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ORIGINAL ARTICLE

Physical activity, psychosocial status, and sleep quality in COVID-19 survivors following telerehabilitation: A prospective intervention and follow-up study

COVID-19 geçirenlerde telerehabilitasyon sonrası fiziksel aktivite, psikososyal durum ve uyku kalitesi: Prospektif müdahale ve izlem çalışması

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Abstract

Purpose: Coronavirus disease (COVID-19) has a negative impact on physical activity, anxiety, depression, sleep, and overall quality of life (QoL). Tele-rehabilitation offers an alternative when rehabilitation is not possible. The study was aimed to explore the impact of telerehabilitation on the physical activity, psychosocial status, sleep quality, QoL, and daily activities of living (ADLs) of COVID-19 survivors.

Methods: During the pandemic, twenty individuals who were hospitalized due to COVID-19 and subsequently discharged participated in a 12-week telerehabilitation program that included an exercise brochure and telephone calls. The data were collected using Google Forms at discharge and at the 1st, 2nd, 3rd, and 6th months after discharge. The International PA Questionnaire (IPAQ) was used to assess physical activity, while the Hospital Anxiety and Depression Scale (HADS) was used to determine psychosocial status. For sleep quality assessment, the Pittsburgh Sleep Quality Index (PSQI) was used. The Nottingham Health Profile (NHP) was used to assess QoL and the Barthel Index (BI) for ADLs.

Results: There was a significant increase in IPAQ total score after telerehabilitation [discharge vs. 3rd month ($p=0.006$)], with the similarity in IPAQ total score at 3rd vs. 6th months ($p>0.007$). The HADS anxiety score decreased significantly over its time course compared with the discharge ($p<0.007$). The PSQI global score significantly decreased after telerehabilitation ($p<0.05$). NHP and BI scores were not different among assessment periods ($p>0.007$).

Conclusion: In individuals hospitalized due to COVID-19, a 12-week telerehabilitation program after discharge may have contributed to an increase in physical activity levels and helped maintain these levels during the following three months. Our findings suggest that telerehabilitation may be potentially beneficial in supporting physical activity, reducing symptoms of anxiety and depression, and improving sleep quality in COVID-19 survivors. However, further studies including a control group are needed to validate these results.

Keywords: COVID-19, Quality of life, Physical activity, Sleep quality, Telerehabilitation

Öz

Amaç: *Koronavirüs hastalığı (COVID-19), fiziksel aktivite, anksiyete, depresyon, uyku ve genel yaşam kalitesi üzerinde olumsuz etkilere neden olur. Telerehabilitasyon, yüz yüze rehabilitasyonun bir alternatifi olabilir. Bu çalışmada, COVID-19 nedeni ile hastaneye yatırılan bireylerde, taburculuk sonrası uygulanan telerehabilitasyonun fiziksel aktivite, psikososyal durum, uyku kalitesi, yaşam kalitesi ve günlük yaşam aktiviteleri (GYA) üzerindeki etkisini araştırmayı amaçlandı.*

Yöntem: *Pandemi sırasında, COVID-19 nedeni ile hastaneye yatan ve taburcu olan yirmi kişi, egzersiz broşürü ve telefon görüşmeleri kullanılarak gerçekleştirilen 12 haftalık telerehabilitasyon programına dahil edildi. Veriler, taburculukta ve taburculuk sonrası 1., 2., 3. ve 6. aylarda Google Formlar kullanılarak toplandı. Fiziksel aktivite Uluslararası Fiziksel Aktivite Anketi (IPAQ); psikososyal durum Hastane Anksiyete ve Depresyon Ölçeği (HADS) ile değerlendirildi. Uyku kalitesinin değerlendirilmesinde Pittsburgh Uyku Kalitesi Endeksi (PSQI) kullanıldı. Yaşam kalitesi Nottingham Sağlık Profili (NHP); GYA Barthel İndeksi (BI) ile değerlendirildi.*

Bulgular: *Telerehabilitasyon sonrası IPAQ toplam puanı 3. ayda taburculuğa göre anlamlı olarak artarken ($p=0,006$), 3. ve 6. ay IPAQ toplam puanları benzerdi ($p>0,007$). HADS anksiyete puanı, taburculuğa göre zaman içinde anlamlı olarak azaldı ($p<0,007$). PSQI global puanı, telerehabilitasyon sonrası anlamlı olarak azaldı ($p<0,05$). NHP ve BI skorları açısından değerlendirme dönemleri arasında farklılık saptanmadı ($p>0,007$).*

Sonuç: *COVID-19 nedeni ile hastaneye yatırılan bireylerde, taburculuk sonrası uygulanan 12 haftalık telerehabilitasyon programı, fiziksel aktivite düzeyinde artış sağlayarak, bunu takip eden üç ay boyunca fiziksel aktivite düzeyinin korunmasına katkıda bulunmuş olabilir. Bulgularımız, telerehabilitasyonun COVID-19 geçiren bireylerde fiziksel aktiviteyi destekleme, anksiyete ve depresyon semptomlarını azaltma ve uyku kalitesini artırma açısından faydalı olabileceğini göstermektedir. Elde edilen bu sonuçların doğrulanabilmesi için kontrol grubu dahil edilerek yapılacak ileri çalışmalara ihtiyaç vardır.*

Anahtar kelimeler: *COVID-19, Yaşam kalitesi, Fiziksel aktivite, Uyku kalitesi, Telerehabilitasyon*

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INTRODUCTION

The new type of coronavirus has caused a global health emergency, requiring the implementation of restrictive measures.[1] Pneumonia and severe acute respiratory tract infection may occur in severe coronavirus disease (COVID-19) cases.[2] In the context of physiotherapy and rehabilitation, the implementation of a COVID-19 awake repositioning prone protocol and the implementation of an early passive or active assisted mobilization program during the acute phase of the disease are recommended.[3] Following hospital discharge in the post-COVID period, rehabilitation programs should focus on respiratory and physical therapy to improve lung function and overall physical strength, thereby supporting full recovery from the effects of the virus. Furthermore, mental health support should be incorporated to address the psychological consequences associated with the disease.[4,5]

Telemedicine is a clinical practice that connects patients to healthcare professionals via electronic platforms, improving patients' self-management and allowing the care of patients with limited access to healthcare.4 Telerehabilitation and information technologies to provide remote rehabilitation services to individuals at home are considered an advantage in minimizing the risk of exposure and transmission of the infectious agent from person to person. Telerehabilitation improves health outcomes and quality of life (QoL) by reducing hospitalization rates and readmissions, providing early discharge, facilitating access to rehabilitation services, and reducing costs.[5]

Regular physical activity (PA) and exercise benefit health in many ways, such as increasing cardiorespiratory fitness and reducing symptoms of anxiety and depression.[6] Increased cardiorespiratory fitness may play a preventive and therapeutic role against respiratory tract infections. It may prevent or help treat pneumonia and acute respiratory distress syndrome, which develops with COVID-19 and leads to respiratory failure.[2]

A significant decrease in PA has occurred due to social isolation during the COVID-19 pandemic, including among patients and healthy individuals.[7] Decreased PA and increased sedentary behavior may cause a rapid deterioration in cardiovascular health and premature death in the population with high cardiovascular risk.[7] Considering that short-term (1-4 weeks) inactivity is associated with adverse effects on cardiovascular function and structure, home-based PA programs appear to be a clinically relevant intervention to promote health benefits.[7]

The need for isolation due to the COVID-19 pandemic creates an unprecedented, stressful situation for an unknown period. Mood disorders, including depression, post-traumatic stress disorder, and anxiety, are common in COVID-19 survivors.[8] These disorders persist even after two years in COVID-19 survivors. The increased anxiety and depression may negatively affect sleep quality.[8] Sleep disturbance may directly affect emotional function as sleep plays a fundamental role in emotion regulation.[8] These concerns may accompany a severe decrease in QoL and function after COVID-19.[9] Therefore, the study aimed to investigate the effects of physiotherapist-directed, unsupervised home-based telerehabilitation on PA, sleep, depression, and QoL at discharge and the first, second, third, and sixth months after discharge in previously hospitalized COVID-19 survivors. We hypothesized that 12-week physiotherapist-directed home-based telerehabilitation would positively influence physical and psychosocial outcomes, including PA, anxiety and depression symptoms, and sleep quality in survivors of COVID-19.

METHODS

This study was conducted between October 2020 and March 2022, following approval by the Clinical Research Ethics Board of Hacettepe University (approval number KA-20085 and approval date: October 20, 2020).

Study design and participants

The study was designed as a prospective, single-arm interventional study with follow-up. The inclusion criteria consisted of being >18 years, being admitted to Hacettepe University Adult Hospital COVID-19 wards with a SARS-CoV-2 infection diagnosed by positive PCR assay findings, and having been discharged with mild

to moderate disease according to World Health Organization (WHO) disease severity classification,[10] being referred to Hacettepe University, Faculty of Physical Therapy and Rehabilitation, Cardiopulmonary Rehabilitation Unit for the routine physiotherapy program, and being clinically stable. Participants had to be volunteers who consented to the study, could read and write, had a smartphone, and were proficient in using it. Being admitted to the intensive care unit (ICU) (severe and critically ill patients),[10] having unstable clinical conditions, severe neuromuscular and musculoskeletal problems, an inability to cooperate in completing questionnaires, and a lack of willingness to volunteer were determined as the exclusion criteria.

Assessments

Informed consent was obtained electronically from all individuals before participating in the study. All assessments were filled in electronically during that week at discharge, at the end of each month for a 12-week home-based telerehabilitation period (the 1st, 2nd, 3rd months after discharge), and the 6th month after discharge via Google Forms. Demographics, physical characteristics, length of hospital stay due to COVID-19, and comorbidity status of participants were recorded.

The modified Medical Research Council (mMRC) dyspnea scale is used to assess how breathlessness interferes with an individual's routine activities over the past week. It is a five-point scale, ranging from 0 to 4: 0 indicates breathlessness only during intense physical exertion; 1 reflects shortness of breath when walking briskly on flat ground or ascending a mild incline; 2 refers to having to walk slower than peers on flat ground due to breathlessness or needing to pause while walking at a personal pace; 3 corresponds to needing to stop for air after walking approximately 100 meters or a few minutes on flat ground; 4 denotes being too breathless to leave home or experiencing difficulty while getting dressed.[11]

Physical activity

The Turkish version of the International PA Questionnaire (IPAQ)-short form was used to evaluate PA level. The IPAQ-short form is a seven-question questionnaire used to assess PA levels in people aged 18-69 years. Walking (MET-min/week), moderate and vigorous activity duration, and total score are obtained.[12,13] The IPAQ scores were classified as inactive (<700 MET-week), moderately active (700–2500 MET-week), and active (>2500 MET-week).[14]

Psychosocial status

The psychosocial status was evaluated using the Turkish version of the Hospital Anxiety and Depression Scale (HADS). The HADS is a 14-item self-report scale consisting of anxiety and depression subscales.15 The scores were classified as 0-7, non-cases; 8-10, doubtful cases; and 11–21, cases. Higher scores indicate worse psychosocial status.[15,16]

Sleep quality

Sleep quality was assessed using the Turkish version of the Pittsburgh Sleep Quality Index (PSQI). The PSQI has seven components: perceived sleep quality, latency, duration, habitual sleep efficiency, sleep disturbances, medications, and daytime dysfunction.[17] The total score ranges from 0 to 21, and a total score >5 is considered a significant sleep disturbance.[17]

Health profile

The Turkish version of the Nottingham Health Profile (NHP) was used to assess the QoL. The NHP is developed to measure perceived health problems and the extent to which these problems affect normal daily activities.[18] The NHP evaluates perceived restriction or discomfort in sub-sections: energy, pain, emotional reactions, sleep, social isolation, and PA. Each subsection has a score limit ranging from 0 (no restriction) to 100 (presence of all listed restrictions).[18]

Activities of daily living

The Barthel Index (BI) mainly assesses mobility and self-care activities. It consists of 10 subheadings: eating, bathing, self-care, dressing, bladder control, bowel control, toilet use, chair/bed transfer, mobility, and use of stairs.[19,20] A score of 0 shows complete dependence, while 100 indicates complete independence.[19,20] BI scores of 0-20 indicate 'total' dependency, 20-35 indicate 'severe' dependency, 40-55 indicate 'moderate' dependency, 60-95 indicate 'slight' dependency, and 100 indicate 'independent.[19,20]

Figure 1 shows the study flowchart. The telerehabilitation period lasted 12-week following discharge. All assessments were

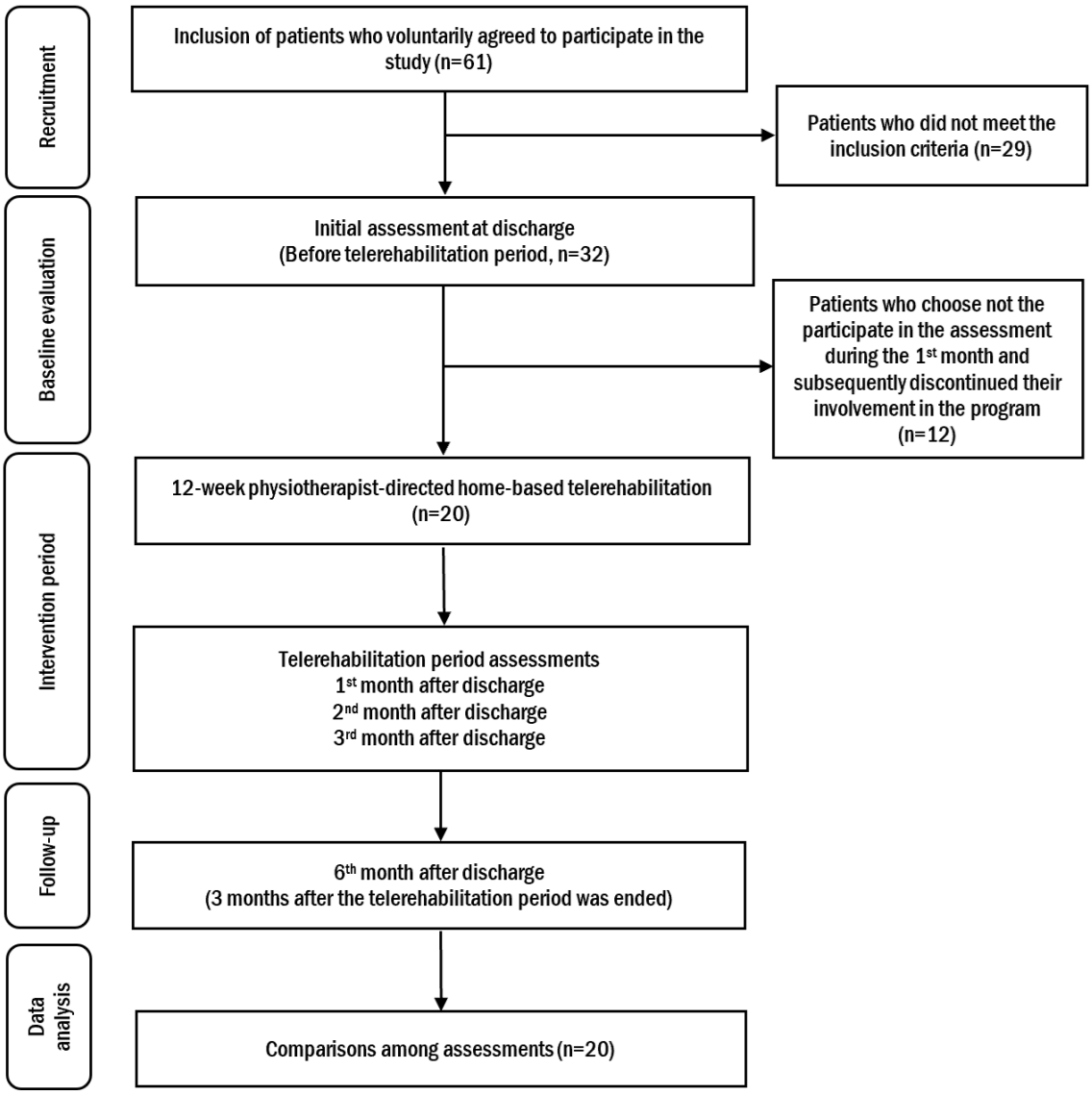

Figure 1. Study flowchart.

collected five times (at discharge and at the end of the 1st, 2nd, 3rd, and 6th months after discharge).

Intervention

The intervention consisted of exercise recommendations delivered by physiotherapists through telerehabilitation as part of a 12-week home-based rehabilitation program for individuals discharged after COVID-19.

An exercise brochure for COVID-19 survivors was prepared and sent electronically to participants after discharge.[21] The brochure included the active cycle of breathing techniques and range of motion exercises for upper and lower extremities to be performed in bed, sitting, and standing. Exercises included shoulder flexion and abduction, scapular adduction, hip flexion and abduction, knee extension, and sit-to-stand exercises. The exercises were planned to facilitate activities and functions in daily life, and the participants were informed to perform them daily. Participants were instructed to begin with five repetitions and progressively increase depending on tolerance. They were asked to perform exercises three times per day, and the repetitions and frequency of the given

exercises were adapted with follow-ups. In addition to exercises, participants were advised to engage in regular walks whenever possible. Weekly phone calls were conducted to provide appropriate adaptations for the difficulties experienced during the exercises.

Statistical analyses were performed using the Statistical Package for the Social Sciences (SPSS) version 25.0 (IBM Corp., Armonk, NY, USA) software program. Normality was tested using the Shapiro-Wilk test. The data were presented as the median and interquartile range (IQR) and frequency. A comparison of variables across all assessment months was conducted using the Friedman test. Statistical significance was set at $p<0.05$ for the comparison of all assessment periods. The Wilcoxon signed rank test was used to assess the differences in variables between discharge vs. all assessment months (1st, 2nd, 3rd, and 6th), discharge vs. 1st month, 1st vs. 6th month, 2nd vs. 6th month, and 3rd vs. 6th month. Considering pairwise comparisons, statistical significance was determined at $p<0.007$ using Bonferroni correction.

RESULTS

Thirty-two patients were accepted to participate at discharge. However, during the program's 1st month, 12 participants decided to discontinue their involvement and refused to perform exercises. As a result, 12 patients were excluded from the study. Twenty individuals completed 12-week of home-based telerehabilitation (Figure 1). The participants' characteristics are described in Table 1.

Table 2 presents the scores of mMRC, IPAQ, HADS, PSQI, NHP, and BI. There were no significant differences in mMRC among the assessments ($p>0.05$, Table 2).

Physical activity

There were significant improvements in the IPAQ moderate PA ($p=0.022$), walking score ($p=0.001$), and total score ($p<0.001$) among all assessment periods, while vigorous PA was not different among monthly assessments ($p>0.05$, Table 2, Figure 2). There were no statistically significant differences in IPAQ moderate PA scores among the two assessment period comparisons ($p>0.007$). For the IPAQ walking score, there was a statistically significant increase in IPAQ walking score between discharge vs. 6th month ($p=0.006$). However, the IPAQ walking score was not statistically different between discharge vs. 1st month, 2nd month, 3rd month, 1st vs. 6th month, 2nd vs. 6th month, and 3rd vs. 6th month ($p>0.007$).

Table 1. The characteristics of the COVID-19 survivors (N=20).

	Mean±SD
Age (years)	54.35±14.46
Body weight (kg)	77.38±15.72
Height (cm)	165.95±10.26
Body Mass Index (kg/m^2)	28.13±5.27
Smoking (pack-years)	17.10±28.11
Length of hospital stay (days)	8.30±5.02
	n (%)
Sex (female/male)	9/11 (45/55)
Comorbidity types	
Ischemic heart disease	2 (10)
Diabetes	5 (25)
Lung disease	1 (5)
Kidney disease	3 (15)
Liver disease	3 (15)
Other (dyslipidemia, obesity)	5 (25)
Smoking history	
Smoker	- (0)
Ex-smoker	11 (55)
Non-smoker	9 (45)
Education level	
Literate	1 (5)
Primary school	5 (25)
Middle school	1 (5)
High school	4 (20)
University	7 (35)
Higher degree	2 (10)
Marital Status	
Married	12 (60)
Single	2 (10)
Divorced	6 (30)
Working Status	
Full-time work	10 (50)
Part-time work	1 (5)
Unemployed	3 (15)
Retired	6 (30)

A statistically significant improvement was observed in the IPAQ total score between discharge and the 3rd month post-discharge ($p=0.006$). No significant changes were detected in comparisons between discharge and the 1st, 2nd, or 6th months, nor between the 1st and 6th,

2nd and 6th, or 3rd and 6th months (p>0.007). In terms of PA classification based on IPAQ total scores, 70% of participants were categorized as physically inactive at discharge. This proportion declined progressively to 40% at the 1st month, 35% at the 2nd month, and reached its lowest at the 3rd month with 20%, before slightly increasing to 25% by the 6th month (see Table 3).

Psychosocial status

The statistically significant improvements were observed in HADS anxiety (p<0.001) and HADS depression scores (p=0.002) among assessments (Table 2, Figure 2). There were significant decreases in HADS anxiety scores between discharge vs. 1st month (p=0.002); discharge vs. 2nd month (p<0.001); discharge vs. 3rd month (p=0.002); discharge vs. 6th month (p<0.001). There were no differences in HADS anxiety scores regarding the 1st vs. 3rd month, 2nd vs. 6th month, and 3rd vs. 6th month (p>0.007). There were significant decreases in HADS depression scores between discharge vs. 2nd month (p=0.003) and discharge vs. 3rd month (p=0.002). There were no differences in HADS depression scores regarding discharge vs. 1st and 6th month, 1st vs. 3rd month, 2nd vs. 6th month, and 3rd vs. 6th month (p>0.007).

Sleep quality

The global score of the PSQI decreased during the telerehabilitation period (p<0.001). Regarding the PSQI global score, there were significant differences in pairwise comparisons: discharge vs. 2nd month (p=0.002); discharge vs. 3rd month (p<0.001); discharge vs. 6th month (p=0.001). However, PSQI global scores were not different between discharge vs. 1st month, 1st vs. 6th month, 2nd vs. 6th month, and 3rd vs. 6th month (p>0.007). PSQI subjective sleep quality (p<0.001) (subjective sleep quality pairwise comparisons: discharge vs. 2nd month, p=0.005; discharge vs. 3rd month, p=0.005; discharge vs. 6th month, p=0.001), PSQI sleep latency (p=0.018 with no significance in pairwise comparisons [p>0.007]); PSQI sleep duration (p<0.001) (sleep duration pairwise comparisons: discharge vs. 6th month, p=0.003; 1st vs. 6th month, p<0.001; 2nd vs. 6th month (p=0.003); 3rd vs. 6th month (p=0.013), PSQI sleep disturbance (p<0.001) (sleep disturbance pairwise comparisons: discharge vs. 3rd month, p=0.006; discharge vs. 6th month, p=0.005), and daytime dysfunction (p<0.001) (discharge vs. 2nd month, p=0.005; discharge vs. 3rd month, p=0.005) were found to be improved after telerehabilitation. There were no significant differences in PSQI sleep efficiency and PSQI use of sleep medication scores among all assessment periods (p>0.05, Table 2).

Health profile

NHP domains, except for the energy sub-dimension (p=0.020), were not different among all assessment periods (p>0.05, Table 2). However, the NHP energy scores were not different in pairwise comparisons (p>0.007).

Activities of Daily Living

Regarding BI scores, there were significant differences among all assessment periods (p=0.009). Considering the BI score, however, statistically significant improvements were not observed in pairwise comparisons (p>0.007).

The post hoc power analyses were performed using G*Power version 3.1.9.6 (Heinrich Heine University, Düsseldorf, Germany). Analyses based on the comparisons of HADS anxiety score at discharge vs. 3rd month, HADS anxiety score at discharge vs. 6th month, HADS depression score at discharge vs. 3rd month, and PSQI global score at discharge vs. 3rd and 6th months revealed statistical powers of 88.8%, 96.5%, 89.2%, 98.9%, and 98.7%, respectively.

DISCUSSION

The present study investigated the effects of a 12-week physiotherapist-directed home-based telerehabilitation program using phone calls on discharged COVID-19 survivors. The main findings were significant improvements in PA level, anxiety and depression, and sleep quality following telerehabilitation, which were maintained after three months.

The persistent dyspnea and respiratory failure in COVID-19 survivors appear to be multicausal and play a significant role in lung function impairment.[2] Li et al. investigated the effects of a 6-week unsupervised home-based exercise program consisting of breathing control, thoracic expansion, and aerobic and strength exercises in discharged COVID-19 survivors.[22] A treatment effect for mMRC-dyspnea was stated immediately after the intervention, with 90.4% being dyspnea-free in the telerehabilitation group as opposed to 61.7%

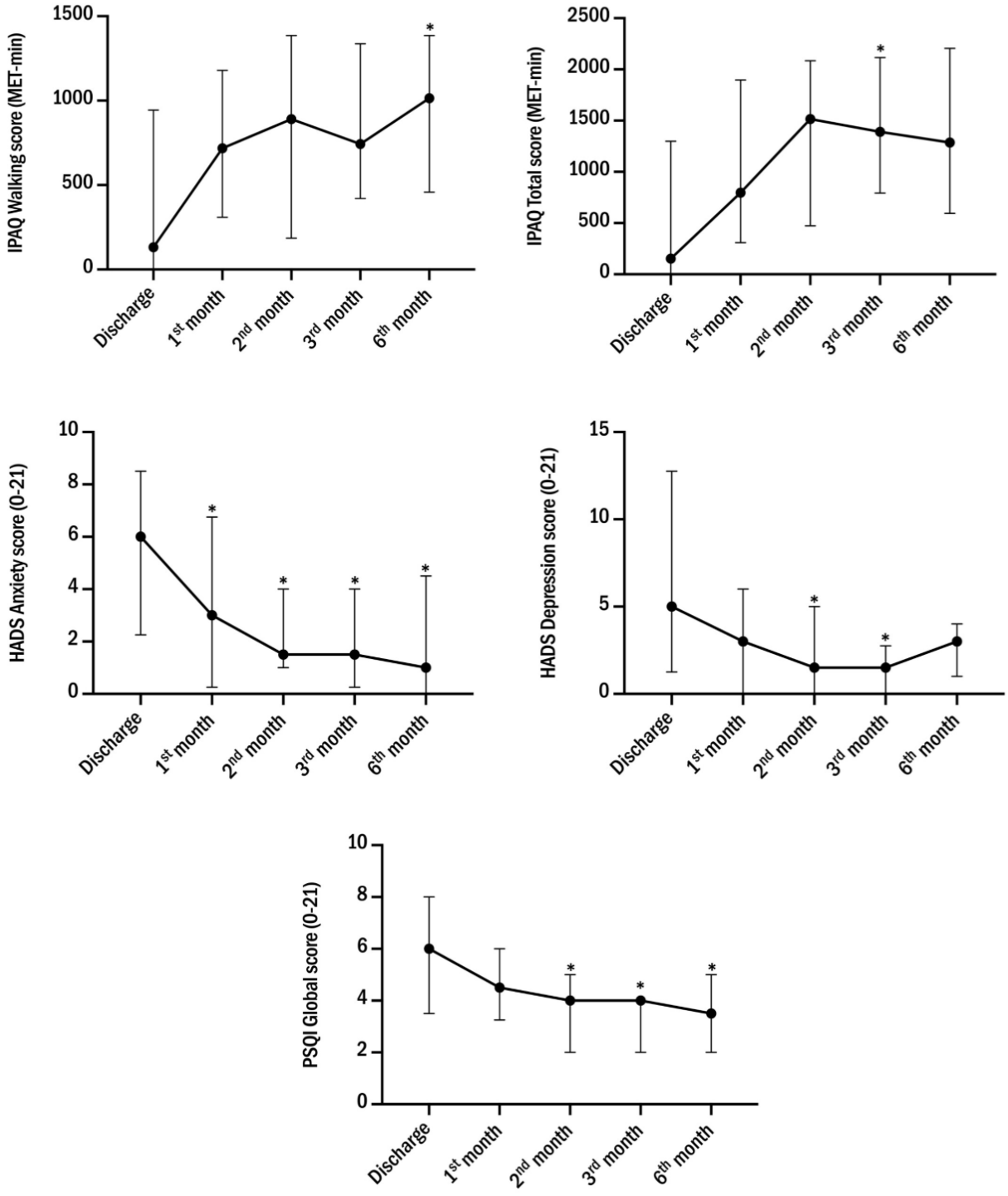

Figure 2. Changes in the median and interquartile range of the IPAQ, HADS, and PSQI scores. Wilcoxon rank sum test * defined as significant differences in median scores between at discharge and 1st, 2nd, 3rd, and 6th month ($p<0.007$).

Table 2. The comparison of dyspnea, physical activity, anxiety and depression, sleep quality, health profile of the COVID-19 Survivors (n=20).

	at Discharge	1st Month	2nd Month	3rd Month	6th month	
	Median (IQR)	Median (IQR)	Median (IQR)	Median (IQR)	Median (IQR)	p
mMRC score (0-4)	1 (0-1)	0 (0-1)	0.50 (0-1)	0 (0-1)	0 (0-1)	0.203
IPAQ (MET-min)						
Vigorous PA	0 (0-0)	0 (0-0)	0 (0-240)	0 (0.0-780)	0 (0-600)	0.231
Moderate PA	0 (0-0)	0 (0-120)	120 (0-360)	0 (0-630)	0 (0-3900)	0.022*
Walking	132 (0-944)	717.75 (309-1180)	891 (186-1386)	742.5 (421-1337)	1015 (458-1386)	0.001*
Total	154 (0-1299)	797 (309-1898)	1517 (474-2084)	1390 (792-2115)	1287 (594-2206)	<0.001
HADS						
Anxiety (0-21)	6 (2.25-8.5)	3 (0.25-6.75)	1.50 (1-4)	1.50 (0.25-4)	1 (0-4.50)	<0.001*
Depression (0-21)	5 (1.25-12.75)	3 (0-6)	1.50 (0-5)	1.50 (0-2.75)	3 (1-4)	0.002*
PSQI						
Subjective sleep quality	1 (1-2)	1 (1-1)	1 (0-1)	1 (0.25-1)	0.50 (0-1)	<0.001
Sleep latency	1 (1-2)	1 (0-1.75)	1 (0.25-2)	1 (0-1)	1 (0-1.75)	0.018*
Sleep duration	1 (0.25-1)	1 (1-1.75)	1 (0-1)	1 (0-1)	0 (0-0)	<0.001
Sleep efficiency	0 (0-1)	0 (0-1)	0 (0-0.75)	0 (0-1)	1 (0-1)	0.077
Sleep disturbance	1 (1-2)	1 (1-2)	1 (1-1)	1 (1-1)	1 (1-1)	<0.001
Use of sleep medicat.	0 (0-0)	0 (0-0)	0 (0-0)	0 (0-0)	0 (0-0)	0.406
Daytime dysfunction	0.50 (0-1)	0 (0-0)	0 (0-0)	0 (0-0)	0 (0-0)	<0.001
Global score (0-21)	6 (3.50-8)	4.50 (3.25-6)	4 (2-5)	4 (2-4)	3.50 (2-5)	<0.001
NHP (0-100)						
Energy	39.20 (0-63.2)	0 (0-39.20)	0 (0-51.60)	0 (0-35.40)	0 (0-33.60)	0.020*
Pain	7.91 (0-28.5)	8.53 (0-17.75)	0 (0-22.11)	0 (0-21.44)	0 (0-31.07)	0.233
Emotional reactions	0 (0-24.9)	0 (0-7.85)	0 (0.0-20.41)	3.61 (0-22.55)	0 (0.0-19.33)	0.142
Social isolation	0 (0-0)	0 (0-16.51)	0 (0-22.01)	0 (0-16.9)	0 (0-16.51)	0.955
Sleep	12.57 (0-26.9)	0 (0-12.57)	6.29 (0.0-12.57)	0 (0-12.57)	0 (0-12.57)	0.072
Physical mobility	11 (0-34.5)	10.79 (0-17.87)	10.79 (0-21.83)	10.79 (0-21.62)	10.68 (0-26.62)	0.589
BI total score (0-100)	100 (95-100)	100 (100-100)	100 (100-100)	100 (100-100)	100.0 (100-100)	0.009*

*p<0.05. mMRC, Modified Medical Research Council Dyspnea Scale. IPAQ: International Questionnaire of Physical Activity-Short Form. HADS: Hospital Anxiety Depression Scale. PSQI: Pittsburgh Sleep Quality Index. NHP: Nottingham Health Profile. BI: Barthel Index.

Table 3. The frequencies of physical activity, anxiety and depression, and sleep quality classifications of the COVID-19 Survivors.

	at Discharge	1st Month	2nd Month	3rd Month	6th month
	n (%)	n (%)	n (%)	n (%)	n (%)
IPAQ classification					
Inactive (<700 MET-min)	14 (70)	8 (40)	7 (35)	4 (20)	5 (25)
Moderate (700–2500 MET-min)	5 (25)	9 (45)	9 (45)	13 (65)	11 (55)
Active (>2500 MET-min)	1(5)	3 (15)	4 (20)	3 (15)	4 (20)
HADS Anxiety classification	n (%)	n (%)	n (%)	n (%)	n (%)
0-7	15 (75)	17 (85)	19 (95)	20 (100)	20 (100)
8.-10	3 (15)	1 (5)	1 (5)	0 (0)	0 (0)
11-21	2 (10)	2 (10)	0 (0)	0 (0)	0 (0)
HADS Depression classification	n (%)	n (%)	n (%)	n (%)	n (%)
0-7	13 (65)	16 (80)	18 (90)	19 (95)	20 (100)
8.-10	2 (10)	0 (0)	1 (5)	1 (5)	0 (0)
11-21	5 (25)	4 (20)	1 (5)	0 (0)	0 (0)
BI Functional classification	n (%)	n (%)	n (%)	n (%)	n (%)
Independent (100)	12 (60)	16 (80)	19 (95)	16 (80)	16 (80)
Slight dependency (60-95)	6 (30)	4 (20)	1 (5)	4 (20)	4 (20)
Moderate dependency (40-55)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
Severe dependency (20-35)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
Total dependency (<20)	2 (10)	0 (0)	0 (0)	0 (0)	0 (0)

IPAQ: International Questionnaire of Physical Activity-Short Form. HADS: Hospital Anxiety Depression Scale. BI: Barthel Index.

in the control group, but not at the follow-up time points.[22] Pehlivan et al. investigated the effectiveness of telerehabilitation using breathing and range of motion exercises, active cycle of breathing technique, and aerobic training, and an exercise brochure with the same content for the control group, for three days a week for six weeks.[21] They reported a significant improvement in the mMRC dyspnea level in the telerehabilitation group.[21] The significant effect of telehealth care (combined with education and/or exercise training) in chronic lung disease on PA was reported, with no significant difference in physical capacity and dyspnea.[23] We did not observe a significant improvement in mMRC scores after telerehabilitation. This finding could be associated with not including severe COVID-19 cases, which were previously hospitalized in the ICU.

McDonough et al. demonstrated that video-assisted exercise training during the COVID-19 pandemic increased moderate and vigorous PA and decreased perceived PA barriers, with no significant differences in sedentary and light PA in young adults.[24] Lai et al. showed that a 12-week telerehabilitation program increased exercise motivation and PA in individuals with long COVID-19 compared with controls.[25] Similarly, our findings are consistent with previous studies.[25,26] suggesting that telerehabilitation without regular clinical visits can positively affect PA levels. We found that the IPAQ total score increased compared to discharge throughout the telerehabilitation period and was preserved for three months after the telerehabilitation period ended. The improvement after telerehabilitation could be related to the improved psychosocial status of participants. Insignificance in vigorous PA may result from the fact that the participants did not undergo supervised exercise training, and the preference of the COVID-19 survivors to engage in low-intensity activities.

Post-COVID-19 syndrome often presents overlapping clusters of symptoms that can change over time and affect any system in the body, and commonly reported symptoms include fatigue, breathlessness, sleep problems, anxiety, and depression in the COVID-19 pandemic.[27] Exercise has positive effects on mental disorders.[28] Recent research has reported that combined exercise with digital games is a potential method for coping with anxiety and depression, considering limited access to exercise facilities during the COVID-19 pandemic.[29] It has been shown that a 20-min single-session moderate-intensity exercise game reduces anxiety in healthy individuals in a home-based environment during the COVID-19 quarantine period.[29] de Araújo Furtado et al. reported improvements in depression and anxiety among post-discharge COVID-19 patients assigned to either an asynchronous telerehabilitation group or a booklet-based rehabilitation group, with benefits observed in both groups.[30] Our findings are consistent with these results,[29,30] and the observed improvements in anxiety and depression may have been positively influenced by the improvement in PA; however, further research is needed to evaluate long-term effects.

Breathing and physical exercises were reported to reduce stress and positively affect sleep problems.[28] Lower PSQI score after telerehabilitation compared with the PSQI score at discharge indicates that physiotherapist-directed telerehabilitation may positively affect sleep quality in COVID-19 survivors. The benefits of telerehabilitation for improving sleep quality have also been reported in individuals with COVID-19 during the pandemic.[25]

In terms of QoL, it is widely acknowledged that exercise can enhance health-related QoL.[31] A 24-session telerehabilitation program for COVID-19 patients after discharge was shown to improve QoL.[32] An unsupervised home-based 6-week telerehabilitation program via smartphone in discharged COVID-19 survivors was shown to improve the physical component of QoL with no difference in the mental component of QoL compared to the control group.[22] Nambi et al. stated that resistance training combined with low-intensity aerobic exercise caused a more remarkable QoL improvement than high-intensity aerobic exercise in community-dwelling older patients with post-COVID-19 sarcopenia.[33] We did not detect any significant differences in QoL after telerehabilitation. Similar to our finding regarding QoL, no improvement in QoL was reported in a study investigating the effects of 12-week of telerehabilitation in individuals with long COVID.[25] One possible explanation is that the NHP provides a generic QoL assessment and may not adequately capture disease-specific

physical or psychosocial limitations related to post-COVID-19 recovery. COVID-19–specific questionnaires may better reflect longitudinal changes in patients' health status and treatment-related effects.[34]

A study showed that nearly 70% of the COVID-19 survivors had poor BI scores.[35] Inpatient rehabilitation in individuals with COVID-19 was shown to improve ADLs.[36] Even though the participants' BI scores differed among all assessment periods in our study, no significant difference was observed in pairwise comparisons. The high baseline independence of participants (60% were functionally independent at discharge) who had mild to moderate COVID-19 and did not require ICU admission may explain this finding. The BI may perform better in detecting functional limitations when more severe cases are included. Furthermore, COVID-19–specific scales such as the Post-COVID-19 Functional Status Scale may more accurately capture functional limitations at discharge and during long-term follow-up.[37,38]

Limitations

This study has several limitations. Firstly, the absence of a control group limits the ability to attribute improvements solely to the telerehabilitation. While our findings suggest that participation in telerehabilitation may be associated with improvements in PA levels, these results should be interpreted with caution, as improvements could also reflect natural recovery after COVID-19. Future studies including control groups are needed to confirm these effects and to clarify whether they are specific to telerehabilitation. Secondly, the study relied on patient-reported outcome measures; incorporating objective functional measures could strengthen future research. Moreover, including only individuals with mild to moderate COVID-19 may have limited the generalizability of the findings to those with severe disease. Thirdly, twelve individuals dropped out for personal reasons. This dropout rate may have influenced the overall effectiveness of the program and could introduce bias when interpreting the results. Fourthly, the HADS was used to assess anxiety and depression after discharge and return to the community. Since HADS was originally developed to identify emotional disorders in patients undergoing medical and surgical treatment in hospital settings.[15] Therefore, additional research may be helpful to validate and verify the efficacy of its Turkish version among community-dwelling adults. Despite these limitations, the study provides preliminary insights regarding the potential of physiotherapist-directed home-based telerehabilitation for discharged COVID-19 survivors who did not require ICU admission, including observations over a 6-month follow-up period.

Conclusion

To conclude, participating in a 12-week home-based telerehabilitation program was associated with improvements in PA, anxiety symptoms, and sleep quality among discharged COVID-19 survivors. Over a three-month follow-up period, PA levels also seemed to be sustained by the intervention. Although these findings are preliminary and limited by the absence of a control group, they suggest that home-based telerehabilitation could be a practical and potentially beneficial approach for supporting both physical and psychosocial recovery when access to supervised rehabilitation is restricted. These findings are preliminary and highlight the need for randomized controlled trials to confirm their effectiveness and to compare outcomes with more comprehensive telerehabilitation programs.

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