

The Influence and Feasibility of Therapeutic Exercise Videos at Home on the Functional Status of Post-COVID-19 Hospitalization

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Abstract

The COVID-19 pandemic pushed physicians to modify conventional practices to reduce the exposure and risk of infection among patients and health workers. Telemedicine is one of the safest methods, and telerehabilitation could prevent the sequelae of COVID-19. A quasi-experimental study with randomized sampling without masking/blinding was conducted. The study was conducted from August 2021 to March 2022 at Hospital A in Pekanbaru, Hospital B in Jayapura, and Hospital C in Jakarta, Indonesia. A total of 27 patients were recruited and divided into control and intervention groups. The control group was given conventional education on therapeutic exercise at home, while the intervention group was shown educational videos about therapeutic exercise at home. The comparison of all functional outcomes between the two groups after the intervention showed a significant difference. The intervention group improved more than the control group, except for the fatigue severity scale. Most of the responses showed that this video was feasible and useful and did not need to be supervised by health workers. Therapeutic exercise educational videos can be an option to deliver rehabilitation programs for post-COVID-19 hospitalized patients.

Keywords: educational video, post-COVID-19, rehabilitation, telerehabilitation, therapeutic exercise

Introduction

The coronavirus disease (COVID-19) is a highly contagious lung infectious disease, so much so that the World Health Organization (WHO) declared the spread of this disease as a pandemic in March 2020. It affects multiple systemic conditions, and some of its effects are long-lasting.¹ One of the most common symptoms is deconditioning the respiratory, cardiovascular, musculoskeletal, and psychological systems, ultimately reducing functional capacity.²

A functional capacity evaluation (FCE) systematically measures a person's ability to perform work activities safely.³ The six-minute walk test (6MWT) is one of the simplest FCEs. This activity measures the walking distance on a flat, hard surface in six minutes, assesses the distance traveled for six minutes, and describes the response of the cardiopulmonary and musculoskeletal systems involved during the exercise. Furthermore, functional capacity can be assessed using a sit-to-stand test to assess lower endurance and mobilization ability if the person cannot accomplish the 6MWT.⁴

During the pandemic, there were several adaptations in the provision of medical providers (e.g., personal protective equipment, education materials via social media platforms, and negative pressure isolation rooms). Telerehabilitation provides rehabilitation and habilitation services through information and communication technology.^{5,6} This study aimed to determine the effect and feasibility of providing therapeutic exercise educational videos on functional capacity in post-COVID-19 hospitalization. These findings will support the home program of telerehabilitation for post-COVID-19 patients.

Method

This study was a multicenter quasi-experimental pilot study with consecutive sampling without masking/blinding to analyze the effect of educational videos on therapeutic exercises on the functional status of the subjects after COVID-19 hospitalization. The outcomes were measured by physical medicine and rehabilitation specialists using the 6MWT, oxygen saturation, the Borg scale, the 30-second sit-to-stand test (30s STS), the fa-

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Received : June 22, 2023
Accepted : July 22, 2023
Published : July 31, 2023

tigue severity scale (FSS), and the Barthel index upon discharge and after seven days of intervention. The study was conducted from August 2021 to March 2022 at Hospital A in Pekanbaru, Hospital B in Jayapura, and Hospital C in Jakarta.

In this study, the subjects were divided into two groups, consisting of the intervention and control groups. The sampling method was consecutive sampling with the inclusion criteria of aged ≥ 18 years, discharged after moderate to severe COVID-19 hospitalization, and able to walk, as well as the exclusion criteria of not consenting to the study, having a mental or physical disability that hindered mobilization, musculoskeletal pain, severe cardiovascular or neurological problems, and pregnancy.

The control group was given conventional educational therapy only (without videos) about therapeutic exercises that can be done at home. The intervention group was given educational therapy using a video that can be watched on a smartphone about therapeutic exercises that can be done at home. The exercise frequency was 2–3 times a day with 5–10 repetitions for each movement. Both groups were given the same exercise prescription.

Three levels of exercise can be done based on the participants' functional level. Level 1 was given to those who could not perform the 30s STS, level 2 was for those who could perform the 30s STS but had below-average results, and level 3 was for those who could perform the 30s STS with average results based on age. All the participants were asked to do the therapeutic exercise at home and fill in the logbook form to monitor their compliance. The logbook consisted of the day of the exercise and vital signs before and after the exercise (blood pressure, heart rate, and oxygen saturation).

The functional status was measured upon discharge and seven days after discharge using the following methods:

- The 6MWT is a submaximal cardiopulmonary functional testing modality. It measures the distance an individual can walk as fast as possible, in six minutes, on a 100-foot (30 meters) flat surface.⁷
- Oxygen saturation is a measure of how much hemoglobin is currently bound to oxygen compared to the amount of unbound hemoglobin, presented in percentage (%).⁸
- The Borg scale is a self-reported measure to select perceived exertion and dyspnea ratings. The perceived exertion rate ranges from 6 to 20, with a higher scale indicating more vigorous activity. The dyspnea rating is on a scale of 0 to 10, with a higher scale indicating severe shortness of breath.^{9,10}
- The 30s STS examines the ability of an individual to stand up from a sitting position repeatedly in 30 seconds. It is a simple tool to investigate lower limb strength and functionality.¹¹

- The FSS is a tool to measure the impact of fatigue on an individual. It consists of nine questions, with total scores ranging from 9 to 63, and the cutoff score of 36 indicates that the individual is suffering from fatigue.¹²
- The Barthel index is an ordinal scale that measures functional independence regarding personal care and mobility. It consists of 10 items, with scores ranging from 0 to 100 (a higher score means greater independence).¹³

Additionally, the feasibility of this educational therapy method using a video was evaluated using a questionnaire filled out only by the intervention group. The questionnaire is a technology acceptance model (TAM) questionnaire with a convergent validity value measured by AVE (average variance extracted) = 0.7.

All statistical analyses were conducted using the free version of IBM SPSS 22.0 (IBM Corp., Armonk, NY, USA). Univariate analysis was used to describe the participants' characteristics and all variables. The 6MWT was measured in meters, the 30s STS in times, and the FSS and Barthel index by their scores. A paired t-test was used to compare the value for normally distributed data. Alternatively, the Wilcoxon test was used. The data is presented in mean \pm SD or confidence interval (CI) 95%, with a p-value <0.05 considered significant.

Result

A total of 27 participants were enrolled in this study. Table 1 shows that most participants were male, with a mean age of 53.56 years, and graduated from senior high school. This study was dominated by participants with normal and grade I obesity. About 85% had comorbid lung disease, while 18.5% had a metabolic disease. This table also shows that the caregiver category is dominated by wives (51.9%), most of whom had diploma degrees (40.7%) and spent full days taking care of the participants (70.4%).

The distribution of the outcome indicator was normal, and the data set was homogenous for both groups before the intervention. The variables consisted of walking distance (meters), repetitions of the 30 STS, percentage of oxygen saturation, Barthel index score, and FSS score. Table 2 shows that the comparison of functional outcomes before and after the intervention was significantly improved. There was no significant difference in FSS.

Figure 1 shows the functional outcomes' improvement after one week of intervention in both groups. The control group showed improvement, although this was not statistically significant. Otherwise, the intervention group showed significant improvement in all the functional outcomes. This study also evaluated the feasibility of the therapeutic exercise video. Most responses showed

that this video was feasible and useful and did not need to be supervised by health workers (Figure 2).

Table 1. Participants' Characteristics (n = 27)

Variable	Category	%	Mean±SD
Age (years)			53.74±17.02
Sex	Female	44.4	
	Male	55.6	
Body mass index	Underweight	3.7	
	Normal	29.6	
	Overweight with risk	14.8	
	Obesity I	29.6	
	Obesity II	22.2	
Education	Elementary school	11.1	
	Junior high school	3.7	
	Senior high school	33.3	
	Diploma	18.5	
	Bachelor's	22.2	
Occupation	Master's	7.4	
	Uneducated	3.7	
	Civil servant	11.1	
	Housewife	18.5	
	Entrepreneur	22.2	
Comorbid	Retired	11.1	
	Private employee	37	
	Lungs	81.5	
Metabolic		18.5	
Caregiver status			
	Relationship		
Relationship	Wife	51.9	
	Husband	14.8	
	Child	29.6	
	Relatives	3.7	
Education	Junior high school	3.7	
	Senior high school	18.5	
	Diploma	40.7	
Occupation	Bachelor	37	
	Housewife	51.9	
	Student	7.4	
	Civil servant	7.4	
	Private employee	18.5	
Duration of care	Entrepreneur	11.1	
	Retired	3.7	
	Full day (≥16 hours)	70.4	
Half-day (8–16 hours)	29.6		

Note: SD = Standard Deviation

Discussion

Tanguay, et al.,¹⁴ found that people with COVID-19 still faced moderate to severe pulmonary and functional disabilities when returning home after hospitalization. The clinical profiles of the participants were heterogeneous since some required spending several weeks in intensive care while others required only a short hospital stay. These differences may explain the wide range of disabilities across domains among our participants at the beginning of the intervention. Still, other factors may also explain these differences (e.g., pre-existing comorbidities, age).

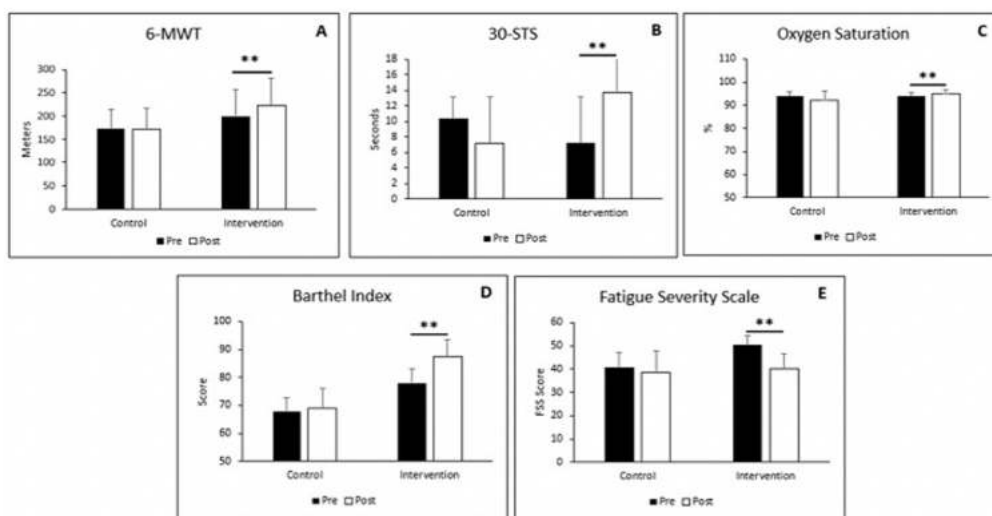
The criteria for people with COVID-19 who should be hospitalized are dyspnea or increased respiratory rate (≥30 breaths per minute), 94% oxygen saturation or decreased saturation to <90% with ambulation, and a high risk for respiratory failure.¹⁵ For COVID-19 hospitalized patients, respiratory rehabilitation aims to improve symptoms of dyspnea, relieve anxiety and depression, reduce complications, prevent and improve dysfunction, reduce disability, preserve function to the maximum extent, and improve quality of life.¹⁶⁻¹⁸ This study's participant characteristics were in line with studies by Hasani Azad, et al.,¹⁹ and Khamis, et al.²⁰ The dominant COVID-19 inpatients were men, with the most common comorbidities including hypertension (51.3%), diabetes mellitus (49.8%), dyslipidemia (21.6%), and heart disease (20.9%).^{21,22}

Telerehabilitation is an ideal healthcare delivery method as it can provide safe, long-distance services, adhere to the pandemic's sanitary measures, and cover a large geographic region.¹⁴ Paneroni, et al.,²¹ involved 25 COVID-19 survivors provided with telerehabilitation services in the form of exercise and lifestyle education for one hour daily. After one month of telerehabilitation, an improvement in exercise tolerance and dyspnea was found.²¹ No side effects were encountered during the

Table 2. Comparison of Functional Outcome Before and After Intervention between Control and Intervention Groups

Variable	Group	Mean±SD		Sig (2-tailed)
		Before Intervention	After Intervention	
6MWT (meters)	Control	171.92±41.87	172.7±42.61	0.021
	Intervention	199.20±56.58	222.8±59.04	
30s STS (times)	Control	10.42±2.71	7.25±5.83	0.002
	Intervention	7.25±5.83	13.8±4.32	
Saturation (%)	Control	93.83±2.04	92.1±4.12	0.012
	Intervention	93.80±1.74	95.2±1.61	
Barthel index (score)	Control	67.75±5.06	69.1±6.86	<0.001
	Intervention	78.07±5.11	87.6±5.95	
FSS (score)	Control	40.67±6.21	38.4±9.33	0.611
	Intervention	50.47±3.93	40±6.67	

Notes: SD = Standard Deviation, 6MWT = Six-minute Walk Test, 30s STS = 30-Second Sit-to-Stand Test, FSS = Fatigue Severity Scale.



Notes: **p-value <0.01

Figure 1. Functional Outcomes of the Control and Intervention Groups

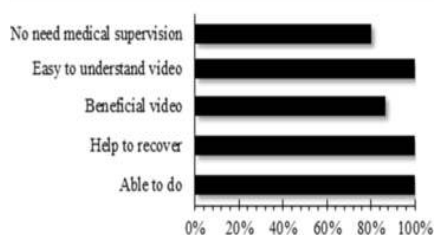


Figure 2. The Feasibility Study

study, and the results confirmed the feasibility and safety of a special telerehabilitation program for COVID-19 pneumonia survivors.²¹ The current study also shows that a telerehabilitation program using a video can improve the functional outcomes of and is safe for post-COVID-19 patients with histories of hospitalization.

The assessment tools to evaluate functional outcomes in patients with COVID-19 are the Barthel index, the Functional Independence Measure, the 6MWT, and the 30s STS. Spirometry and lung diffusion capacity for carbon monoxide determination have been used to assess respiratory function in persons with COVID-19.²²

The recorded walking distance in this study before the intervention was 171.92±41.8 meters in the control group and 199.20±56.6 meters in the intervention group. This result was in line with the study of Chikhanie, *et al.*, wherein the walking distance of post-COVID-19 patients in the ICU was 138.7±144.4 meters.²³ After the intervention, the walking distance increased to 0.75 meters for the control group and 23.6 meters for the intervention

group. Based on the study by Bohannon, *et al.*,²⁴ the minimal clinically important difference (MCID) for change in the 6MWT distance of adults with pathology was 14–30.5 meters. The walking distance improvement in the intervention group can reach the MCID of the 6MWT and the statistically significant difference compared to the control group.^{23,24}

The Barthel index before and after the intervention was improved in both groups, especially in the intervention group. The delta of the control group versus that of the intervention group was 1.33 (67.75±5 to 69.08±6.8) versus 9.53 (78.07±5.1 to 87.6±5.9), showing a significant difference between the two groups. The oxygen saturation in this study was similar in both groups (93.83%±2.0% in the control group and 93.80%±1.7% in the intervention group) before the intervention. Improvement was seen only in the intervention group (1.4%), with a significant difference from the control group (-1.75%). Bohannon, *et al.*, showed that the oxygen saturation improved by 3% before and after the pursed-lips breathing exercise (acute effect).²⁴

Fernández-de-Las-Peñas, *et al.*, found that 70% of hospitalized persons with COVID-19 exhibited fatigue and/or shortness of breath seven months after hospitalization.²⁵ Furthermore, 45% reported at least one limitation in their daily activities. This study confirms that prolonged fatigue and shortness of breath become highly common long-term symptoms after hospital discharge, supporting the assumption that they can be persistent post-COVID-19 symptoms.²⁶

Rehabilitation after critical illness is a key component in the continuum of care. Consensus-based guidelines suggest that as important as post-discharge rehabilitation is, initial inpatient-tailored rehabilitation interventions, including early mobilization and clearing of the airway, should be initiated during hospitalization.²⁶ Green, *et al.*, suggest that if the participant does not have independent sitting balance, then "phase 1" mobilization should begin with sitting balance exercises, an inclined table, and muscle strengthening exercises.²⁷ Those with independent sitting balance can progress to weight-bearing supported/active "phase 2" mobilization, with exercises including "sit-stand," line-up, or gait assistance.²⁷ Early active mobilization was associated with increased muscle strength, better mobility status on discharge, and more days after discharge.²⁷

Previous studies revealed that the exercises are easy to do and understand by the participants. Those who participated in this study had primary school, secondary school, and tertiary school educational backgrounds, and one participant did not have an educational background.^{16,27} Almost all the outcome parameters in this study's intervention group increased significantly compared to those in the control group. One can presume that the intervention group had better outcomes because of the clear video with simple narratives explaining the exercises, which can be replayed. This makes it easier for the subjects to follow the exercise properly at home, thus improving compliance.

It is important to do the correct exercise to achieve the desired results. Telerehabilitation may ease the continuity of care, but physicians may have some limitations in giving feedback on whether the exercise has been performed correctly. Therefore, the role of the caregiver should be emphasized in telerehabilitation, not only for general supervision but also to assess and correct exercise movement.

The feasibility evaluation also showed that most participants thought the home telerehabilitation program was feasible, beneficial, and easy to understand. Incorporating educational videos in telerehabilitation is more cost-effective and efficient in targeting successful home programs than conventional methods. Health workers can choose from various video delivery methods: DVDs, uploading to a website, or developing specific applications. However, there are some constraints to using telerehabilitation. For instance, it only applies to participants with smartphones and internet connections, and those with multiple comorbid or special conditions might need tailored exercise.

The weaknesses of this study included the low number of subjects and the use of consecutive sampling (which could not represent the general population of COVID-19 patients). This study also did not measure the long-term

effects of this program. On the other hand, one strength of this study is that it was conducted in multiple health centers. To the authors' knowledge, this study was the first on post-COVID-19 multicenter telerehabilitation using a home program educational video in Indonesia. Further studies need to consider the method's long-term effects and a larger population.

Conclusion

Significant functional improvement can be observed after one week of therapeutic exercise as instructed through videos at home compared to the conventional method. Therapeutic exercise educational videos can be an option to deliver rehabilitation programs for post-COVID-19 hospitalized patients. Overall, this study shows that telerehabilitation using video education is feasible and can improve the functional status of post-COVID-19 hospitalized patients.

Abbreviations

COVID-19: coronavirus disease 2019; WHO: World Health Organization; 30s STS: 30-second Sit-to-Stand Test; 6MWT: Six-Minute Walk Test; FSS: Fatigue Severity Scale; SD: Standard Deviation; CI: Confidence Interval; ADL: Activity of Daily Living; MCID: Minimal Clinically Important Difference.

Ethics Approval and Consent to Participate

The study was approved by the Ethics Committee of the Faculty of Medicine Universitas Indonesia—Dr. Cipto Mangunkusumo National Referral Public Hospital (protocol number 21-07-0770 and date of approval 09/13/2021). Informed consent was obtained from all the participants involved in the study. Written informed consent was also obtained from the patients to publish this paper.

Competing Interest

The authors declare that there are no significant competing financial, professional, or personal interests that might have affected the performance or presentation of the work described in this manuscript.

Availability of Data and Materials

The data presented in this study is available in this article.

Authors' Contribution

Conceptualization: LKW; methodology: MH, PS, and IF; software: OH and IW; validation: LKW, MH, PS, and BN; formal analysis: MR and BN; investigation: MH, PS, IF, OH, and IW; resources: MH, PS, IF, OH, and IW; data curation: MR and BN; writing—original draft preparation: MH, PS, and IF; writing—review and editing: OH, IW, BN, DT, and TZT; visualization: MR and BN; supervision: LKW; project administration: BN.

Acknowledgment

This study received no external funding.

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