ORIGINAL ARTICLE

IMPACT OF TELE-REHABILITATION ON POST COVID-19 SYNDROME: A BRAZILIAN EXPERIENCE

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Highlight: (1) Tele-rehabilitation helped the pulmonary rehabilitation in post-COVID-19 syndrome. (2) Tele-rehabilitation improved the muscular strengthen in post-COVID-19 syndrome. (3) Tele-rehabilitation is a feasible, accessible and low-cost assistance alternative

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IMPACT OF TELE-REHABILITATION ON POST COVID-19 SYNDROME: A BRAZILIAN EXPERIENCE

ABSTRACT

Objective: The aim of this study was to report the effectiveness of the proposed tele-rehabilitation program to promote the respiratory rehabilitation and the functional recovery of people with post-COVID-19 syndrome. **Method:** 99 patients with COVID-19 sequelae participated in the tele-rehabilitation program, were shared in three groups: oxygen group (OG), COPD group (COPD-G), and general group (GG). The program lasted 12 sessions and included a protocol of respiratory exercises and muscle strengthening. Medical Research Council (MRC) and CR-10 Borg Scale were used to asses the patients at the beginning and at the end of the program, the oxygen saturation (SO2) and the heart rate (HR) were measured daily. **Result:** The patients had an increase of 5% in COPD-G ($p<0.001$) and 6% in OG/GG ($p<0.001$) for the SO_2. For the MRC scale, patients had an increase of at least one point in COPD-G ($p<0.001$) and two points in OG/GG ($p<0.001$). The BORG scale values had a decrease of at least 5 and 4 points in the scale in COPD-G ($p=0.003$) and OG/GG ($p<0.001$) wich indicates that the intervention benefited the both groups. There were no significant differences between the initial and the final assessments for HR. **Conclusion:** The tele-rehabilitation program helped the pulmonary rehabilitation and the functional recovery of people with post-COVID-19 syndrome, and it also improved the muscular strengthen, the effort perception to do the exercises and the oxygen saturation. This program arose as a feasible, accessible and low cost assistance alternative that could be used beyond the pandemic period.

Keywords: physical therapy, COVID-19, tele-rehabilitation, group exercises, rehabilitation

INTRODUCTION

The SARS CoV-2 (COVID-19) pandemic brought major challenges to patient care as well as an exponential increase in the health system demand[1].

The post-COVID-19 Syndrome or long COVID, whose definition is still absent in the literature, can have unfavorable consequences resulting from the hospitalization process, such as prolonged time on mechanical ventilation (MV), sedation, neuromuscular blockers, corticosteroids and immobility. Concomitantly, the extended bed rest contributes to muscle weakness, dysphagia, neuromyopathy, and impairments in walking[2]. Previous studies of severe acute respiratory syndrome (SARS) and H1N1 influenza showed that these physical

manifestations can be due to the prolonged need for intensive care, called post-intensive-care syndrome[3,4]. Studies of acute respiratory distress syndrome (ARDS) survivors related to SARS showed significant functional impairment, such as inability to walk, to climb stairs, to perform simple household chores, hands trembling, muscle weakness, dyspnea on minimal effort, as well as poor quality of life[5,6], even after six months from the hospital discharge.

Pulmonary fibrosis due to pneumonia is one of the main sequelae of post-COVID-19 syndrome, resulting in dyspnea and fatigue in more than 80% of patients. Cardiac and cardiovascular complications have been reported such as acute cardiac injury, myocarditis, vascular inflammation, and arrhythmic complications. Besides the muscular, neurologic, cardiac, and pulmonary sequelae, psychological impairments such as anxiety, fearfulness and depression[7] have also been observed, imposing limitations on patient´s daily activities and affecting their quality of life.

Since the outbreak of SARS-CoV-2 in Brazil in 2020 and 2021, the high number of COVID-19 survivors required rehabilitation, but the face-to-face medical attendance was suspended and/or limited. Given the health catastrophe that Brazil has experienced and due to high demanding of hospital beds, many patients were discharged from hospital even before recovering from COVID-19. Consequently, many of these patients returned home on oxygen therapy, and the telerehabilitation program was proposed to support the specific needs of these patients.

The tele-rehabilitation has been highly researched as a new option of treatment, and it involves the rehabilitation service by telecommunication networks and/or internet. It is also used to ensure the continuity in the treatment especially to the vulnerable people as well as the ones with difficulties to access health services[2,8].

The aim of this study was to report the effectiveness of the proposed telerehabilitation program to promote the respiratory rehabilitation and the functional recovery of people with post-COVID-19 syndrome.

METHODS

This observational and prospective study of tele-rehabilitation program to post-COVID-19 syndrome, with convenience sample, originated from an extension project of the physical therapy course of Pontifícia Universidade Católica de São Paulo, São Paulo, Brazil. The project was developed in 2021 with the purpose of treating patients with COVID-19 sequelae, specially those without any access to specialized health assistance post-COVID-19 and/or were waiting for care in health services.

The tele-rehabilitation program had two editions in 2021. The first one was in the beginning of April and the second in August. By an electronic form, 2,500 people in all the Brazilian national territory applied to take part in the project.

The patients were screened based on the complaints and severity criteria such as oxygen use, chronic obstructive pulmonary disease (COPD), dyspnea on minimal effort, more than 50% of lung involvement on computed tomography and neuromyopathy.

Other inclusion criteria adopted were to have a computer or cell phone with camera installed, internet access, oximeter, and the presence of another person in the residence during the sessions.

The patients with unstable vital signs, contraindications to exercise, high risk of fall, without conditions to maintain the sit posture, and visual, cognitive and hearing impairment were excluded. Therefore, 120 patients were eligible to the program, and 99 concluded all the sessions, completing the entire tele-rehabilitation program (figure 1).

The study was approved by the Ethics Committee of Research of the Pontifícia Universidade Católica de São Paulo (research number: 50879921.8.0000.5482) and all the participants read and agreed to the informed consent form.

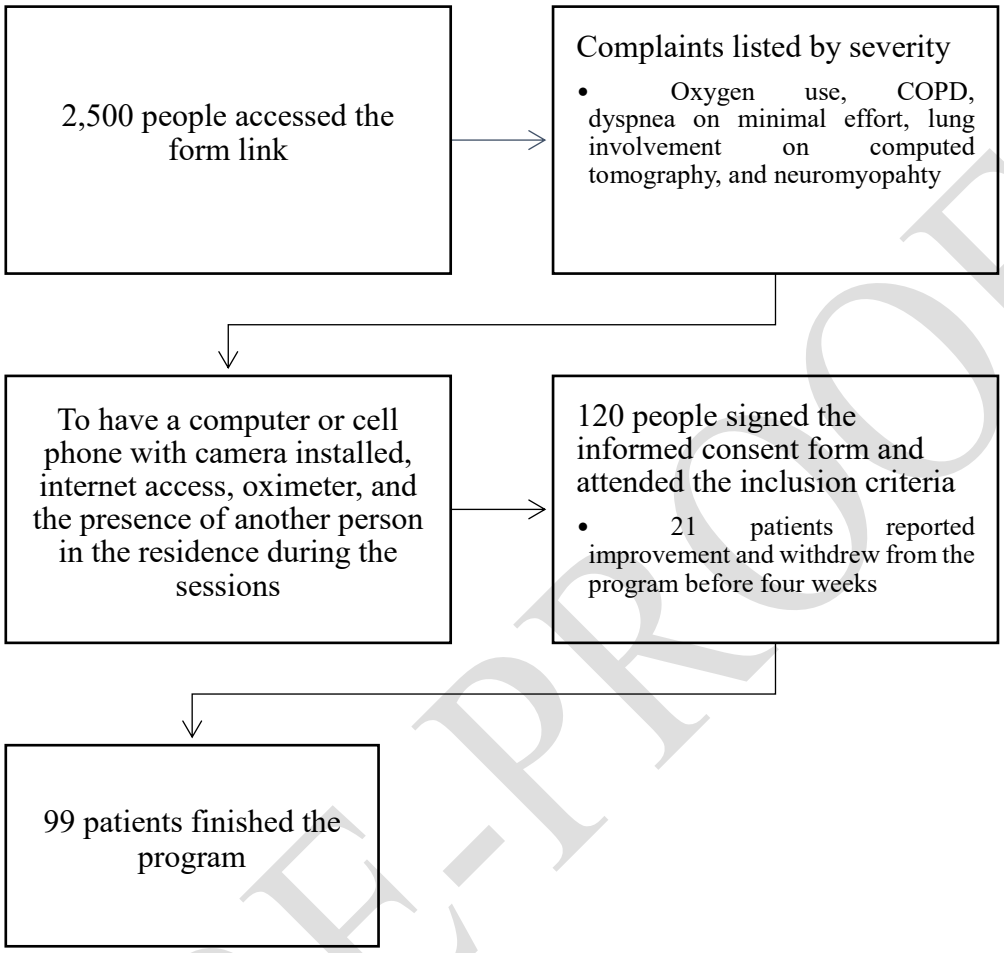
The study adopted a free digital plataform in-group tele-rehabilitation program as an option to reach a higher number of patients and to allow social interaction to help the patients with their functional goals[9].

The participants were shared in three groups according to the use of oxygen – oxygen group (OG), presence of COPD – COPD group (COPD-G), and other complaints – general group (GG).

The tele-rehabilitation program included therapeutic exercises with the objective of improving respiratory muscle strength, lung expansibility, gas exchange effectiveness, oxygenation, exertion tolerance, autonomy, and well-being. The program lasted four weeks, with three weekly sessions of 45 to 50 minutes; and exercises were assigned when there were no video sessions. The exercises recommended for the unsupervised days were consistent with the difficulties presented by the patients during the session and, therefore, were individually guided and without monitoring regarding adherence. All the meetings were synchronous, scheduled with the maximum of four patients each of the same group (OG, COPD-G or GG), and supervised by a physiotherapist.

The patients belonging to the OG and GG groups performed the same protocol of respiratory exercises whereas the COPD-G group performed an adapted protocol (charts 1 and 2). The weekly protocol for muscle strengthen was the same for the three groups (chart 3). The respiratory and motor functions were reinforced gradually in progression started at the 7th session, considering the increase of load and number of repetitions to promote the muscular and respiratory strengthen and endurance. The exercises progressions considered each participant´s health conditions and abilities.

Figure 1- Flowchart of the participants included in the study.



Source: study data.

Chart 1 - Respiratory exercises of OG and GG performed in three weekly sessions.

Exercises	Repetitions
1. Maximal sustained inspiration (2") (for external intercostal muscles)	2 sets of 5 repetitions of each exercise
2. Maximal sustained inspiration (2") (with diaphragmatic proprioception)	
3. Inspiration repeated 3 times (for external intercostal muscles), with shoulder flexing	
4. Inspiration repeated 3 times (with diaphragmatic proprioception)	
5. Maximum inspiration with contralateral flow direction (with compression on the right side)	
6. Maximum inspiration with contralateral flow direction (with compression on the left side)	
7. Compression in the lateral chest during the expiration, followed by maximal inspiration and quickly decompression in the end of inspiration	
From 7th session, the exercises 5 and 6 will be changed for:	From 7th session – 2 sets of 8 repetitions
- maximal sustained inspiration (2") against resistance in the superior area of the chest (for external intercostal muscles)	
- maximal sustained inspiration (2") against resistance in the diaphragmatic area	

Chart 2 – Respiratory exercises of COPD-G performed in three weekly sessions.

Exercises	Repetitions
1. Maximal sustained inspiration (2") (for external intercostal muscles)	2 sets of 5 repetitions for each exercise
2. Maximal sustained inspiration (2") (with diaphragmatic proprioception)	
3. Inspiration repeated 3 times (for external intercostal muscles), with shoulder flexion (flexing)	
4. Inspiration repeated 3 times (with diaphragmatic proprioception)	
Perform the prolonged expiration with lip frenum in the exercises with sustained inspirations or inspirations in repetition	
5. Inspirations and expirations with lip frenum – prolonged expirations	5 repetitions
	From 7th session – 2 sets of 8 repetitions for exercises number 1 to 4

Chart 3 – Muscular strengthening exercises performed weekly.

Exercises	Repetitions
1. To sit and stand on a chair with crossed arms over the chest	2 sets of 5 and/or 8 and/or 10 repetitions; From the 7th session: 3 sets of 5 and/or 8 and/or 10 repetitions;
2. In an upright position, hold the chair, flex both ankles and extend both ankles. Or, sitting in a chair with the hands on the knees, flex both ankles and extend both ankles	2 sets of 20 repetitions; From the 3th week: 2 to 3 sets of 30 repetitions;
3. In a sitting position, to perform hip flexing with one leg and then the other	10 repetitions for each leg From the 7th session: 12 to 15 repetitions
4. While supporting the body by one hand on the chair, squat at the knees	5 to 10 repetitions for each leg
5. Shoulder flexing with a broomstick	10 repetitions; From the 7th session: 12 to 15 repetitions and/or adding a weight in each hand
6. Elbow and shoulder flexing with elbow extension, keeping the forearms prone with a broomstick	10 repetitions; From the 7th session: 12 to 15 repetitions and/or adding a weight in each hand

The participants were assessed both at the beginning and at the end of the program, and in each session, through Medical Research Council (MRC) scale for muscle strength and CR-10 Borg Scale for dyspnea and saturation level. The participants rated their perceived exertion and dyspnea before and after the exercises in a scale of 0 to 10 (with 0 = "more comfortable" and 10 = "less comfortable") on a specially daily control form. This strategy allowed the daily monitoring of the exercise performance and the monitoring of the participants´ development. The CR-10 Borg Scale was used to assess the perceived exertion during the exercise, and it has been a useful tool to measure the cardiorespiratory function in patients in rehabilitation programs[10]. The MRC Scale quantifies the muscle strengthen during all the range of motion based on a 0 to 5 rating scale (with 0 = "without muscle contraction" and 5 = "to perform the movement against a maximal resistance")[11]. To apply the MRC scale, the patient was asked to

perform the guided movements, and the execution was observed using the video image. The oxygen saturation (SpO_2) and the heart rate (HR) were measured before, during, and after the exercises by oximetry. The lung involvement was calculated from computed tomography (CT) considering "<25%", "25%-50%", "50-70", and ">70%" to classify the grade of lung involvement.

STATISTICAL ANALYSIS

The data of 99 patients after 12 sessions of the tele-rehabilitation program were analyzed and the OG and GG groups data were analyzed together and compared to the COPD-G.

The sex, age, comorbidities, persistent symptoms, lung involvement, and data about hospital admission were checked using descriptive statistics. We used the Chi-square and the Fisher´s exact tests to assess the association of the qualitative variables between the two groups. Depending on the normal distribution of the data, Student *t* test to independent samples or non-parametric Mann-Whitney test were used to assess the association of the quantitative variables between the groups.

According to the normal distribution of the data, the Student t-paired test or non-parametric Wilcoxon test were used to compare the initial and final outcomes (CR-10 BORG, MRC, HR, SPO_2) for each group. The level of statistical significance was set at 5%. The statistical analysis used the R free software version 4.0.2 (www.r-project.org).

RESULTS

Sample characterization

Table 1 shows the total demographic and clinical characteristics of the patients in the sample and in the subgroups COPD-G and OG/GG.

The total sample was composed of women in majority (55%), and the average age of the patients was 56 years old. Most patients did not have comorbidities (55%), and those whose have comorbidity, the most one was systemic arterial hypertension (SAH) (33%). There was no difference between COPD-G and OG/GG groups in relation to sex, age, and comorbidities.

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Table 1: Demographic and clinical characteristics of the patients according to the groups: distribution of frequency (n and %) and average, standard deviation, median, first (Q1) and third (Q3) quartiles.

	Group			
Variable	**COPD-G**	**OG/GG**	**Total**	**P**
Sex				0.080
Female	15 (71.4)	39 (50)	54 (54.5)	
Male	6 (28.6)	39 (50)	45 (45.5)	
Age				0.934
average (sd)	56 (13)	56 (13)	56 (13)	
median (Q1-Q3)	57 (47-65)	56.5 (48-64)	57 (48-65)	
Comorbities[1]				0.209
No	14 (66.7)	40 (51.3)	54 (54.5)	
Yes	7 (33.3)	38 (48.7)	45 (45.5)	
Obesity				0.426
No	21 (100)	72 (92.3)	93 (93.9)	
Yes	0 (0)	6 (7.7)	6 (6.1)	
SAH				1.000
No	14 (66.7)	52 (66.7)	66 (66.7)	
Yes	7 (33.3)	26 (33.3)	33 (33.3)	
DM				0.061
Não	20 (95.2)	57 (73.1)	77 (77.8)	
Sim	1 (4.8)	21 (26.9)	22 (22.2)	

sd: standard deviation; Q1: first quartile; Q3: third quartile; [1]DM: *diabetes mellitus*, Systemic Arterial Hypertension (SAH) and/or Obesity

Table 2 shows the distribution of frequencies of persistent symptoms reported by patients in the sample as a whole and of those in the subgroups COPD-G and OG/GG.

The persistent symptoms often reported by the patients after the COVID-19 diagnosis were dyspnea (71%), cough (38%), pain (37%), fatigue (36%), sensibility/pain/weakness in the limbs (21%), orthopnea (12%), and loss of smell/taste (7%). In comparison between the two groups, there were more patients with dyspnea in COPD-G (95% *vs.* 64%, p=0.005). No statistical differences were found to other persistent symptoms.

Table 2: Distribution of frequency (n and %) of persistent symptoms reported by patients according to the groups.

	Group			
Variable	**COPD-G**	**OG/GG**	**Total**	**P**
Dyspnea				**0.005**
No	1 (4.8)	28 (35.9)	29 (29.3)	
Yes	20 (95.2)	50 (64.1)	70 (70.7)	
Fatigue				0.853
No	13 (61.9)	50 (64.1)	63 (63.6)	
Yes	8 (38.1)	28 (35.9)	36 (36.4)	
Loss of smell/taste				0.988
No	19 (90.5)	73 (93.6)	92 (92.9)	
Yes	2 (9.5)	5 (6.4)	7 (7.1)	
Cough				0.976
No	13 (61.9)	48 (61.5)	61 (61.6)	
Yes	8 (38.1)	30 (38.5)	38 (38.4)	
Sensibility				0.566
No	18 (85.7)	60 (76.9)	78 (78.8)	
Yes	3 (14.3)	18 (23.1)	21 (21.2)	
Orthopnea				0.472
No	17 (81)	70 (89.7)	87 (87.9)	
Yes	4 (19)	8 (10.3)	12 (12.1)	
Pain				0.274
No	11 (52.4)	51 (65.4)	62 (62.6)	
Yes	10 (47.6)	27 (34.6)	37 (37.4)	

sd: standard deviation; Q1: first quartile; Q3: third quartile

Table 3 shows the data of the hospitalar admission in the sample as a whole and in the subgroups.

In the total data from the research sample, 54% of patients had lung involvement equal or higher than 50%. Most participants were not admitted to the intensive care unit (ICU) (61%).

For those who were admitted, the average time of admission was 24 days. 58% of the patients admitted to the ICU were on average intubated for 15 days. 56% reported to be admitted to the nursery for 15 days on average. 78% of patients received oxygen supplementation during the hospital admission and 17% remained with oxygen supplementation at home. When compared COPD-G to OG/GG, the OG/GG had more patients admitted to the ICU (14% *vs.* 46%, p=0.009) and more patients who required oxygen supplementation during hospital admission (57% *vs.* 83%, p = 0.026).

Table 3: Characteristics of hospital admission according to the groups: distribution of frequency (n and %) and average, standard deviation, median, first (Q1) and third (Q3) quartiles.

	Group			
Variable	**COPD-G**	**OG/GG**	**Total**	**P**
Lung involvement				0.065
<25%	8 (38.1)	16 (20.8)	24 (24.5)	
25-50%	7 (33.3)	14 (18.2)	21 (21.4)	
50-70%	4 (19)	25 (32.5)	29 (29.6)	
>70%	2 (9.5)	22 (28.6)	24 (24.5)	
Total	21 (100)	77 (100)	98 (100)	
ICU				**0.009**
No	18 (85.7)	40 (54.1)	58 (61.1)	
Yes	3 (14.3)	34 (45.9)	37 (38.9)	
Total	21 (100)	74 (100)	95 (100)	
Time of ICU (days)				0.697
average (sd)	17 (10)	25 (23)	24 (22)	
median (Q1-Q3)	20 (12.5-22.5)	18.5 (12-29)	20 (12-26)	
Total	3	34	37	
OTI				0.99
No	1 (33.3)	16 (43.2)	17 (42.5)	
Yes	2 (66.7)	21 (56.8)	23 (57.5)	
Total	3 (100)	37 (100)	40 (100)	
Time of OTI (days)				0.510
average (sd)	9 (9)	16 (18)	15 (12)	
median (Q1-Q3)	9 (7-11)	12 (6-15)	12 (6-15)	
Total	2	21	23	
Nursery				0.567
No	10 (50)	33 (42.9)	43 (44.3)	
Yes	10 (50)	44 (57.1)	54 (55.7)	
Total	20 (100)	77 (100)	97 (100)	
Time of Nursery (days)				0.141

average (sd)	11 (8)	16 (18)	15 (16)	
median (Q1-Q3)	7.5 (7-13.5)	14.5 (9-20)	13.5 (7-20)	
Total	10	44	54	
Hospital O_2				**0.026**
No	9 (42.9)	13 (16.9)	22 (22.4)	
Yes	12 (57.1)	64 (83.1)	76 (77.6)	
Total	21 (100)	77 (100)	98 (100)	
Home O_2				0.945
No	18 (85.7)	64 (82.1)	82 (82.8)	
Yes	3 (14.3)	14 (17.9)	17 (17.2)	
Total	21 (100)	78 (100)	99 (100)	

sd: standard deviation; Q1: first quartile; Q3: third quartile; OTI: orotracheal intubation, ICU: intensive care unit; O_2: oxygen; hospital O_2: oxygen supplementation at hospital admission; home O_2: oxygen supplementation at home

SpO_2, HR, BORG and MRC scales: comparison between the initial and the final assessments

Table 4 shows the initial and final assessments data of SO_2, HR, and BORG and MRC scales.

In both groups, the values of final assessment of SO_2 and MRC were significantly higher than the initial value, which indicates that the tele-rehabilitation program improved the oxygenation and muscle strengthen. For the SO_2, half of patients had an increase of 5% in COPD-G ($p<0.001$) and 6% in OG/GG ($p<0.001$). For the MRC scale, half of patients had an increase of at least one point in COPD-G ($p<0.001$) and two points in OG/GG ($p<0.001$).

For the BORG scale, in both groups, the final assessment was significantly lower than the initial, which indicates that the tele-rehabilitation program decreased the effort to perform the proposed exercises. Half of patients had a decrease of at least 5 and 4 points in the scale in COPD-G ($p=0.003$) and OG/GG ($p<0.001$), respectively.

There were no significant differences between the values of the initial and the final assessments for HR.

Table 4 – Comparison between the initial and final assessments in each group for SO_2, HR, BORG and MRC scales.

Variable	Group	Assessment	N	Average	sd	Q1	Median	Q3	P
SO2	**COPD-G**	**Initial**	21	91.95	2.46	91	93	93	**<0.001**
		Final	21	97.48	1.17	97	98	98	
		(initial - final)	21	5.52	2.60	4	5	7	
	GO/GG	**Initial**	78	91.09	2.09	90	91	93	**<0.001**
		Final	78	97.22	1.37	96	97	98	
		(initial - final)	78	6.13	2.34	5	6	8	
BORG	**COPD-G**	**Initial**	21	5.71	2.19	5	6	7	**<0.001**
		Final	21	1.05	1.43	0	1	2	
		(Initial - final)	21	-4.67	1.91	-6	-5	-3	
	OG/GG	**Initial**	78	5.17	1.94	4	5	6	**<0.001**
		Final	76	0.95	1.36	0	0	2	
		(initial - final)	76	-4.24	1.85	-5	-4	-3	
HR	**COPD-G**	**Initial**	21	82.76	12.85	74	80	91	0.563
		Final	20	77.85	10.97	69.5	80	85.25	
		(initial - final)	20	-4.25	15.80	-11.5	0.5	6	
	OG/GG	**Initial**	77	86.69	13.26	76	86	96	0.296
		Final	73	84.71	13.19	74	84	93	
		(initial - final)	73	-2.18	14.54	-11	-1	7	
MRC	**COPD-G**	**Initial**	20	54.20	7.03	50.75	57.5	60	**0.004**
		Final	20	58.15	5.55	60	60	60	
		(initial - final)	20	3.95	5.62	0	1	5.75	
	OG/GG	**Initial**	76	55.49	5.61	54	58	60	**<0.001**
		Final	74	59.24	1.90	60	60	60	
		(initial - final)	74	3.32	4.67	0	1.5	5	

sd: standard deviation; Q1: first quartile; Q3: third quartile

SO_2, HR, and BORG and MRC scales: comparison between COPD-G and OG/GG

For the SO_2, compared to the initial assessment, half of patients had an improvement of 5% and 7% in the COPD-G and OG/GG, respectively. However, regarding oxygen saturation, the benefit of the physiotherapeutic intervention was the same in the both groups (p=0.342).

For the MRC scale, there was an increase of at least 1.83% and 1.89% in muscle strengthen in the COPD-G and OG/GG in half of patients, and the physiotherapy benefited both groups muscle strengthen (p=0.942).

For the CR-10 BORG scale, there was a decrease of at least 86% and 100% in the effort perception to do exercises in the COPD-G and OG/GG in half of patients. The benefit of the tele-rehabilitation program was the same in both groups (p=0.287).

For the HR, there was no improvement between the groups after the physiotherapy intervention (p=0.881).

DISCUSSION

The literature is scarce about evidence of the feasibility and the efficacy of the tele-rehabilitation programs. However, studies published during the COVID-19 pandemic point out the tele-rehabilitation is better than no rehabilitation[8]. The results of this study support that the telerehabilitation program is feasible and can be a good option of treatment for patients with post-COVID-19 syndrome.

In this study, the results showed that the tele-rehabilitation program can benefit patients with post-COVID syndrome, and they were similar to the cardiopulmonary telerehabilitation results programs for post-COVID-19[8,12].

In this study, the most common comorbidities were SAH, DM, and obesity. The COPD was not associated to the other pre-existing comorbidities as the COPD patients had priority to participate in the program. The Chinese communications pointed out that severe cases and mortality were related to advanced age, SAH, DM, and cardiovascular diseases [13,14]. A meta-analysis including eight studies and 46,248 patients affirmed that SAH increased the risk of developing severe forms of COVID-19 more than twice[15]. Other study with 1,591 patients admitted in ICU showed that SAH (49%) and cardiovascular diseases (21%) were the more often comorbidities than cancer (8%) and COPD (4%)[16]. Whereas the patients with SAH were the eldest, the average age of patients in this study was 56 years old[16].

Dyspnea was a persistent symptom present in 76% of the sample and had a significant improvement at the end of the twelve sessions, demonstrating that the intervention promoted considerable improvement in this index assessed by BORG scale for both COPD-G and OG/GG groups (<0.001). Not only the SO_2 had an important increase at the end of the program (< 0.001), but also the indices of the MRC scale (< 0.001 OG/GG and < 0.004 COPD-G). The respiratory exercises proposed focused on the activation of inspiratory muscles and lung

expansibility, improving the performance of the inspiratory muscles and decreasing the dyspnea severity resulting in a better tolerance for daily demands. Respecting the individuality of each patient, general muscle strengthening exercises were assigned for group, and during the sessions the patients who showed improvement left the program and returned to their daily routine.

Gustavson et al[9] described the practical considerations for adapting in-person group rehabilitation to group tele-rehabilitation and highlighted that the outcomes assessment deserved adjusts. The authors pointed out that many tools of measurement were not validated to virtually administration and required a careful choice and application. For this tele-rehabilitation program, the CR-10 BORG and the MCR scales were virtually adapted and got the necessary parameters to follow up the patients.

Although there was not a guideline to assess post-COVID-19 patients in telerehabilitation programs, many studies used questionnaires to assess quality of life, depression and anxiety symptoms, as well the sit-to-stand test, CR-10 BORG and MRC scales, and analogic visual scale to fatigue. Some studies, in an in-person assessment, included a pulmonary functional test and the respiratory muscle strengthening assessment by manovacuometry[17,18].

The outcomes in tele-rehabilitation programs to post-COVID-19 patients can differ due to hospitalization or not and admission or not to the ICU. The literature pointed out the necessity to analyze these different conditions to verify the effects of tele-rehabilitation in more severe cases[18].

In this study, the type of hospital admission was considered to characterize the sample. The OG/GG group showed there were more patients admitted to the ICU when compared to COPD-G. Although more than half of patients had lung involvement higher or equal to 50%, there were no differences between the groups for the degree of lung involvement observed in CT image. The positive effect of tele-rehabilitation in relation to dyspnea, saturation and muscle strengthening did not differ between the COPD-G and OG/GG. Although this outcome needs better understanding, it indicates that the tele-rehabilitation program is a good option for severe cases.

The number of sessions and the weekly frequency of the present study were similar to others for tele-rehabilitation program for post-COVID-19 patients. The individual tele-rehabilitation study by video call treated 50 post-COVID-19 patients during 24 sessions and the assessment was at the beginning, at 12th session and at the end of the program. The parameters assessed had significant improvement at the 12th session and it remained constant until the end of the program[19]. In the present study, the 12 proposed sessions showed positive impacts in the patients' recovery.

However, the patients´ interest in continuing the program reinforces the need to establish a therapeutic follow-up to ensure the effective performance of their daily activities to keep their health condition and quality of life.

Seron et al[8], in a systematic review, summarized the scientific evidence about tele-rehabilitation in physiotherapy and highlighted one study with low methodological bias in which the pulmonary telerehabilitation had similar results to the in-person rehabilitation in relation to the improvement of dyspnea in patients with COPD.

The decision of this study to use a synchronous intervention in a telerehabilitation in-group was assertive. The use of a web plataform allowing videoconference provided some advantages such as the possibility of the patients to perform the exercises with supervision, and to promote a positive dynamic of the group and a meeting point during the social isolating[9]. However, evidence about the tele-rehabilitation is scarce and the researches are about applications with messages and calls.

The in-group intervention is an effective practice evidenced in other studies[20,21] and, in this study, it was used to motivate the patients. The in-group intervention allowed the patients to exchange experiences towards the difficulties to do the exercises. All the meetings started with questions about the weekly occurrences and the professionals or the groups´ colleagues helped by reporting their own experiences. This procedure was a strategy used to increase the adherence to the program. The integration with the physiotherapists promoted the discussion of the symptoms among the patients during the program. This fact contributed to the better understanding of both muscle and respiratory conditioning and the in-group intervention.

The synchronous form of the program with the integration of the physiotherapists allowed the discussion of each question or situation, which was present during the program.

This fact contributed to the better understanding of both muscle and respiratory conditioning and the in-group intervention.

The average age of the participants (56 years old) might have collaborated for the tele-rehabilitation program interaction. Elderly people have shown more difficult to interact with new technologies, what may cause a negative impact in the results of this option of rehabilitation[12]. For this reason, this information is valuable when developing strategies to implement the tele-rehabilitation program for the elderly group.

The absence of technological devices or difficulty in accessing the internet was another challenge imposed on the tele-rehabilitation program[12]. These facts impacted the access to the tele-rehabilitation program by some participants, not to mention other exclusion criteria, such as do not have an oximeter and another person in the residence during the sessions. These factors excluded people at a socioeconomic disadvantage, making it impossible for them to participate in this program. This situation directly affects the health conditions and health-related quality of life of people in disadvantaged and vulnerable social classes.

Within the limitations of this study, we emphasized the absence of the control group and the follow-up after the end of the tele-rehabilitation program to verify if the improvements remained. It is important to consider that this tele-rehabilitation program emerged from the social need to serve the population, and without a control group, in which patients would not be attended. There was also urgency in developing the study due to the lack of research available on the theme. Recently, some researchers have been conducting and publishing some clinical randomizing trials about tele-rehabilitation, which will provide better results with scientific evidence[22]. Another limitation of this study was that we did not consider socioeconomic variables, such as income, education, occupation, and racial groups.

To conclude, it is worth highlighting that due to the impossibility of applying other assessment methods, the effective register of positive results presented in this study can be questioned by some readers. However, the intention of the authors is to motivate other researchers to reflect on in-group intervention studies and about the tele-rehabilitation in patients with post-COVID-19 persistent symptoms, which studies are scarce.

CONCLUSION

The tele-rehabilitation program helped the pulmonary rehabilitation and the functional recovery of people with post-COVID-19 syndrome, and it also improved the muscular strengthen, the effort perception to do the exercises and the oxygen saturation.

The telerehabilitation program in-group arose as a feasible, accessible and low-cost assistance alternative that could be used beyond the pandemic period.

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IMPACT OF TELE-REHABILITATION ON POST COVID-19 SYNDROME: A BRAZILIAN EXPERIENCE

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