et al., 2021, p. 838).

2 METHODS

This is an analytical-descriptive, longitudinal, prospective and quantitative study (Hochman et al., 2005, p. 2-9). The research began by searching the medical records of patients treated at Clínica INSPIRAR, located in Santarém-Pará, Brazil, from August/2020 to December/2021 with a diagnosis of “post-COVID-19” with medical referral for physical therapy treatment, obtaining a total of 180 patients, but only 30 patients adequately met the inclusion criteria of this research, among them, performing spirometry, computed tomography with the compromise percentile and participating in the study.

2.1 VARIABLES AND MEASURES

Patient demographics (i.e., age, gender, body mass index, educational level, lifestyle and health habits), comorbidities, medications, and COVID-related information (date of positive PCR test, CT scan with degree of involvement, clinical course and complications, signs and symptoms of long-term COVID) were collected in a face-to-face interview using a questionnaire designed by the authors. The severity of COVID-19
was categorized into 3 categories: mild, moderate and severe, excluding critically ill patients.

Then, they were submitted to the Functional Independence Measure (FIM) scale, where the total score is calculated from the sum of points attributed to each item within the six categories (Personal care, Toilet control, Mobility and transfer, Locomotion, Communication and Cognitive/Social). This score is stipulated by the scale, through its equivalent in functionality, with a minimum score of 18 and a maximum of 126 (Abentroth et al. 2021, p. 243-250).

In addition, patients also responded to the Medical Research Council (MRC) dyspnea scale, which classifies the effects of shortness of breath on daily activities. The MRC scale is delimited into five degrees, and the higher the degree, the greater the dyspnea report (Papiris et al., 2005, p. 755-761).

It is noteworthy that, before this study, the patients had already been submitted to pulmonary function assessment (spirometry) and outpatient pulmonary rehabilitation (at a physiotherapy clinic) on an individual basis.

2.2 DATA ANALYSIS

From the data collection, the tabulation of statistical information was performed using Microsoft Excel software version 2010 for descriptive statistics, with data correlation and bivariate analysis, using the R software (R Core Team) version 2019. Regarding the descriptive analyses, the mean, standard deviation, median of quantitative variables were evaluated, using the Shapiro-Wilk test for significance analysis of 0.05 (5%) for the \( p \) value. The correlation between the variables (Bivariate Correlation, through Pearson's coefficient) was verified, both to identify whether any (and which/which) of these could have a stronger association with the tests applied in the evaluation stage, and also to verify whether the explanatory variables were correlated with each other.
2.3 ETHICAL CARE

The research was approved by the Research Ethics Committee of the Hospital Regional do Baixo Amazonas – Drº Waldemar Penna, the process is registered in Plataforma Brasil (CAAE: 45403021.1.0000.0133 under opinion number 4.897.987) and was conducted in accordance with the norms of Resolution 466/2012 of the National Health Council, where a Data Use Commitment Term (DUCT) was signed by the owner of the research site to search the medical records, then the selected participants signed the terms of free and informed consent.

3 RESULTS

The study was carried out from July to December 2021 with patients diagnosed with long-term COVID-19 and who underwent outpatient rehabilitation through pulmonary physiotherapy to trace and analyze their demographic, functional and symptomatic profile.

Therefore, 30 patients with post-COVID-19 conditions were selected: 73% (n=22) male and 27% (n=8) female with a mean age of 53.4 years, where the predominant age group was between 56 and 75 years, equivalent to 50% in relation to the other groups. Based on the severity of COVID-19, 60% of patients had the disease in its severe form, requiring hospitalization and/or ventilatory support (oxygen therapy and invasive/non-invasive mechanical ventilation). Computed tomography of the chest was used to assess the degree of impairment at the pulmonary level, which showed a percentage equivalence of 49.8 of pulmonary lesion with ground glass pattern and confirmation of COVID-19.

In Table 1, all the sociodemographic characteristics and health conditions of the patients in this study can be analyzed.

<table>
<thead>
<tr>
<th>VARIABLES</th>
<th>TOTAL (n=30)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age (years)</td>
<td>53</td>
</tr>
<tr>
<td>BMI (kg/m²)</td>
<td>29</td>
</tr>
<tr>
<td>Age group, n (%)</td>
<td></td>
</tr>
<tr>
<td>18-36</td>
<td>1 (3.3)</td>
</tr>
<tr>
<td>37-54</td>
<td>14 (46.7)</td>
</tr>
<tr>
<td>55-75</td>
<td>15 (50.0)</td>
</tr>
<tr>
<td>COVID-19 severity rating, n (%)</td>
<td></td>
</tr>
</tbody>
</table>
Mild 4 (13.3)
Moderate 8 (26.7)
Severe 18 (60.0)

Regular physical activity, n (%) 
Yes 12 (40.0)
No 18 (60.0)

BMI classification, n (%) 
Malnutrition 1 (3.3) 
Normal Weight 2 (6.7) 
Overweight 18 (60.0) 
Obesity grade 1 17 (16.7) 
Obesity grade 2 10 (10.0) 
Obesity grade 3 3 (3.3)

Comorbidities others, (%) 
Hypertension 13 (43.3)
Diabetes 6 (20.0)
Osteoporosis 3 (10)
Osteoarthritis 2 (6.7)
Asthma 2 (6.7)
Rhinitis 2 (6.7)
Anxiety 1 (3.3)
Diverticulitis 1 (3.3)
Heart disease 1 (3.3)
Renal insufficiency 1 (3.3)
None 8 (26.7)

Continuous use of medications, n (%) 
Yes 21 (70.0)
No 9 (30.0)

Subtitle: cm: centimeter; kg: kilogram; BMI: Body Mass Index; m²: square meter. Source: Authors.

Regarding the hospitalization history, 53.3% (n=16) of the patients required hospitalization with a mean (standard deviation) of 7.5 days, with a discrepancy in data dispersion, given that one patient, due to clinical complications, presented a 35-day hospitalization history. Regarding the need for ventilatory support (oxygen therapy, invasive and/or non-invasive mechanical ventilation) it was present in 93% (n=28) of the sample, with an average time of use of 14.2 days. There was an association between hospitalization history and ventilatory support (p < 0.05), as shown in Table 2.

Table 2. Hospitalization history versus ventilatory support history of patients with COVID-19.

<table>
<thead>
<tr>
<th>HH</th>
<th>No</th>
<th>Yes</th>
<th>Total</th>
<th>p value</th>
</tr>
</thead>
<tbody>
<tr>
<td>VSH</td>
<td></td>
<td></td>
<td></td>
<td>&lt; 0.001</td>
</tr>
<tr>
<td>No</td>
<td>2</td>
<td>0</td>
<td>2 (6.7%)</td>
<td></td>
</tr>
<tr>
<td>Yes</td>
<td>0</td>
<td>2</td>
<td>0 (0.0%)</td>
<td></td>
</tr>
</tbody>
</table>

Subtitle: cm: centimeter; kg: kilogram; BMI: Body Mass Index; m²: square meter. Source: Authors.
Due to the fact that the majority of patients presented changes in body mass index, ranging from overweight (60%) to obesity (33%), we sought to analyze this variable with the hospitalization history, as shown in Table 3.

Table 3. Analysis of BMI versus Hospitalization History.

<table>
<thead>
<tr>
<th>HH</th>
<th>n</th>
<th>Average</th>
<th>Median</th>
<th>SD</th>
<th>Normal Test</th>
<th>F Test</th>
<th>T Test</th>
</tr>
</thead>
<tbody>
<tr>
<td>No</td>
<td>14</td>
<td>27.26</td>
<td>26.55</td>
<td>3.89</td>
<td>0.59</td>
<td>0.10</td>
<td>0.22</td>
</tr>
<tr>
<td>Yes</td>
<td>16</td>
<td>29.61</td>
<td>28.53</td>
<td>6.19</td>
<td>0.14</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Subtitle: BMI: Body Mass Index; HH: hospitalization history; SD: standard deviation. Source: Authors.

Furthermore, the average time from the first symptoms until the performance of the pulmonary function test (spirometry) and beginning of rehabilitation was 2.4 months, an average of 8 weeks for the beginning of physical therapy treatment. Among the first symptoms, 86.7% of the patients reported weakness and shortness of breath and 60% reported mainly chest pain. In addition, the mean time from the first symptoms to the performance of this study was 8.2 months, with 80% of patients experiencing persistent symptoms, such as muscle weakness, corresponding to 50% of reports of post-COVID-19 symptoms (Table 4).
Table 4. Symptomatology reported during and post-COVID-19 by volunteer patients.

<table>
<thead>
<tr>
<th>First Symptoms</th>
<th>n</th>
<th>%</th>
<th>Post-COVID-19 Symptoms</th>
<th>n</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Weakness</td>
<td>26</td>
<td>86.7</td>
<td>Weakness</td>
<td>15</td>
<td>50.0</td>
</tr>
<tr>
<td>Shortness of breathe</td>
<td>26</td>
<td>86.7</td>
<td>Shortness of breathe</td>
<td>10</td>
<td>33.3</td>
</tr>
<tr>
<td>Chest pain</td>
<td>18</td>
<td>60.0</td>
<td>Anxiety</td>
<td>5</td>
<td>16.7</td>
</tr>
<tr>
<td>Cough</td>
<td>15</td>
<td>50.0</td>
<td>Back pain</td>
<td>4</td>
<td>13.3</td>
</tr>
<tr>
<td>Loss of smell/taste</td>
<td>15</td>
<td>50.0</td>
<td>Body ache</td>
<td>2</td>
<td>6.7</td>
</tr>
<tr>
<td>Body ache</td>
<td>13</td>
<td>43.3</td>
<td>Joint pain</td>
<td>2</td>
<td>6.7</td>
</tr>
<tr>
<td>Fever</td>
<td>12</td>
<td>40.0</td>
<td>Deafness</td>
<td>1</td>
<td>3.3</td>
</tr>
<tr>
<td>Headache</td>
<td>11</td>
<td>36.7</td>
<td>Panic</td>
<td>1</td>
<td>3.3</td>
</tr>
<tr>
<td>Sore throat</td>
<td>3</td>
<td>10.0</td>
<td>Hypertension</td>
<td>1</td>
<td>3.3</td>
</tr>
<tr>
<td>Coryza</td>
<td>2</td>
<td>6.7</td>
<td>Chest pain</td>
<td>1</td>
<td>3.3</td>
</tr>
<tr>
<td>Joint pain</td>
<td>2</td>
<td>6.7</td>
<td>Memory loss</td>
<td>1</td>
<td>3.3</td>
</tr>
<tr>
<td>Back pain</td>
<td>2</td>
<td>6.7</td>
<td>Alopecia</td>
<td>1</td>
<td>3.3</td>
</tr>
<tr>
<td>Nausea</td>
<td>1</td>
<td>3.3</td>
<td>None</td>
<td>6</td>
<td>20.0</td>
</tr>
<tr>
<td>Renal insufficiency</td>
<td>1</td>
<td>3.3</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Eye pain</td>
<td>1</td>
<td>3.3</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Memory loss</td>
<td>1</td>
<td>3.3</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Loss of apetite</td>
<td>1</td>
<td>3.3</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>30</td>
<td>100.0</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Source: Authors.

In the pulmonary evaluation, through spirometry, ventilatory disorders were present in 80% (n=24) of the sample, and of these, 70% (n=21) were diagnosed with predominantly restrictive disorder, with forced vital capacity (FVC) with a mean of 70, the percentage of forced expiratory volume in one second (FEV1) with a mean of 80 and the forced expiratory volume in one second, in liters, (FEV1) with mean of 2.6.

When measuring the Functional Independence Measure (FIM) scales, as well as the Medical Research Council (MRC), in this study to analyze the degree of functional independence and persistence of dyspnea, the first was divided and analyzed according to its six categories, that is: (1) personal care; (2) sphincter control; (3) mobility/transfers; (4) locomotion; (5) communication and (6) social cognitive. None of the patients showed alterations in categories 1, however 3.3% (n=1), 16.7% (n=5) and 6.7% (n=2) of the patients presented alterations in categories 3, 4 and 5, respectively. Only category 6 showed greater changes, around 53.3% (n=16) of the sample, which included: social interaction ability, problem solving and memory.

Table 5 shows the descriptive analysis of the FIM, taking into account that the scores are equivalent to the categories as follows: (1) 42 points, (2) 14 points, (3) 21
points, (4) 14 points, (5) 14 points and (6) 21 points, equivalent to 126 points (TOTAL FIM) with a score from 1 to 7 to characterize the degree of dependence, where 100% of the sample presented a FIM score from 6.85.

Table 5. Descriptive analysis of FIM scale for COVID-19 survivors post outpatient rehab.

<table>
<thead>
<tr>
<th>FIM (n=30)</th>
<th>CAT 1</th>
<th>CAT 2</th>
<th>CAT 3</th>
<th>CAT 4</th>
<th>CAT 5</th>
<th>CAT 6</th>
<th>FIM TOTAL</th>
<th>SCORE FIM</th>
</tr>
</thead>
<tbody>
<tr>
<td>Average</td>
<td>42.0</td>
<td>14.0</td>
<td>20.93</td>
<td>13.80</td>
<td>13.87</td>
<td>18.70</td>
<td>123.30</td>
<td>6.85</td>
</tr>
<tr>
<td>Standard error</td>
<td>0.0</td>
<td>0.0</td>
<td>0.07</td>
<td>0.09</td>
<td>0.10</td>
<td>0.56</td>
<td>0.67</td>
<td>0.04</td>
</tr>
<tr>
<td>Median</td>
<td>42.0</td>
<td>14.0</td>
<td>21.00</td>
<td>14.00</td>
<td>14.00</td>
<td>20.00</td>
<td>124.50</td>
<td>6.92</td>
</tr>
<tr>
<td>Standard deviation</td>
<td>0.0</td>
<td>0.0</td>
<td>0.37</td>
<td>0.48</td>
<td>0.57</td>
<td>3.05</td>
<td>3.65</td>
<td>0.20</td>
</tr>
<tr>
<td>Sample variance</td>
<td>0.0</td>
<td>0.0</td>
<td>0.13</td>
<td>0.23</td>
<td>0.33</td>
<td>9.32</td>
<td>13.32</td>
<td>0.04</td>
</tr>
</tbody>
</table>


Regarding the MRC, the patients were asked about the degree of dyspnea in their daily activities after the period of pulmonary rehabilitation. The average of the responses regarding the degree of the MRC was 1.87, a graduation that was between 1 (“No problems with shortness of breath except in case of intense exercise.”) and 2 (“Short of breath in case of haste or when walking on a slightly inclined floor.”).

4 DISCUSSION

It is a fact that people of all ages are at risk of infection by COVID-19 and even of reaching the most severe level of the disease. However, patients aged ≥60 years and patients with underlying medical comorbidities (obesity, cardiovascular disease, chronic kidney disease, diabetes, chronic lung disease, smoking, cancer, solid organ or hematopoietic stem cell transplantation) may be at increased risk of developing more severe complications of COVID-19, but in cases of clinical decompensations and/or immunosuppressive status (Aleem; Ab; Slenker, 2020; Cascella et al., 2020).

In this context, this research corroborates with some studies on the assessment of lung function in patients with COVID-19 after hospital discharge, where no significant differences were found between the three groups of cases (mild, moderate and severe) in relation to gender, smoking, chronic disease and body mass index, and also report that
the mean duration from the onset of the disease to the pulmonary function test was 20 days in mild cases, 29 days in moderate cases and 34 days in severe cases (Mo et al., 2020).

It is a fact that persistent symptoms of COVID-19 are common, with 72.5% of patients reporting at least one symptom within 60 days or more after diagnosis, symptom onset, or hospitalization, or within 30 days or more after recovery from acute illness or discharge from hospital. This is consistent even across studies that followed patients for nearly 6 months, suggesting that symptoms may persist long after recovery in some patients (Nasserie; Hittle; Goodman, 2021, p. e2111417-e2111417).

Although most of the patients in this research had been previously hospitalized, which would already suggest a prolonged burden of morbidity as well as general implications of the pandemic for mental health, such as anxiety, depression and panic, there was no association between the hospitalization history with the long-term COVID-19 symptoms reported by the patients. After all, this is what is expected of a target audience who underwent early pulmonary rehabilitation, despite still having some symptoms, which are probably sequelae of the disease and not of the length of stay, since there was no significant association with clinical manifestations.

When it comes to pulmonary rehabilitation, among the methods of evaluating pulmonary function in post-COVID-19 patients, spirometry is one of the most used, however in some studies the impact on pulmonary function did not seem to be significant, since FVC and FEV1 values did not change to low levels of normality patterns (Malik et al., 2022, p. 253-262; Baldini et al., 2021; Darcis et al., 2021, p. 209-216).

On the other hand, other studies indicate a significant decrease in FVC and FEV1 values. Among the reasons that contribute to this decrease in lung function are alveolar destruction, pulmonary interstitial fibrosis due to SARS CoV-2 infection, COVID-19 pneumonia and multiple physical and respiratory impairments, confirmed in imaging tests, such as computed tomography (Albu et al., 2021, p. 469-480; Cortés-Telles et al., 2021, p. 103644; Salem et al., 2021, p. 3271-3280; Solanki et al., 2021, p. A1753).

Fibrotic changes in the lung following COVID-19 infection, therefore, are the most likely mechanism implicated in the restrictive impairment of lung function. Lung
injury by SARS-CoV-2 causes recruitment and activation of fibroblasts and post-COVID-19 patients are at increased risk of developing pulmonary fibrosis. Another possible mechanism that contributes to the decline in lung function is respiratory muscle fatigue (Salem 

It is noteworthy that, after the acute phase of the disease, it is also important to address the functional status considering the long-term physical, cognitive and psychosocial repercussions. The evaluation must be carried out by a specialized multidisciplinary team using the biopsychosocial model, which involves body functions and structures, activities and social participation (De Facio 

However, the intensity of some symptoms is difficult to determine, but it is essential to emphasize the use of validated evaluative tools and instruments that determine the intensity and characteristics of each symptom. Although there are still not many validated evaluative instruments for COVID-19, it is important to seek scales that provide a more precise definition of the intensity of the disease's impact on patients. Alternatively, the fatigue rating scale (FAS), originally used to assess patients with sarcoidosis, has been applied to patients with COVID-19, although it has not yet been specifically validated for this population. Therefore, in this study, we chose to use the MRC (dyspnea) and FIM (functionality) scales which, although reported in few studies on COVID-19, offer pertinent analyzes of dyspnea and the functional status of patients affected by this disease (Cares-Marambio et al., 2021, p. 14799731211002240).

In this scenario, it has also been shown that cognitive and neuropsychiatric impairment persists for months after acute SARS-CoV-2 infection. A meta-analysis recorded 81 studies on cognitive function in patients surviving COVID-19 infection and showed that one-fifth of these individuals had cognitive impairment 12 or more weeks after confirmed infection (Serrano-Castro et al., 2022, p. 3563).

That is, corroborating this research, since the patients were evaluated in an average of 8 months from the first symptoms to the post-pulmonary rehabilitation, presenting a relevant degree of functional independence through the FIM scale, but the emphasis was given exactly to the changes in category 6, which involves social cognition. Furthermore, in contrast to other persistent symptoms that may be self-limiting (eg, anosmia), cognitive
impairment may worsen over time in susceptible individuals (Serrano-Castro et al., 2022, p. 3563).

Regarding shortness of breath (dyspnea), one of the most reported persistent symptoms in long-term COVID-19, in this research quantified as mild dyspnea through MRC after pulmonary rehabilitation, it only confirms what studies have detected that, as the SARS-CoV-2 virus mainly affects the respiratory system, recovered individuals continue to experience shortness of breath for up to 6 months, due to abnormalities in the physiological functioning of the lungs. In addition, it should be noted that dyspnea also has its mechanism of origin at the extrapulmonary level, which involves musculoskeletal alterations or even a characteristic of cardiovascular deconditioning (Qamar et al., 2023, p. 103361).

Finally, it is important to highlight that studies already predicted the challenge of dealing with the consequences even after overcoming the emergency phase of the pandemic, such as the increased demand, including in the Unified Health System (SUS), for diagnosis, treatment and rehabilitation of patients. surviving patients, arising from the possible chronic complications of COVID-19, such as: respiratory, increased incidence of heart diseases arising from COVID-19, with increased risk of stroke and heart attack, in addition to the increase in consultations and psychotherapy for previous aggravated psychiatric cases due to the pandemic (Campos et al., 2020).

In conclusion to this study, it is inferred that the patients had a positive outcome in measuring the long-term functional impact when undergoing early physiotherapeutic treatment, and even so, the persistence of debilitating symptoms was detected, in an average period of 8 months after the onset of COVID-19. This finding highlights the ongoing need for follow-up and support for post-COVID-19 patients, with a view to promoting quality of life. Furthermore, the identification of persistent symptoms reinforces the importance of continued research on the COVID-19-syndrome in order to improve the most effective treatment strategies for survivors of this challenging health condition.

Therefore, it is important to obtain a more complete understanding of the functional impact and persistent symptoms in post-COVID-19 patients, long-term follow-
up is recommended. Longitudinal studies that assess patients at regular intervals after initial rehabilitation can provide valuable information about symptom evolution and functional progress over time.
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