Original Article

ACTA FISIÁTRICA
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The influence of a physiotherapeutic intervention program for patients with post-COVID-19 syndrome: a quasi-experimental study

A influência de um programa de intervenção fisioterapêutica para pacientes com pós-COVID-19: um estudo quase experimental

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ABSTRACT

Post-COVID-19 syndrome affects patients regardless of the severity of the disease. The most common symptoms are fatigue, migraine, attention deficit, dyspnea, and depression. Physiotherapeutic intervention has been used as a strategy to aid the rehabilitation of patients. **Objective:** To analyze the effects of a physiotherapeutic rehabilitation program on quality of life, functional capacity, perceived exertion, perception of pain, and muscle strength in patients with post-COVID-19 syndrome. **Methods:** This is a quasi-experimental study with 33 participants, divided into two groups: an intervention group (IG) who received the physiotherapeutic rehabilitation program and a control group (CG) who did not. Participants were assessed for strength before and after the intervention period, using handgrip dynamometry and being assessed with a visual analog scale (VAS) for pain, the six-minute walk test (6MWT) for functional capacity, the BORG scale for exertion perception, and the SF-36 scale for quality of life. **Results:** A significant increase ($p<0.05$) in quality of life was observed in the IG in the SF-36 domains of physical functioning, physical role limitations, bodily pain, and increased handgrip strength. There was a significant difference ($p<0.05$) between the groups for perceived exertion before and after the intervention. No significant differences were found among the other variables. **Conclusion:** The physiotherapeutic intervention program improved the quality of life assessed with the SF-36 domains of physical functioning, physical role limitations, and bodily pain, and increased handgrip strength of patients with symptoms of post-COVID-19 syndrome.

Keywords: Post-Acute COVID-19 Syndrome, Physical Therapy Modalities, Rehabilitation

RESUMO

A síndrome pós-COVID-19 afeta pacientes independentemente da gravidade da doença. Os sintomas mais comuns são fadiga, cefaleia, déficit de atenção, dispneia e depressão. Para ajudar na reabilitação dos pacientes, a intervenção fisioterapêutica tem sido utilizada como estratégia. **Objetivo:** Analisar os efeitos de um programa de reabilitação fisioterapêutica na qualidade de vida, capacidade funcional, percepção de esforço, percepção da dor e força muscular, em indivíduos com a síndrome pós-COVID-19. **Métodos:** Trata-se de um estudo quase experimental, com 33 indivíduos, divididos em dois grupos: intervenção (GI) que recebeu um programa de reabilitação fisioterapêutica e controle (GC) que não recebeu. Os participantes foram avaliados antes e após o período de intervenção para força, por meio de dinamometria de preensão palmar; nível de dor, pela escala visual analógica; capacidade funcional, pelo teste de caminhada de seis minutos; percepção de esforço, através da escala modificada de BORG e qualidade de vida pelo instrumento SF-36. **Resultados:** Observou-se no GI aumento significativo ($p<0,05$) da qualidade de vida nos domínios de capacidade funcional, aspectos físicos e redução da dor e aumento da força de preensão palmar. Houve diferença significativa ($p<0,05$) entre os grupos para percepção de esforço nos momentos antes e após as intervenções. Para as demais variáveis não foram evidenciadas diferenças significativas. **Conclusão:** O programa de intervenção fisioterapêutica promoveu melhora dos domínios de capacidade funcional, aspectos físicos e da dor da qualidade de vida, e aumento da força de preensão palmar de indivíduos com sintomas da síndrome pós-COVID-19.

Palavras-chaves: Síndrome Pós-COVID-19 Aguda, Modalidades de Fisioterapia, Reabilitação

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Conflict of Interests
Nothing to declare

Submitted: August 08, 2023
Accepted: November 30, 2023

How to cite
Soares SRC, Mendonça TG, Siqueira MF, Silva T, Anjos TC, Alves RS, et al. The influence of a physiotherapeutic intervention program for patients with post-COVID-19 syndrome: a quasi-experimental study. Acta Fisiatr. 2023;30(4):232-239.

DOI: 10.11606/issn.23170190.v30i4a214740

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Instituto de Medicina Física e Reabilitação – HCFMUSP

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INTRODUCTION

December 2019 marks the beginning of the COVID-19 pandemic caused by the SARS-CoV-2 virus, which has overwhelmingly impacted humanity. The first case of hospitalization was recorded in China that same month, and since then, there has been a short interval between the first hospitalization and the first death. This pandemic resulted in a challenging scenario, with almost 768 million confirmed cases and 6.9 million deaths by July 10, 2023. In this context, an unexpected and little-known demand emerged, the Post-COVID-19 Syndrome, also known as Long Covid or post-acute Covid.[1-3]

A meta-analysis study investigated the long-term effects of COVID-19 in 47,910 patients and identified 55 significant post-COVID-19 sequelae, more distinctively fatigue (58%), headache (44%), attention deficit (27%), hair loss (25%), and dyspnea (24%). Furthermore, symptoms such as joint pain, anosmia, ageusia, chest discomfort, decreased respiratory capacity, fibrosis, and obsessive-compulsive disorder were observed.[4] These findings corroborate the epidemiological alert issued by the Pan American Health Organization (PAHO) in August 2020, which already documented the complications associated with COVID-19.[5,6]

The variety of symptoms in post-COVID-19 syndrome is a challenge for healthcare teams[2,4,7] and its heterogeneity requires a multidisciplinary and flexible approach involving collaboration between the different areas of healthcare at all levels for better diagnosis and treatment.[4,7-9]

COVID-19 causes successive cumulative injuries as the virus binds to the angiotensin-converting enzyme (ACE2), present in several tissues of the human body, causing a reduction in the cell surface, interfering with the renin-angiotensin-aldosterone system (RAAS) and deregulating blood pressure. This explains why reports of fatigue and decreased muscle and respiratory strength were not restricted to patients who developed the most severe form of the disease or who used intense corticosteroids but were also found among moderate and mild forms of the disease.[10-12]

The immune imbalance caused by the inflammatory cytokines bombarding the patient's muscles leads to muscle weakness. This condition worsens with immobility and rest, damaging not only the movements by the peripheral musculoskeletal regions but also the muscles of the internal organs, such as the diaphragm, myocardium, kidneys, and liver, also affecting the nervous system.[11,12] These losses were enhanced by immobility due to changes in lifestyle and social restrictions imposed by the policies to manage COVID-19 infection, which resulted in neuropsychiatric changes.[13,14] In this context, early treatment of the symptoms of post-COVID-19 syndrome prevents the worsening of health status, slows the progression of the cascade of complications and avoids the negative impact on functionality and quality of life.[15-17]

Given this perspective, considering the diversity and the impact on society and the health system the COVID-19 infection may cause, it is necessary to advance the research on post-COVID-19 syndrome, as there is still much to be understood about the possible treatments and their responses.[7] The World Health Organization (WHO) emphasizes the importance of individualized treatment addressed to each person's needs, considering the functional limitations and persistence of the symptoms.[5] Initially, the treatments were delivered to patients with post-intensive-care syndrome, but as the pandemic progressed, researchers noticed that even after the COVID-19 infections were extinguished, similar symptoms were still ongoing among patients regardless of the severity of the disease.[8] The society and the institutions were then instructed to implement recommendations by PAHO and WHO.[5,6] Post-COVID-19 Syndrome stimulated the development of low-cost techniques based on the available scientific evidence of pulmonary and cardiac rehabilitation and the population's education regarding safe behaviors to avoid the disease.[5,6]

Physiotherapeutic rehabilitation can improve functionality, lung function, and muscle strength, alleviating symptoms and preventing complications. Regarding the post-COVID-19 syndrome, the patients can be monitored at the ICU and regarding the continuation of the symptoms. Improving these conditions after a rehabilitation program contributes to the patient's quality of life recovery and the impact of rehabilitation, favoring health surveillance figures and reducing the negative impact on people's lives and economic conditions.[18-21]

OBJECTIVE

This study aimed to determine the influence of a physiotherapeutic program on the quality of life, functional capacity, perceived exertion and pain, and handgrip strength of individuals with post-COVID-19 syndrome.

METHODS

This study is a quasi-experimental, non-randomized controlled trial. This study was approved by the Research Ethics Committee of the University of Vale do Sapucaí (CAAE: 48774521.0.0000.5102), approval no.: 4,993,224 and complied with the ethical guidelines and standards of the Brazilian Nacional Health Council (CNS) ordinance 466/2012 and the Declaration of Helsinki (2000). This study was conducted between October 2021 and February 2022. The volunteers in this research signed the Informed Consent Form (ICF) before participating in the study.

The volunteers in this study were individuals of both sexes, admitted for post-COVID-19 rehabilitation services at the Outpatient Clinic III of the Samuel Libânio Clinical Hospital (Hospital das Clínicas Samuel Libânio – HCSL) in the city of Pouso Alegre, Minas Gerais State, Brazil.

A total of 33 individuals of both sexes with post-COVID-19 syndrome were included and conveniently allocated into two groups: the intervention group (IG, n= 23) and a control group (CG, n= 10). The IG consisted of patients admitted for conventional physiotherapeutic intervention in the Outpatient Clinic III rehabilitation service of HCSL. In contrast, the CG was formed by ten individuals waiting for physiotherapeutic care at HCSL during the same period. The IG received 10 to 40 physiotherapeutic treatment sessions according to the needs of each patient, and the CG did not receive any intervention.

Individuals aged 18 to 80 years, of both sexes, diagnosed with post-COVID-19 syndrome, hemodynamically stable, and regularly admitted to the rehabilitation facility of the Outpatient Clinic III of HCSL, and who had not yet received the first service met the inclusion criteria.

The authors excluded individuals who could not understand the assessment questionnaires and functional evaluations, who had dysfunctions that hindered the upper or lower limbs movements, unstable systemic blood pressure (above 190mmHg x 120mmHg) unstable angina, deep vein thrombosis without anticoagulant

drug treatment, diabetes mellitus and glycemic concentration above 300mg/dl, absolute contraindications for the six-minute walk test (6MWT), and who withdrew from treatment.

The researchers conducted the assessments in a different place from where the interventions were delivered. The patients' personal data were initially collected to compose the sociodemographic and clinical status. Then, blood pressure, oxygen saturation, and heart rate were recorded as the patient's vital signs. Before and after the physiotherapeutic rehabilitation program, all participants were assessed for strength with a handgrip dynamometer, functional capacity with the 6-minute walk test (6MWT), perceived exertion with the BORG scale, pain perception with the visual analog scale (VAS), and quality of life with the SF-36 questionnaire.

The SF36 questionnaire, applied to evaluate health changes, consists of 36 questions for assessing the quality of life. The questions are grouped and comprise the domains of physical functioning, physical role limitations, bodily pain, perception of general health, energy/vitality, social functioning, emotional role limitations, and mental health.[22]

The upper limb muscle strength assessment was conducted with a handgrip dynamometer. The participant was asked to sit with the elbow at 90º, with the shoulder positioned in adduction and neutral rotation, the forearm in half pronation, and the wrist neutral and able to move up to 30° of extension. The dynamometer was supported by the evaluator, and the patient had the arm suspended in the air with the hand positioned on the dynamometer. The subject received verbal encouragement to perform maximum muscular strength and grip the dynamometer. Three measurements were taken and the strongest grip was recorded in kilogram-force (Kgf).[17,23]

Functional capacity was determined by the 6MWT, following the guidelines of the American Thoracic Society, in which the participant walks back and forth on a 30-meter flat surface as quickly as possible, performing the maximum number of laps during six minutes.[24] The perceived exertion was measured using the Modified BORG Scale25, and pain perception was assessed with the Visual Analogue Scale (VAS).[26]

The intervention was conducted by physiotherapists from the physiotherapy service of Outpatient Clinic III of HCSL. They were aware of the objective of the study and applied conventional cardiopulmonary interventions according to an individualized kinesio-functional diagnosis. The cardiopulmonary rehabilitation program included respiratory training, strength activities with progressive loads, and education about the benefits of physical exercise.[7,9,10,18,27] The researchers did not participate at any time in the intervention, duration of care, and discharge criteria established by the physiotherapy service.

In the IG, the researchers carried out the evaluations before and after the physiotherapeutic rehabilitation program. Each individual underwent at least ten physiotherapeutic visits, and the physiotherapy team responsible party determined the duration of each visit and the discharge criteria. The discharge criteria considered the qualitative recovery of individuals regarding the relief of muscular and respiratory dysfunctions, the improvement of functional mobility, and the ability to prepare the patients for activities of daily living.[27,28] The CG was subjected to the same assessments but received no intervention. The first assessment was conducted when the patient sought the service and accepted the invitation to participate in the study. The second assessment happened eight weeks after the first baseline evaluation. The second assessment of the CG was defined according to the intervention period of the IG, as most visits were concluded between 5 and 8 weeks, agreeing with other studies that applied intervention protocols of 6 to 8 weeks.[7,28-30]

The interventions were based on cardiopulmonary rehabilitation. The exercise program respected individuality and followed a progression of loads according to the evolution of each individual's cardiac and blood pressure responses.[9,10]

Post-COVID-19 rehabilitation sessions were held twice a week, in groups, on alternate days, and lasted 60 minutes. Upon arrival, the physiotherapist assessed the patient's general condition and then exposed them to exercises. Initially, breathing was trained with the patient in a sitting position, and maximum inspirations and expirations were performed. Next, the patient trained lip break to extend the exhalation until the diaphragm was contracted. Afterward, stretching exercises for the upper limbs and trunk were performed.

The exercises to strengthen the lower limbs began with the support of a chair, and the patient trained in adduction and abduction of the legs, sit and stand, leg elevation, knee extension, sitting alternating elbow to knee movement, raising the left knee towards the chest height with the right elbow touching the left knee diagonally and vice versa. Also, the patients performed ankle rotation with the extended leg such that the foot would make a circular movement, concluding this part with alternating ankle dorsiflexion with stretched legs.

The upper limbs were strengthened in a standing or sitting position using a dumbbell or elastic band. The patients were trained to make barbell or dumbbell curls and lateral raises. With the help of the stick, patients exercised trunk rotation and shoulder flexion. Cycle ergometers, exercise bikes, and treadmills were used for aerobic conditioning. The exercises were generally performed in three sets of eight to twelve repetitions. At last, the patient recovered to their baseline conditions and their vital signs were measured again. The physiotherapists conducted the intervention and managed the progression of exercises and loads.

The statistical package for Social Sciences (SPSS® - IBM Corp., Chicago), version 20.0, was used for statistical analysis. The variables were analyzed with the intention-to-treat method. A descriptive analysis was conducted, obtaining the means, standard deviations, and confidence intervals. The Kolmogorov-Smirnov test was applied to determine the data normality for all datasets. The inter-group effect of the intervention was compared with the two-way analysis of variance (ANOVA) for repeated measures, followed by the sphericity Mauchly's test. In cases of sphericity violation, the Huyng-Feldt correction was applied. The Bonferroni post hoc test was used to compare inter and intragroup data. A significance level of 5% was set for comparison of all tests.

RESULTS

No participants dropped out during the research. Table 1 contains the sociodemographic characteristics of the participants. The groups were heterogeneous at baseline, however, they had similar post-COVID-19 complaints and symptoms. The CG was younger and had more individuals who practiced physical activity. In the IG, individuals demanded hospitalization and mechanical ventilation. Table 2 presents the results of the SF-36 questionnaire for each domain, functional capacity, perceived exertion, and pain intensity using the 6MWT, modified BORG scale, and VAS, respectively.

Table 1. Clinical and sociodemographic characteristics of participants

Variables		Control Group (n= 10)	Intervention Group (n= 23)
Sex - n (%)	Female	06 (60)	17 (74)
	Male	04 (40)	06 (26)
Age - n (%)	18 a 30	03 (30)	02 (09)
	31 a 40	02 (20)	02 (09)
	41 a 50	04 (40)	08 (35)
	51 a 60	01 (10)	04 (17)
	61 a 70	00 (00)	04 (17)
	71 a 80	00 (00)	03 (13)
Education - n (%)	Illiterate	00 (00)	00 (00)
	Primary school	01 (10)	04 (17)
	High-school	05 (50)	14 (61)
	Bachelor	04 (40)	05 (22)
Marital Status - n (%)	Single	06 (60)	06 (26)
	Married	03 (30)	11 (48)
	Divorced	00 (00)	06 (26)
	Widow(er)	01 (10)	00 (00)
Housing - n (%)	Rented	02 (20)	05 (22)
	Mortgage	02 (20)	01 (04)
	Own home	06 (60)	14 (61)
	Concession	00 (00)	03 (13)
Working - n (%)	Yes	10 (100)	15 (65)
	No	00 (00)	08 (35)
Family Income - n (%)	Up to 1 MW	02 (20)	05 (22)
	Up to 2 MW	00 (00)	07 (30)
	Up to 3 MW	06 (60)	06 (26)
	Above 3 MW	02 (20)	05 (22)
Smoking - n (%)	Yes	01 (10)	00 (00)
	No	09 (90)	23 (100)
Illegal substance use - n (%)	Yes	00 (00)	00 (00)
	No	10 (100)	23 (100)
Use of alcoholic drink - n (%)	Yes	09 (90)	08 (35)
	No	01 (10)	15 (65)
Practice of physical exercise - n (%)	Yes	07 (70)	06 (26)
	No	03 (30)	17 (74)
Balanced diet - n (%)	Yes	03 (30)	14 (61)
	No	07 (70)	09 (39)
Continuous use drugs - n (%)	Yes	05 (50)	13 (55)
	No	05 (50)	10 (45)
Hospitalization - n (%)	Yes	00 (00)	10 (43)
	No	10 (100)	13 (57)
Use of mechanical ventilation - n (%)	Yes	00 (00)	08 (35)
	No	00 (00)	15 (65)
Post-COVID-19 syndrome - n (%)	Fatigue	08 (80)	19 (83)
	Migraine	02 (20)	10 (43)
	Dyspnea	02 (20)	14 (60)
	Attention deficit	03 (30)	13 (56)
	Hair loss	03 (30)	12 (52)
	Arthralgia	02 (20)	16 (69)
	Anosmia	04 (40)	09 (39)
	Ageusia	03 (30)	06 (26)
	Muscle weakness	04 (40)	14 (60)
	Mental disorders	04 (40)	13 (56)
	Others	03 (30)	08 (35)
Number of sessions - n (%)	Ut to 10	00 (00)	10 (43.48)
	11 to 15	00 (00)	04 (17.40)
	16 to 20	00 (00)	06 (26.08)
	21 to 40	00 (00)	03 (13.04)

MW: minimal wage; n: sample size

Table 2. Comparative analysis of means and standard deviations (SD) of SF-36 domains, 6MWT, handgrip strength, Borg exertion perception, and pain intensity between Control and Intervention groups

Variables	Time frame	Control Group (GC) Mean± SD	Intervention Group (GI) Mean± SD	*p-value*		
				A*G	A	G
SF-36 Physical functioning	Before	85.00± 14.33	54.54±30.55[AB]	0.033	0.329	0.034
	After	81.00± 20.52	64.77±30.45			
SF-36 Physical Role Limitations	Before	60.00± 47.43	34.09±37.43[B]	0.736	0.046	0.131
	After	72.50± 41.58	50.00±47.60			
SF-36 Bodily Pain	Before	51.10± 25.63	50.77±23.81[B]	0.367	0.021	0.678
	After	66.70± 26.03	56.90±27.81			
SF-36 General Health	Before	57.10± 16.70	58.40±16.79	0.411	0.204	0.908
	After	62.30± 16.86	59.04±15.46			
SF-36 Energy/Vitality	Before	53.30± 14.91	50.23±19.36	0.176	0.501	0.911
	After	51.50± 19.30	56.13±15.11			
SF-36 Social Functioning	Before	53.75± 27.03	53.40±33.45	0.421	0.07	0.793
	After	68.90± 23.65	59.65±35.76			
SF-36 Emotional Role Limitations	Before	60.00± 34.43	39.39±40.68	0.911	0.139	0.188
	After	70.00± 36.75	50.00±45.71			
SF-36 Mental Health	Before	64.00± 17.59	53.09±22.32	0.251	0.251	0.334
	After	64.00± 14.60	60.72±23.28			
6MWT (m)	Before	349.80± 128.34	254.86±169.33	0.5	0.6	0.19
	After	348.10± 125.15	265.32±179.78			
Handgrip Strength (kgf)	Before	23.70± 9.23	21.68±8.49[B]	0.3	0.029	0.406
	After	26.40± 10.43	22.64±7.54			
BORG	Before	0.80± 0.89	2.50±1.94[A]	0.258	0.127	0.016
	After	0.70± 0.82	1.86±1.55[A]			
VAS	Before	0.20± 0.63	1.72±2.39	0.136	0.136	0.085
	After	40.20± 0.63	1.00±1.85			

*[A] p < 0.05 for intergroup comparison (CG vs. IG) of the same row; [B], p < 0.05 for intragroup comparison (before vs. after) in the same column; A*G, group interaction, such that A means Assessment and G means Group; kgf, kilogram-force; m, meters*

After the interventions, significant improvement in the domains of physical functioning, physical role limitations, and bodily pain were observed in the IG, as assessed by the SF-36. Additionally, there was an increase in handgrip strength. Nonetheless, no significant differences were found in the CG for the analyzed variables. Also, the IG significantly increased perceived exertion before and after the intervention compared to the CG. For the other variables, no significant differences were found.

DISCUSSION

Physiotherapy can shorten the time lived with persistent symptoms and restore the patient's quality of life,[18,19] and early physiotherapeutic follow-up can ensure that the symptoms of post-COVID-19 syndrome do not compromise the quality of life.[2] Studies emphasize that the action of physiotherapists may also include primary health care services and is not restricted to hospitalized patients.[16] Cardiorespiratory physiotherapy enhances the patient's recovery after a serious illness.[24,27-30]

The results of this study agree with the meta-analysis by Chen[11] which addressed the concern in identifying and quantifying patients with post-COVID-19 syndrome and reinforced the suggestions by Cacau et al.[28] about the demand to evaluate, quantify, reeducate, and develop a personalized physiotherapeutic intervention to shorten the time lived with persistent the post-COVID-19 syndrome symptoms and stop the cascade of complications. A significant gain in quality of life and increased handgrip strength were observed in the GI.

1A- Hip adduction and abduction; 1B- Trunk rotation; 1C- Shoulder flexion using stick; 1D- Sit and stand; 1E- Sitting alternating elbow to knee (flexion of hip and elbow); 1F- Shoulder abduction with elastic band resistance

Figure 1. Physiotherapeutic exercise routine delivered to the Intervention group

These results agree with the meta-analysis of 389 participants by Pouliopoulou et al.[29] who examined the effects of physical exercise on individuals with post-COVID-19 syndrome. Physiotherapy intervention has improved the quality of life and physical capacity of individuals with this condition. For functional capacity, no significant differences were found in this study, opposite to the findings of Pouliopoulou et al.[29] who showed that physical exercise improves the results of the 6MWT'. A larger sample size can advance the understanding of the results.

In our study, the CG presented higher averages than the IG at baseline, however, after the intervention, the IG had progression in handgrip strength, perceived exertion assessed with the Modified BORG Scale, and in the domains of physical functioning, physical role limitations, and bodily pain evaluated with the SF-36 quality of life assessment. Even though the CG had better baseline conditions regarding age, infection severity, hospitalization, and lack of mechanical ventilatory assistance during infection, the results evidenced a meaningful evolution of the IG after the physiotherapeutic intervention.

Regular exposure to physical exercise stimulates the body to promote cardiovascular and respiratory adaptations, such that oxygen consumption is adjusted to meet new demands, improving the general physical condition.[2,7,11,19,24,27,29] The results obtained among the participants of the IG regarding physical functioning, physical role limitations, and bodily pain assessed by the SF-36 agree with the current literature, as authors have demonstrated that supervised rehabilitation programs promote better results compared to unsupervised individual initiatives.[30]

From baseline to the end of the interventions, a significant difference was observed in bodily pain assessed by the SF-36, a domain with a critical impact on quality of life. Physical exercises and activities that protect the patients from immobility release natural opioids, such as endorphins, as well as non-opioids, such as norepinephrine, dopamine, and serotonin, which are all substances that inhibit and modulate pain.31 Physiotherapy intervention can also reduce chronic pain of several musculoskeletal origins, in addition to increasing muscle strength and reducing anxiety and depression symptoms. Pain is multidimensional, with differing origins, and is not limited to musculoskeletal disorders.[13,31]

After the intervention, the IG had increased handgrip strength compared to the baseline. Studies show that handgrip strength is an anthropometric measurement, an indication of physical fitness, and a health predictor. Its decrease is associated with sarcopenia, reduced mobility, aging, decreased physical strength, the presence of musculoskeletal disorders, and mortality.[12,23] Our results indicate that the rehabilitation provided an opportunity to prevent immobility in the GI. This immobility was imposed not only by the pre-existing lifestyle but also by social isolation, a social strategy adopted to stop the spread of the virus.[6,14]

In this study, perceived exertion was significant in the intergroup analysis. The therapeutic approach addressed individual needs and allowed the patient to exercise at the appropriate intensity so as not to be exposed to excessive load and, simultaneously, allow for load adjustments since the patients reported less exertion when performing the tasks while their body fitness adapted and evolved.[24,25,32,33] The improvement in the perceived exertion evaluated with the BORG scale is subjective, however, it was a vital parameter to dictate the pace and intensity of the activities the patients were proposed.[25]

The findings of our study suggest that a customized rehabilitation program that includes muscle strengthening and breathing, mobility, and relaxation exercises may promote well-being and improve quality of life. These programs may be considered natural agents that affect oxidative stress combat free radicals, and neutralize the effect of pro-inflammatory cytokines.[7,9,10,27,31,33] The personalization of such programs motivates and engages the patient during the rehabilitation process once they comprise realistic and achievable objectives that consider their limitations and disabilities.[16,29,33]

As the physiotherapeutic rehabilitation program discussed in this article is restricted to a regional service, it was difficult for individuals from the surrounding regions to access our facility. This issue imposed a limitation on our study. Furthermore, the sample size was small due to the difficulty in referring professionals and the small number of individuals seeking specialized services, causing the groups to be heterogeneous regarding hospitalization, need for ventilatory assistance, and age. Future studies should have a healthy control group, standardized interventions, and randomization of intervention groups to better understand the evolution of post-COVID-19 syndrome and treatments.

CONCLUSION

The personalized physiotherapeutic intervention program improved the SF-36 domains of physical functioning, physical role limitations, and bodily pain, as well as muscular strength measured with a handgrip dynamometer, without changing the levels of functional capacity in the 6-meter walk test, perception of pain, and exertion of patients with symptoms of post-COVID-19 syndrome.

ACKNOWLEDGMENTS

We thank God and acknowledge the participants who volunteered to join in the study, the University of Vale do Sapucaí (UNIVAS) and the Samuel Libânio Clinical Hospital (Hospital das Clínicas Samuel Libânio – HCSL) for allowing the physiotherapists to be followed up at the Outpatient Clinic III.

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