



The Effect of Pulmonary Rehabilitation on Pain, Respiratory Functions and Activities of Daily Living in COVID-19 Patients

Pulmoner rehabilitasyonun COVID-19 Hastalarında Ağrı, Solunum Fonksiyonları ve Günlük Yaşam Aktivitelerine Etkisi

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Abstract

Aim: Coronavirus disease 2019 (COVID-19) requires a multidisciplinary approach owing to its multisystem involvement. Pulmonary rehabilitation may be required in patients with COVID-19. In our study, we aimed to examine the effect of the pulmonary rehabilitation program applied after the acute period of back pain in patients with severe pulmonary involvement, dyspnea and health profiles of the patients.

Material and Method: In our retrospectively planned study, 50 patients with advanced pulmonary involvement who were treated for COVID-19 and discharged from the hospital and who were diagnosed with shortness of breath, back pain and difficulties in daily living activities in the 1st month chest diseases polyclinic controls and who were given a pulmonary rehabilitation program for a period of 1 month were included in our study. Before and 1 month after the pulmonary rehabilitation program, back pain was evaluated with the Visual Analog Scale (VAS), respiratory functions were evaluated with the Modified Medical Research Council (mMRC) Scale, and activities of daily living were evaluated with the Nottingham scale.

Results: A statistically significant difference was found between the beginning and the end of the pulmonary rehabilitation program in the mMRC Scale scores ($p<0.001$) and back pain VAS scores ($p<0.001$) was detected. Moreover, it was obtained significant improvement at baseline scores of "The Nottingham Health Profile" scores after the pulmonary rehabilitation program in all subgroups (NHP "pain": $p<0.001$, NHP "emotional reactions": $p<0.001$, NHP "sleep": $p<0.001$, NHP "social isolation": $p<0.001$, NHP "physical activity": $p<0.001$, NHP "energy level": $p<0.001$).

Conclusion: Post-COVID syndrome treatment and follow-up are important for early prevention. The pulmonary rehabilitation program applied after the acute period of with severe lung involvement COVID-19 has been seen to improve back pain, dyspnea symptoms and health profile. Need for new randomized controlled studies on this subject.

Keywords: COVID-19, Health Profile, Pulmonary Rehabilitation

Öz

Amaç: Koronavirüs hastalığı 2019 (COVID-19), çoklu sistem tutulumu nedeniyle multidisipliner bir yaklaşım gerektirir. COVID-19 hastalarında pulmoner rehabilitasyon gerekebilir. Çalışmamızda şiddetli akciğer tutulumu, nefes darlığı olan hastalarda sırt ağrısı sonrası uygulanan pulmoner rehabilitasyon programının etkisini ve hastaların sağlık profillerini incelemeyi amaçladık.

Gereç ve Yöntem: Retrospektif olarak planlanan çalışmamıza, ileri akciğer tutulumu tanısı ile COVID-19 tedavisi gören, hastaneden taburcu edilen ve göğüs hastalıkları polikliniği 1.ay kontrollerinde nefes darlığı, sırt ağrısı ve günlük yaşam aktivitelerinde güçlüğ saptanması sonrası 1 ay süre ile pulmoner rehabilitasyon programına alınan 50 hasta dahil edildi. Pulmoner rehabilitasyon programı öncesi ve 1 ay sonrasında sırt ağrısı Vizüel Analog Skala (VAS) ile, dispne düzeyi Modifiye Tıbbi Araştırma Konseyi Skalası (mMRC) ile ve sağlık profili Nottingham Sağlık Profili (NHP) skalası ile değerlendirildi.

Bulgular: Pulmoner rehabilitasyon programının başlangıcı ile bitişi arasında mMRC Skalası puanları ($p<0.001$) ve sırt ağrısı VAS puanları ($p<0.001$) arasında istatistiksel olarak anlamlı fark bulundu ($p<0.001$). Ayrıca pulmoner rehabilitasyon programı sonrası "Nottingham Sağlık Profili" puanlarında tüm alt gruplarda (NHP "ağrı": $p<0.001$, NHP "duygusal reaksiyonlar": $p<0.001$, NHP "uyku": $p<0.001$, NHP "sosyal izolasyon": $p<0.001$, NHP "fiziksel aktivite": $p<0.001$, NHP "enerji düzeyi": $p<0.001$) başlangıç puanlarına göre anlamlı iyileşme tespit edildi.

Sonuç: Post COVID sendrom erken tanı takip açısından önemlidir. Bu çalışmada şiddetli akciğer tutulumu olan COVID-19'un akut döneminden sonra uygulanan pulmoner rehabilitasyon programının sırt ağrısı, nefes darlığı semptomlarını ve sağlık profilini iyileştirdiği görülmüştür. Bu konuda yapılmış randomize kontrollü yeni çalışmalara ihtiyaç olduğunu düşünmekteyiz.

Anahtar Kelimeler: COVID-19, Pulmoner rehabilitasyon, Sağlık Profili

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INTRODUCTION

Coronavirus disease 2019 (COVID-19) is an infectious disease caused by Severe Acute Respiratory Syndrome Coronavirus 2 (SARS-CoV2), which was emerged in December 2019. In addition to causing a severe acute respiratory tract infection, COVID-19 has been observed to cause a multisystem disease which requires a multidisciplinary approach during follow-up and treatment. The most common disease-related symptoms were fever (82%), cough (61%), muscle pain (36%), dyspnea (26%).^[1,2]

We do not yet have sufficient scientific reports on the physiotherapy of COVID-19. Based on the data on the long-term follow-up results of COVID-19 patients, the importance of pulmonary rehabilitation in the follow-up of COVID-19 patients was determined. Pulmonary rehabilitation is an important part of multidisciplinary treatment and plays a very important role in the treatment, improvement and care of patients with respiratory dysfunctions. However, international indications for the application of pulmonary rehabilitation in patients have been specified by physical therapy and rehabilitation associations of many countries. In this direction, pulmonary rehabilitation guidelines have been published by the physical therapy and rehabilitation associations of many countries. It is necessary to implement an appropriate personal rehabilitation program for patients at all stages of COVID-19. This program will support the development of respiratory functions and physical strength, reduce complications related to physical inactivity, enable patients to adapt to family, work and community life as soon as possible, and increase their quality of life by reducing the risk of anxiety and depression.^[3,4]

Our aim in this study was to determine the effect of the pulmonary rehabilitation program on respiratory complaints, back pain and activities of daily living in patients who applied to the pulmonary diseases outpatient clinic after with severe pulmonary involvement COVID-19 and continued to have respiratory distress, back pain, and problems in daily living activities.

MATERIAL AND METHOD

This study was carried out in Adana City Training and Research Hospital between January and March 2021. Hospitalized after COVID-19 RT-PCR (Real time- polymerase chain reaction) test (nasopharyngeal/oropharyngeal swab sample) and positive lung computed tomography findings consistent with severe COVID-19 pneumonia, and one month after discharge, pulmonary rehabilitation program for 1 month as a result of physical therapy and rehabilitation consultation with complaints of respiratory distress, back pain and deterioration in daily living activities in chest diseases polyclinic controls the patients who were treated were included in the study. Data for the study were obtained by retrospectively scanning the files of patients who completed a one-month pulmonary rehabilitation program by March 10, 2021.

In our study, the number of patients to be reached was calculated using the G Power 3.1 program. The sample size analysis performed by accepting the type 1 error level as .05, the power as 95%, and the effect size as 0.5, revealed a minimum sample size of 45 participants. A total of 50 patient were reached at the end of the study. Pregnant women, children under 18 years of age, patients with history of lung disease and cancer, who did not meet the criteria for severe COVID-19 pneumonia, and patients with missing data were not included in the study.

As a pulmonary rehabilitation program, upper and lower extremity range of motion exercises (2x10 times/day), pursed lip breathing, diaphragm breathing and deep breathing exercises (2x4/day) were started in the patients included in the study, accompanied by a physiotherapist. As a home program, COVID-19 exercise brochures prepared by the Turkish Physical Therapy and Rehabilitation Association^[5] were given. Compliance of the patients to the program was followed up with outpatient clinic controls and weekly video phone calls.

The study was carried out with the permission of Adana City Training and Research Hospital, Clinic Ethics Committee (Date:10.03.2021, Decision No:1324). All procedures were carried out in accordance with the ethical rules and the principles of the Declaration of Helsinki.

Outcome Measures

The participants were assessed before the pulmonary rehabilitation program which was continued one month and after the end of the one-month. The Medical Research Council Scale (mMRC) was applied to assess the severity of dyspnea. The mMRC is a five-item scale based on various physical activities that cause shortness of breath. Patients are asked to mark the activity level that causes shortness of breath. Patients are asked to mark the activity level that causes shortness of breath. 0 indicates mild, 4 indicates severe shortness of breath.^[6,7] Back pain severity was assessed with a 10 cm Visual Analog Scale (VAS) (0 no pain and 10 most severe pain).^[8] The quality of life was evaluated by the Nottingham Health Profile (NHP). It is a patient-reported questionnaire that assesses quality of life according to six subscales: pain, sleep, physical mobility, energy level, emotional reaction, and social isolation. The scores range between 0 and 100, and lower scores suggest higher quality of life. The second part consists of 7 questions about whether the patient has problems in 7 different situations due to health problems and is between 0-7 points. High scores indicate an excess of health problems.^[9,10]

Statistical Analysis

SPSS version 25 (SPSS, Chicago, IL, United States of America) software were used. Mean \pm SD, median (IQR), number and percentage (%) values were given for descriptive statistics. The normality was tested by the Shapiro-Wilk test. Parametric tests (Paired Samples T Test) were used for data fitting the normal distribution, non-parametric tests (Wilcoxon Signed-Rank Test) were used for data not fitting the normal

distribution. $p < 0.05$ value was accepted statistical significant. The effect size was calculated using the G Power 3.1 Program in the analyzes performed with the Paired Samples T Test.^[11] Cohen's d values:^[12]

Effect Size (d) = 0.20 ≤ small < 0.50, 0.50 ≤ medium < 0.80 and 0.80 ≤ large effect

Effect size formula in the analyses using Wilcoxon Signed Ranks Test

$$r = Z / \sqrt{N_{\text{pairs}}}$$

and Pearson's r values:^[12]

Effect Size (r) = 0.10 ≤ small < 0.30, 0.30 ≤ medium < 0.50 and 0.50 ≤ large effect

RESULTS

A total of 50 patients were reached in our study. Patients were aged between 20 and 70 years.

Demographic and other characteristics of the patients are shown in **Table 1**.

| | | $\bar{x} \pm S.D$ | Median (IQR) |
|------------------|--------|-------------------|---------------|
| Age | | 45.30±10.73 | 44 (11) |
| Size | | 167.72±9.71 | 165 (14) |
| Weight | | 74.02±14.84 | 74.50 (16.50) |
| BMI ^a | | 26.24±4.27 | 26.13 (4.09) |
| | | N | % |
| Sex | Female | 31 | 62 |
| | Male | 19 | 38 |
| Total | | 50 | 100 |

^aBMI: Body Mass Index

NHP 'Pain', 'Emotional Reaction', 'Sleep', 'Social Isolation', 'Physical Mobility' and 'Energy' sub-dimension scores decreased significantly after one month of pulmonary rehabilitation, compared to the before. ($p < 0.001$). The total scores of NHP Parts 1 and 2 also decreased significantly compared to before ($p < 0.001$).

The effect size of the intervention was found to be 'Medium' for the 'Social Isolation' sub-dimension of the NHP 1st section and 'Large' for the other sub-dimensions. The effect size of the intervention was found to be 'Very Large' for the total scores of the NHP 1st section. The effect size of the intervention for the NHP 2nd section scores was found to be 'Medium'.

VAS scores decreased significantly after one month of pulmonary rehabilitation compared to before ($p < 0.001$). The effect size of the intervention for VAS score was 'Large'.

mMRC scores decreased significantly after one month of pulmonary rehabilitation compared to before ($p < 0.001$). The effect size of the intervention for mMRC score was 'Large'. Comparisons of scale scores at before and after pulmonary rehabilitation are shown in **Table 2**.

DISCUSSION

COVID-19 is a respiratory infectious disease that can cause long-term respiratory, physical and psychological dysfunction. It can progress with symptoms such as myalgia, arthralgia, anxiety and shortness of breath. After the acute phase, patients may experience ongoing symptoms. In many studies, it has been shown that symptoms such as shortness of breath and pain persist and progress with causing restriction in patients' daily activities.^[2,13,14]

| | | $\bar{x} \pm S.D$ | Median (IQR) | Z score | E.S | P value | |
|---------------------------------------|--------------------|-------------------|--------------|-----------------|--------------------|---------------------|---------------------|
| NHP ^e | Pain | Before | 58.76±33.59 | 59.40 (66.87) | 5.970 | 0.597 ^c | <0.001 ^a |
| | | After | 20.70±16.16 | 24.13 (33.25) | | | |
| | Emotional Reaction | Before | 43.79±31.0 | 44.78 (40.09) | 5.512 | 0.551 ^c | <0.001 ^a |
| | | After | 21.71±24.63 | 13.95 (22.24) | | | |
| | Sleep | Before | 48.56±31.58 | 60.49 (61.53) | 5.454 | 0.545 ^c | <0.001 ^a |
| | | After | 22.83±21.66 | 16.10 (43.36) | | | |
| | Social Isolation | Before | 17.66±28.94 | 0 (26.39) | 3.633 | 0.363 ^c | <0.001 ^a |
| | | After | 6.22±14.81 | 0 (0) | | | |
| | Physical Mobility | Before | 52.39±23.37 | 54.47 (31.75) | 6.032 | 0.603 ^c | <0.001 ^a |
| | | After | 17.92±12.74 | 22 (17.75) | | | |
| | Energy | Before | 96.96±10.41 | 100 (0) | 6.015 | 0.601 ^c | <0.001 ^a |
| | | After | 41.23±25.84 | 39.20 (20.60) | | | |
| | NHP-Total Score | Before | 318.15±97.23 | 322.48 (144.37) | 6.154 | 3.44 ^d | <0.001 ^b |
| | | After | 130.63±76.27 | 126.34 (93.34) | | | |
| NHP-Seven Spheres of Life Total Score | Before | 3.86±1.48 | 4 (2) | 3.262 | 0.326 ^c | <0.001 ^a | |
| | After | 3.28±1.84 | 3 (3) | | | | |
| VAS ^f | Before | 7.34±1.82 | 7 (3) | 6.216 | 0.621 ^c | <0.001 ^a | |
| | After | 2.36±1.60 | 2 (2) | | | | |
| mMRC ^g | Before | | 3 (2) | 6.652 | 0.665 ^c | <0.001 ^a | |
| | After | | 1 (2) | | | | |

^aWilcoxon Signed-Rank Test, ^bPaired Samples T Test, ^cE.S: Effect size (E.S) (r), ^dE.S: Effect Size (E.S) (d), ^eNHP: Nottingham Health Profile, ^fVAS: Visual Analog Scale, ^gmMRC: Modified Medical Research Council

COVID-19 has caused distress in all health services, including rehabilitation. Studies investigating the rehabilitation need of COVID-19 patients and whether they benefit or not have recently emerged. In the post-COVID period, patients experience severe respiratory failure requiring respiratory rehabilitation in conditions such as presence of sequelae of pneumonia and lung fibrosis. Suggestions have emerged that a pulmonary rehabilitation program can be shaped according to the individual needs of each patient. Yang et al.^[15] recommended general pulmonary rehabilitation based on 4S (simple, safe, satisfy, save) to patients with pneumonia caused by SARS-CoV2. Liu et al.^[16] found that a 6-week rehabilitation program significantly improved respiratory functions, quality of life, and anxiety in elderly patients with COVID-19. While there are suggestions that early rehabilitation may be beneficial, Italy and the Chinese Association of Rehabilitation Medicine did not recommend early pulmonary rehabilitation due to lack of well tolerance and potential of rapid desaturation.^[17,18] Considering the prevalence of physical impairment after such a critical illness, it has been reported that patients can benefit from physiotherapy during the COVID-19 recovery period after discharge from the hospital.^[19]

Through a rehabilitation program in COVID-19; a comprehensive assessment and individualized progressive treatment plan focusing on return to function, disability and community participation can help each patient to maximize their function and quality of life.^[20]

In a study evaluating symptoms and health-related quality of life after hospitalization and discharge from hospital with COVID-19, the most common ongoing symptoms were fatigue (55%), and dyspnea (42%). Researchers underlined the importance of long-term follow-up and rehabilitation program in COVID-19 patients.^[21] Demeco et al. reviewed the studies on the effect of rehabilitation in COVID-19 patients, and reported that patients who are in recovery of the post-COVID period are subjected to respiratory rehabilitation according to their clinical status.^[22] In our study, rehabilitation was applied to patients with dyspnea, pain and low health profile, and the pulmonary rehabilitation program was determined individually for the patient.

After discharge, COVID-19 patients may experience conditions that require rehabilitation, such as difficulty in breathing, post-traumatic stress disorder, and muscle weakness. A rehabilitation program is recommended for patients with mild pulmonary dysfunction to restore vitality and reduce anxiety and depression.^[23] Pulmonary rehabilitation has been recommended for patients who have passed the critical phase of lung infection, had severe COVID-19, and were discharged, but whose symptoms of pulmonary dysfunction persist.^[17,23] In our study, the patients were those who passed the critical phase of lung infection, were discharged, but still had pulmonary symptoms, as recommended.

In a study investigating the benefit of applying pulmonary rehabilitation after discharge from COVID-19 infection,

improvements in respiratory functions, quality of life, and anxiety were observed. In the same study by Liu et al. patients were recommended with respiratory muscle training, coughing exercises, diaphragm training, stretching exercises, and home exercises consisting of two sessions in a week for 10 minutes once a day during 6 weeks.^[16] Although the specific indications for COVID-19 of pulmonary rehabilitation, which is a part of the rehabilitation program, are not fully clarified, the Turkish Physical Therapy and Rehabilitation Association has published a guideline containing recommendations for pulmonary rehabilitation in patients with COVID-19, particularly considering the damage to the respiratory system.^[24]

In patients with severe COVID-19 pneumonia, it is recommended to establish an individualized pulmonary rehabilitation program for a patient who meets the criteria. General physical assessment of the patient, findings such as fever and dyspnea, blood values, radiological findings, SpO₂, range of motion (ROM), muscle strength, respiratory muscle strength, in-bed activities, functional capacity, exercise capacity and other comorbid conditions were evaluated according to the findings obtained in each patient. Accordingly, a rehabilitation program is planned. Although it is thought that pulmonary rehabilitation to be applied in this period will help the patients' problems such as dyspnea, cough and sputum, muscle weakness that may occur in respiratory and other body muscles, immobilization, anxiety and depression, there is no data in the context of evidence-based medicine. Current evidence from studies evaluating the effectiveness of pulmonary rehabilitation is largely based on studies conducted in individuals with chronic lung disease. In suitable post COVID-19 patients; mobilization, diaphragm breathing, air turning technique, pursed lip breathing may be recommended.^[25-28]

Pulmonary rehabilitation should include inspiratory muscle exercises if the inspiratory muscles are weakened in the postacute phase. Deep and slow breathing, thoracic expansion by raising the shoulders, diaphragmatic breathing, movement of respiratory muscles, and airway clearance techniques can be performed, if necessary.^[29] In our study, similar exercises were applied to the required patients.

A randomized controlled trial showed improvement in respiratory function, quality of life, and depression with 10 minutes of respiratory rehabilitation twice a week for 6 weeks after discharge.^[24]

In the WHO clinical severity of classification COVID-19; the respiratory system is severely affected between the second and fourth stage of the disease.^[30] Whether or not COVID-19 will cause a sequelae in the future is still not clear, therefore, rehabilitation programs that are applied as early as possible in the appropriate patient are crucial.

In our study, after the medical treatment for COVID-19 was completed, a one month personalized pulmonary rehabilitation program was applied to the patients during the COVID-19 recovery period.

As a result of the studies carried out during the COVID-19 pandemic, the importance of rehabilitation programs has been revealed, and physical therapy and rehabilitation clinics have started to play an active role in this regard. When necessary, patients should be directed to physical therapy and rehabilitation clinics, and patients should be provided with rehabilitation. It is stated that accelerating the recovery process with the effective and personalized rehabilitation practices of these clinics can reduce the financial losses of this disease, which brings a heavy financial burden to the our country and the world.^[31] In the current study, a significant improvement was observed in the pain and dyspnea indexes health profiles including pain, emotional reactions, sleep, social isolation, physical activity and energy status of post-COVID-19 patients with 1-month pulmonary rehabilitation program.

The limitations of our study include the differences in the psychological status of the participants, which could affect the perception of the severity of pain and dyspnea. In order to minimize the differences, patients who had completed their COVID-19 treatment, who could apply to the outpatient clinic, and who could describe their pain and dyspnea were included in the study. Another limitation was the small sample size and lack of a control group. Since the aim of the study was to compare the conditions before and after rehabilitation, the control group was not included. In our study, patients who were evaluated at the first control after having COVID-19 were included in the study. These patients were those who applied within the first month, mostly after the 2nd week of the disease. Future studies may evaluate the benefit of rehabilitation in patients with longer-term symptoms, such as 1 month or 3 months, in which the time elapsed after COVID-19 is also evaluated.

CONCLUSION

This study demonstrated that the rehabilitation program implemented due to the ongoing symptoms after the acute period of COVID-19 improved the back pain and dyspnea symptoms and health profiles of post-COVID-19 patients. Patients who have had COVID-19 and have completed their treatment may have ongoing symptoms in the early period. These patients should be evaluated as potential candidates of rehabilitation programs. Need for new randomized controlled studies on this subject.

ETHICAL DECLARATIONS

Ethics Committee Approval: The study was carried out with the permission of Adana Health Sciences University Faculty of Medicine Ethics Committee (Date: 10.03.2021, Number: 1324).

Informed Consent: All participants 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.

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