JOURNAL OF
CONTEMPORARY MEDICINE

DOI:10.16899/jcm.1193557
J Contemp Med 2023;13(3):433-438

Original Article / Orijinal Araştırma

What Is the Effectiveness of the Home Exercise Program on Dyspnea after Mild-Moderate COVID-19 Pneumonia?

Hafif-Orta Derecede COVID-19 Pnömonisi Sonrası Ev Egzersiz Programının Dispne Üzerine Etkinliği Nedir?

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Abstract

Aim: The aim of this study was to investigate the efficacy of a home-based breathing exercise program on dyspnea, quality of life, depression and sleeping disorders in patients with COVID-19 pneumonia after discharge from the hospital.

Material and Method: The study was completed with a total of 60 participants. The intervention group (n=39) received a homed-based exercise program including controlled breathing techniques and low-intensity upper and lower extremity exercises. The control group (n=21) did not receive any intervention. The patients were evaluated with the Modified Borg Scale (MBS), Nottingham Health Profile (NHP), Insomnia Severity Index (ISI) and Beck Depression Inventory (BDI) before and at the end of the intervention.

Results: After treatment, the MBS scores significantly decreased in both the intervention and control groups compared with the baseline values ($p<0.05$). There was a statistically significant difference before and after the treatment when the MBS scores were compared between the groups ($p<0.001$). The changes in the post-treatment BDI, NHP and ISI scores compared to the baseline did not significantly differ between the two groups.

Conclusion: This study showed that home exercise program after COVID-19 pneumonia was significantly effective in relieving dyspnea, but not as effective in improving quality of life and sleep and depression complaints.

Keywords: COVID-19, pneumonia, exercise, dyspnea

Öz

Amaç: Bu çalışmanın amacı COVID-19 pnömonisi tanılı hastalarda hastaneden taburcu olduktan sonra evde uygulanan solunum egzersiz programının dispne, yaşam kalitesi, depresyon ve uyku bozuklukları üzerine etkinliğini araştırmaktır.

Gereç ve Yöntem: Çalışma toplam 60 katılımcı ile tamamlandı. Müdahale grubu (n=39), kontrollü nefes alma teknikleri ve düşük yoğunluklu üst ve alt ekstremite egzersizlerini içeren ev egzersiz programı aldı. Kontrol grubuna (n=21) herhangi bir müdahale uygulanmadı. Hastalar tedavi öncesi ve sonrasında Modifiye Borg Ölçeği (MBÖ), Nottingham Sağlık Profili (NSP), Uykusuzluk Şiddet İndeksi (UŞİ) ve Beck Depresyon Envanteri (BDE) ile değerlendirildi.

Bulgular: Tedaviden sonra, başlangıç değerlerine kıyasla hem müdahale hem de kontrol gruplarında MBÖ puanları önemli ölçüde azaldı ($p<0.05$). Gruplar arasında MBÖ skorları karşılaştırıldığında tedavi öncesi ve sonrası istatistiksel olarak anlamlı fark vardı ($p<0.001$). Tedavi öncesi ve tedavi sonrası BDE, NSP ve UŞİ skorlarındaki değişiklikler ise, iki grup arasında anlamlı farklılık göstermedi.

Sonuç: Bu çalışma ile COVID-19 pnömonisi sonrası ev egzersiz programının dispneyi azaltmada etkili olduğu gösterilirken, yaşam kalitesini, uyku bozukluğunu ve depresyon şikayetlerini iyileştirmede etkisinin anlamlı düzeyde olmadığı gösterilmiştir.

Anahtar Kelimeler: COVID-19, pnömoni, egzersiz, dispne

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Received *(Geliş Tarihi)*: 26.10.2022 **Accepted *(Kabul Tarihi)*:** 15.05.2023

INTRODUCTION

Coronavirus is a single-stranded RNA virus which cause diseases ranging from the common cold to more serious clinical manifestations.[1] This pathogen, identified by World Health Organization (WHO) as Severe Acute Respiratory Syndrome Coronavirus 2 (SARS-CoV-2) in January 2020, has a high risk of transmission and causes bilateral interstitial pneumonia, resulting mortality in progressive cases. The resulting disease associated with this virus has been defined as COVID-19.[2] Per National Health Institutes, disease severity is classified into five levels as asymptomatic or presymptomatic infection, mild illness, moderate illness, severe illness, and critical illness.[3] COVID-19 particularly affects the respiratory system and causes dyspnea. Also physical and psychological negative effects of immobility due to hospitalization are seen in patients with COVID-19 pneumonia. In addition, most patients may have muscle pain and fatigue and accompanying pulmonary[4] and musculoskeletal system symptoms and changes in their mood and quality of life.

The guidelines for the management of acute and subacute process after SARS-CoV-2[5] recommends a rehabilitation program (first in the hospital accompanied by a physiotherapist, followed by a home program, tele-rehabilitation, etc.) in the post-discharge period after the evaluation of the physical, functional, cognitive and psychosocial losses of the patient related to COVID-19. In patients with mild or moderate symptoms, rehabilitation exercises have been shown to improve respiratory system function and relieve muscle pain. Studies have shown that medical treatment, rehabilitation (including joint range of motion exercises) and exercise prescriptions including pulmonary exercises have positive effects on the respiratory and cardiovascular system endurance and quality of life, sleep patterns, and depression after COVID-19 pneumonia.[6-9]

In this study, we aimed to show the effects of a home-based exercise program on dyspnea, sleep, mood and quality of life in patients who had received treatment for COVID-19 pneumonia.

METHODS

This was a quasi-experimental study where participants were assigned to either the intervention group (IG) or control group (CG) without random assignment. All the patients acknowledged their understanding and willingness to participate by providing signed consent. The study was conducted between and February 2021 and August 2021 at Kutahya Health Sciences University Hospital, Turkey. Approval for the study was granted by the Clinical Research Ethics Committee of the university (date/number: 30.12.2020/2020-08/05). The methods used in this study were reported using the TREND statement.

Participants

Recruitment and setting: Patients who were followed up with a diagnosis of mild to moderate COVID-19 and completed their treatment in the hospital during the study period were screened for eligibility by an independent physician and subsequently invited to participate in the study. All the participants were informed in advance about the procedures and assessments to be performed in the study, and those who agreed to participate in the study signed the consent form.

Inclusion criteria

- Age between 20 and 50 years
- Mild-moderate COVID-19 diagnosis
- Completing medical treatment for COVID-19
- Oxygen saturation above 95% at the time of discharge
- Not be vaccinated

Exclusion criteria

- Being uncooperative
- Presence of an additional chronic systemic disease
- Uncontrolled hypertension
- Vision or hearing problem
- Diagnosis of advanced heart or lung disease for which exercise is contraindicated
- Cognitive disorders
- Being immobile

Study procedures

After determining the IG and CG groups, the participants were evaluated by a blinded researcher (M.A.L.), and then home-exercise were planned by a different researcher (F.Y.). They were reevaluated by the same blinded researcher (M.A.L.) at the end of the eight weeks. The participants in IG received an exercise program including breathing techniques and low-intensity upper and lower extremity exercises while CG did not receive any intervention.

Intervention

Exercise program: Before discharge, the patients in IG underwent 30 minutes of training and exercises under the supervision of a researcher with eight years of experience. Training was planned as controlled breathing techniques, methods to alleviate shortness of breath, and low-intensity upper and lower extremity exercises. Patient education included diaphragmatic breathing and pursed-lip breathing as controlled breathing techniques. The home exercise program recommended by WHO was used for low-intensity upper and lower extremity exercises after hospital discharge. This program included warm-up exercises, shoulder shrugs, shoulder circles, side bends, knee lifts, ankle taps, and ankle circles. As conditioning and strengthening exercises, stepping in place, climbing stairs, walking in place, sitting and standing, push-up on the wall and quadriceps isometric exercises were given. Each exercise was planned to be undertaken 10 times twice a day

for five days a week. The patients were also provided with an explanatory visual form that showed how to perform each exercise.

Outcomes

Data regarding the participants' age, gender, height, body weight, body mass index,and education level were recorded on a previously prepared assessment form during face-to-face interviews. The participants' dyspnea, quality of life, sleeping disorders and depression were then assessed using the methods described below. All the assessments were repeated before and after treatment by the same physician (A.O.) who was blinded to the interventions. Quality of life was the primary outcome measure, and sleeping disorders and depression were the secondary outcome measurements.

Assessment of Dyspnea

The Modified Borg scale, consisting of 10 items describing the severity of dyspnea at rest and during exercise, was used to assess dyspnea. This scale was developed by Borg in 1970 to measure the effort spent during physical exercise. It is frequently used to evaluate the severity of dyspnea during exertion and at rest.[10]

Assessment of Quality of Life

The Nottingham Health Profile (NHP) is a subjective scale that determine show patients perceive their illness. In the first part consisting of 38 items, the following six domains are evaluated: energy level, pain, emotional responses, sleep, social isolation, and physical abilities. The questions in the scale are answered as "Yes" or "No" and scored between 0 and 100. An increase in the score indicates an increase in distress experienced by the patient. The second part of the scale is optional and contains seven questions related to work, housekeeping, social life, personal relationships, sexual life, hobbies and interests, and holidays. The questions are scored between 0 and 1, givinga total of 7 points. In this study, the Turkish version of NHP was used. The validity and reliability studies of this version were undertaken by Kucukdeveci et al.[11]

Assessment of Depression

The depression levels of the participants were evaluated using the Beck Depression Inventory (BDI) consisting of 21 questions. Each question has a set of at least four possible responses (0-3), ranging in intensity. According to the total scores obtained, 0-9 is considered normal, 10-19 mild depression, 20-30 moderate depression, and 31-63 severe depression. The validity and reliability of the Turkish version of BDI were shown by Ulusoy et al.[12]

Assessment of Sleeping Disorders

The severity of the insomnia problems of the patients were evaluated with the Insomnia Severity Index (ISI), which measures difficulties in transition to sleep, difficulties in maintaining sleep, waking up very early, satisfaction from sleep patterns, impairments in daily functioning, detect ability of sleep-related disturbances, and the level of stress caused by sleep problems. The scale consists of seven items scored from 0 to 4. The total score that can be obtained from the scale ranges from 0 to 28. The validity and reliability of the Turkish version of ISI were demonstrated by Boysan et al.[13,14]

Sample Size

The sample size calculation was performed with the G*Power version 3.1.9 software. (Heinrich-Heine-Universität Düsseldorf, Düsseldorf, Germany) based on the results of Gonzalez-Gerez et al.[15] The power analysis results were considered for sample calculation using a one-sided hypothesis test with independent samples t-test with a confidence of 95%, power of 80%, alpha of 5%, and effect size of 0.650. As a result of the analysis, 60 patients were required.

Randomization

Randomization was carried out by a different researcher (G.B.), who was not involved in the application of interventions or evaluation of outcomes. Patients to be assigned to IG or CG were selected by simple randomization with a 1:1 allocation ratio according to a list generated by an online randomizer. Opaque and sealed envelopes were used to conceal the allocation before the intervention

Blinding

The principal investigator was blinded to the group allocation during assessment, and was not involved in the data analysis process. The participants were asked not to provide any information about their group allocation to the responsible researcher (M.A.L.) who made the assessment.

Statistical Analyze

The Statistical Package for the Social Sciences (SPSS, IBM, Armonk, NY, USA), version 21.0 was used for statistical analyses. Descriptive data were given by calculating mean, frequency distribution, minimum, maximum, standard deviation, and percentage values. The conformity of the variables to the normal distribution was examined with the Kolmogorov-Smirnov/Shapiro-Wilk test. Student's t-test was used to compare the differences between the groups in the pre-treatment and post-treatment evaluations in both groups, and $p<0.05$ was accepted as the statistical significance level.

RESULTS

The study was completed with a total of 60 participants (41 female, 19 male). There were 39 patients (42.74±14.24 years) in IG and 21 patients (41.76±11.30 years) in CG. Age, gender, body mass index, education levels and smoking status of the individuals participating in the study are shown in **Table 1** by groups. In the comparison of the demographic data of the patients included in our study, no statistically significant difference was found.

Table 1. Demographic characteristics of the groups

	Intervention Group (n=39) (Mean±SD)	Control Group (n=21) (Mean ±.SD)	p value
Age (years)	42.4±14.24	41.76±11.30	0.786
BMI (kg/m2)	27.12±4.74	26.31±4.66	0.530
Sex	**n (%)**	**n (%)**	
Male	13 (33.3)	6 (28.6)	0.705
Female	26 (66.7)	15 (71.4)	
Smoking	**n (%)**	**n (%)**	
+	6 (154)	1(4.8)	0.222
-	33 (84.6)	20 (95.2)	
Education	**n (%)**	**n (%)**	
Illiterate	0	0	
Primary school	6 (15.4)	5 (23.8)	0.722
Middle school	8 (20.5)	4 (19.0)	
University	25 (64.1)	12 (57.1)	

BMI: Body mass index , SD: Standart deviation, *p < 0.05

Primary Outcomes

There were no significant differences between the groups in terms of the MBS scores before treatment (p=0.936). The post-treatment MDS scores significantly increased in both IG and CG after treatment compared to the baseline (p<0.001), but there was a significant difference between the groups (p<0.001) (**Table 2**).

Table 2. Baseline and post-treatment MBS scores of the groups

	Intervention Group (n=39)		Control Group (n=21)		z	p
	(Mean±SD)	Min-Max	(Mean±SD)	Min-Max		
Baseline MBS	3.79±0.46	4 (3-5)	3.80±0.513	4 (3-5)	405,5	0,936
Post-treatment MBS	0.94±0.51	1 (0-2)	2.80±0.51	3 (2-4)	12,50	<0.001
p	<0,001		<0,001			

SD: Standart deviation, MBS: Modified Borg Scale, z: Mann Whitney U Test, *p < 0.05

Secondary Outcomes

There were no significant differences between the groups in terms of the NHP (part 1) scores before treatment (250.69±147.78in IG and 243.73±177.72 in CG, p=0.846). The post-treatment NHP (part 1) scores significantly increased in both groups (p<0.001), and there was no significant difference between IG and CG (p=0.395) **Table 2**).The pre-treatment NHP (part 2) scores did not significantly differ between IG and CG (in IG 3.79±2.66 and 2.76±2.83, respectively, p=0.203). The post-treatment NHP (part 2) scores significantly increased in both IG and CG compared to the baseline (p=0.003 and p<0.001, respectively), and there was no significant difference between the groups (p=0.06) (**Table 3**).

There were no significant differences between the two groups in terms of the pre-treatment ISI scores (11.21±6.55 in IG and 9.76±6.53 in CG, p=0.566). The post-treatment ISI scores significantly increased in both groups compared to the baseline (p<0.001). In addition, no significant difference was observed when the mean differences in the ISI scores between the pre- and post-treatment evaluations were compared between the two groups (p=0.272) (**Table 3**). The pre-treatment BDI scores of the two groups did not significantly differ (20.74±15.46 in IG and 19.10±14.77 in CG, p=0.78). The post-treatment ISI scores significantly increased in both groups compared to the baseline (p<0.001), with no significant difference between the two groups (p=0.174) (**Table 3**).

DISCUSSION

This study evaluated patients diagnosed with mild to moderate COVID-19 pneumonia who received an intervention program including breathing techniques and low-intensity upper and lower extremity exercises. The majority of previous studies in the literature examined the efficacy of pulmonary rehabilitation on respiratory function.[6,16] COVID-19 may

Table 3. Baseline and post-treatment outcome measures of the groups

Variables	Intervention Group (n=39)		Control Group (n=21)		z	p
	(Mean±SD)	Min-Max	(Mean±SD)	Min-Max		
NHP part1 (baseline)	250.69±147.78	234.43 (0-531.92)	243.3±177.72	262.27 (0-602.42)	397	0,846
NHP part1 (after treatment)	61.88±73.27	24.11 (0-244)	91.85±114.03	46.99 (0-401.44)	356	0,395
p	<0.001		<0.001			
NHP part2 (baseline)	3.79±2.66	3 (0-7)	2.76±2.83	2 (0-7)	329	0,203
NHP part2 (after treatment)	0.49±1.45	0 (0-7)	1.10±2.02	0 (0-7)	319,5	0,06
p	0,003		<0.001			
BDI (baseline)	20.74±15.46	18 (0-62)	19.10±14.77	16 (0-56)	391,5	0,78
BDI (after treatment)	4.59±5.72	2 (0-27)	7.19±7.56	4 (0-22)	322,5	0,174
p	<0.001		<0.001			
ISI (baseline)	11.21±6.55	11 (1-28)	9.76±6.53	11 (0-21)	372,5	0,566
ISI (after treatment)	4.62±5.10	4 (0-20)	5.52±4.56	6 (0-13)	339,5	0,272
p	<0.001		<0.001			

SD: Standart deviation, NHP: Nottingham Health Profile, BDI: Beck Depression Inventory, ISI: Insomnia Severity Index, z: Mann Whitney U Test, *p < 0.05

cause changes, especially in the respiratory system, and also the digestive, cardiovascular, musculoskeletal and many other systems.[19] The symptoms of respiratory system are the most obvious and serious, and studies have shown that pulmonary rehabilitation has a positive effect on the quality of life along with the improvement in respiratory function in patients after COVID-19 treatment.[20] We hypothesized that these clinical effects of the breathing exercise would contribute positively to the dyspnea, quality of life, sleep disorders and mood of patients after the completion of medical treatment for COVID-19.

In this study, both patient groups showed improvement in the MBS scores but there were significant differences between the two groups in the post-treatment MBS scores. Dyspnea is one of the most common symptoms after COVID-19, especially in the post-acute disease period. During this period, unless the cause of dyspnea and cough is superinfection (low saturation, newly developed consolidation, fever, and neutrophilia) or pleural inflammation, exercises, especially breathing techniques are effective in treatment.[20] Our study also showed that the exercises given in the post-discharge period significantly reduced the dyspnea scores of the patients similar to the studies in the literature. The time of regression of symptoms after COVID-19 varies. Barman et al. determined that the time until the reduction of symptoms depended on the severity of the disease and other risk factors of the patient.[21] However, a shorter recovery time (e.g.,two weeks) was noted for those with mild/moderate disease. It was also stated that this period could extend up to three months or even longer in cases with severe findings.[22] In this context, although exercise was not given to the control group, the reason for the decrease in dyspnea symptoms in that group may be due to the decrease in the effects of COVID- 19 pneumonia after discharge and the regression of the inflammatory period of the disease.

In the current study, both patient groups had improved NHP scores after treatment and there was no significant difference between the groups in relation to the total post-treatment NHP scores. The improvement in the NHP scale, which evaluates energy level, pain, emotional responses, sleep, social isolation, physical abilities and daily life activities shows that both respiratory and range of motion exercises are effective in recovery. However, in a previous study investigating the effects of exercise among 72 patients with a diagnosis of COVID-19, a significant improvement was found in quality of life in the pulmonary rehabilitation group compared to the control group receiving no rehabilitation intervention.[19] In contrast, in our study,the absence of a significant difference between IG and CG in relation to the improvement in pneumonia and other symptoms after discharge, as well as quality of life may be due to the exercises not being sufficient and not being regularly undertaken in IG.

There are many studies in the literature showing that exercises performed during the COVID-19 pandemic have a positive effect on sleep problems.[23,24] Previous studies have shown a positive effect of exercise on sleep[9] but this relationship has not been investigated in patients with COVID-19 after treatment. Both our patient groups showed an improvement in the ISI scores but there was no significant difference between the groups after treatment. This result shows that exercise therapy has a positive effect on the improvement of sleep problems, but this does not result in a significant difference, similar to our quality of life data. The reason for the lack of difference between the two groups may be that the patients could not adapt to the exercise program and they performed the exercises without supervision. According to the previous studies, exercise has a beneficial role on depression.[25,26] There are also studies in the literature showing the effectiveness of exercise in relieving depression during the COVID-19 pandemic.[27-29] However, in our study examining the effect of exercise on depression in patients after COVID-19 pneumonia, a significant improvement was found in both the intervention and non-intervention groups. In another study, which examined the effect of exercise on depression symptoms in elderly patients with COVID-19, no significant difference was found between the exercise and control groups[19] which is in agreement with our study. In the current study, we performed the first evaluation in COVID-19 patients immediately after their discharge, which may have been the reason for the high depression scores. COVID-19 pneumonia and hospitalization are factors that can affect the patient's emotional state. The improvement in pneumonia and discharge from the hospital may have positively affected the mood of the patients in both groups.

In our study,the absence of a significant difference between the groups expect in dyspnea may be due to the difficulties experienced by IG in adapting to the exercise program after an active COVID-19 infection, considering that exercises were undertaken at home and only supervised by phone calls. Patients with COVID-19 often have multisystem involvement, which results in lasting effects on quality of life, sleep and mood despite reduced dyspnea. The long-term effects of COVID-19 may also be a reason for the insufficient improvement in the quality of life, mood and sleep problems of patients. Lastly, although dyspnea symptoms improve, there may be other systemic problems associated with COVID-19 that continue in the long term after the resolution of the active infection.[19] These problems can affect patients' mood and cause sleep disorders, and consequently reduce their quality of life.

It may contribute to the literature as it is the first study to investigate the effect of home exercise program on dyspnea, functionality and mood in patients with COVID-19 pneumonia. The limitations of this study include the small sample size, patients not being randomized, and the short follow-up period (two months).

CONCLUSION

Many previous studies have described the efficacy of pulmonary exercises in improving respiratory function in patients after COVID-19 pneumonia. In our study, we considered that breathing techniques would improve respiratory capacity after COVID-19 pneumonia, resulting in an improvement in patients' quality of life and mood. However, at the end of the study, both patient groups were observed to have an improvement with no significant difference between the two. Therefore, in order to demonstrate the superiority of breathing exercises, it is considered that patients should be followed up for a longer period of time. It is also concluded that different results can be obtained from exercise programs implemented by patients under supervision.

ETHICAL DECLARATIONS

Ethics Committee Approval: The study was carried out with the permission of Kutahya Health Science University Clinical Research Ethic Committee. (Date: 30.12.2020 Decision No: 2020-08/05).

Informed Consent: All patients signed the free and informed consent form.

Referee Evaluation Process: Externally peer-reviewed.

Conflict of Interest Statement: The authors have no conflicts of interest to declare.

Financial Disclosure: The authors declared that this study has received no financial support.

Author Contributions: All of the authors declare that they have all participated in the design, execution, and analysis of the paper, and that they have approved the final version.

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