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An assessment of post-COVID-19 infection pulmonary functions in healthcare professionals

Running Title: Healthcare professionals and COVID-19

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Highlights

- The medium- and long-term effects of COVID-19 infection on pulmonary function are still unknown.
- The COVID-19 pandemic adversely affected healthcare professionals, inflicting a heavy burden on the healthcare systems of countries.
- Healthcare professionals with persistent complaints who contracted COVID-19 and returned to work using pulmonary function tests, the 6-minute walk test (6MWT), and the diffusing capacity of the lungs for carbon monoxide (DLCO) test.

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Abstract:

Introduction and Purpose: The medium- and long-term effects of COVID-19 infection on pulmonary function are still unknown. The present study aimed to investigate the pulmonary functions in healthcare professionals who had persistent complaints after contracting COVID-19 and returning to work.

Methods: The study included COVID-19-infected healthcare professionals from the Düzce University Medical Faculty Hospital who volunteered to participate. Medical histories, medical records, pulmonary function tests, the diffusing capacity of the lungs for carbon monoxide (DLCO) test, and the 6-minute walk test (6MWT) were used to collect data from all participants.

Results: The study included 53 healthcare professionals, with an average age of 38 ± 10 years (min: 24 years and max: 71 years), including 29 female (54.7%) and 24 male (45.3%) participants. Of the participants, 22.6% were smokers, 35.8% (19 individuals) had comorbidities, and 17% (9 individuals) were hospitalized. The mean length of stay was 9 ± 4 days (mean ± standard deviation). The most prevalent symptoms were weakness (88.7%), muscle aches (67.9%), inability to smell/taste (60.4%), headache (54.7%), fever (45.3%), cough (41.5%), and shortness of breath (37.7%). The mean time to return to work after a positive polymerase chain reaction (PCR) test for COVID-19 was 18 ± 13 days. The average time among post-disease pulmonary function, 6MW, and DLCO tests was 89 ± 36 days (min: 15 and max: 205). The DLCO level decreased in 39.6% (21) of the participants. Female participants had a significantly higher rate of decreased DLCO levels than male participants (25% vs. 55.2%, $p = 0.026$). DLCO levels were significantly higher in participants with long-term persistent complaints ($p = 0.043$). The later the time to return to work, the lower the DLCO value ($r = -0.290$ and $p = 0.035$). The 6MWT distance was positively correlated with hemoglobin and lymphocyte levels at the time of the disease onset and negatively correlated with D-dimer levels. The most prevalent symptoms during the control visits were shortness of breath/effort dyspnea (24.6%), weakness (9.5%), and muscle aches (7.6%).

Conclusion: Significant persistent complaints (47.2%) and low DLCO levels (39.6%) were observed in healthcare professionals during control visits at a mean time of 3 months after the COVID-19 infection. Symptoms and spirometry measurements, including DLCO, may be helpful in the follow-up of healthcare professionals who contracted COVID-19. Further comprehensive studies with long-term follow-up periods are required.

Keywords: Healthcare professional, COVID-19 infection, pulmonary function tests

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Introduction

The coronavirus disease 2019 (COVID-19) is caused by the severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2), which first appeared in Wuhan, China in December 2019, and was officially declared a global pandemic by the World Health Organization on March 11, 2020 (1). As of 13 March 2022, over 455 million confirmed cases and over 6 million deaths have been reported globally (https://www.who.int/publications/m/item/weekly-epidemiological-update-on-covid-19---15-march-2022).

The COVID-19 pandemic adversely affected healthcare professionals, inflicting a heavy burden on the healthcare systems of countries. In particular, healthcare professionals at epidemic centers were exposed to an elevated infection risk. Healthcare professionals were at risk from patient contact and affected by community-induced transmission (2, 3). In the absence of their colleagues who were sick or were quarantined during the pandemic, healthcare workers had to work extra shifts to sustain the healthcare system. They also had to quickly adapt to a various spectrum of medical interventions, as they were required to work outside of their medical specialty. In the meantime, healthcare workers had to adapt to newly published guidelines during the pandemic to treat patients diagnosed with COVID-19. They also had to make unprecedented clinical and ethical decisions determining their patients' mortality (4).

During the COVID-19 pandemic, frontline healthcare workers are more likely to encounter COVID-19 infection at the time of their return to work. The fear of being re-infected with the virus and re-infecting family members continues to affect healthcare workers who return to work after recovering from the infection. Knowing the long-term effects of COVID-19 on healthcare workers, who will be back at work and continue to be on the front line during the pandemic, is important for the healthy management of the pandemic. For this reason, various countries publish guidelines that determine the return to work criteria of healthcare workers and update these guidelines according to the course of the pandemic. For example, the guideline published by the British Columbia Ministry of Health for healthcare professionals to return to work after COVID-19 infection (http://www.bccdc.ca/Health-Professionals-

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Site/Documents/COVID19_HCW_ReturnToWorkGuidance.pdf) summarized the criteria that must be met for a healthcare worker to return to work. If the healthcare worker has mild respiratory symptoms after the isolation period is completed, it was suggested that the decision to return to work should be made on a case-by-case basis through a risk assessment by the individual healthcare worker and their leader. In general, it has been recommended that returning to work while being still symptomatic should be considered an exception, not the rule.

The long-term outcomes of people infected with SARS-CoV-2 have not yet been fully understood (5). Whilst a series of longitudinal investigations are underway to increase the knowledge and understanding, reports highlight that sustained transmission and emerging variants continue to cause global challenges to healthcare providers. Currently, it is estimated that of those infected with COVID-19 in the UK, one in ten people will experience prolonged symptoms lasting months to years including fatigue, breathlessness, neurological deconditioning (6). In addition to these symptoms; healthcare workers may continue to experience numerous symptoms (such as severe fatigue, shortness of breath, anxiety, depression, pain, persistent cough, difficulty swallowing, change in voice, incontinence, diarrhea, and dysphagia). This broad spectrum of symptoms, covering the recovery period after COVID-19 infection, shows that COVID-19 infection is not just a respiratory disorder, but a multisystem disease, therefore, the decision to return to work should be evaluated multidisciplinary (7).

The present study aimed to investigate the pulmonary functions of healthcare professionals with persistent complaints who contracted COVID-19 and returned to work using pulmonary function tests, the 6-minute walk test (6MWT), and the diffusing capacity of the lungs for carbon monoxide (DLCO) test.

Methods

Study Population

Healthcare professionals from the Düzce University Medical Faculty Hospital who contracted COVID-19 and volunteered to participate in the study between August 2020 and April 2021 were included in the study. Medical histories, medical records, pulmonary function tests, the DLCO test, and the 6MWT were used to collect data from all participants. The characteristics of the study population shown in Figure 1.

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The permission was obtained from our institutional ethics committee for the use of patient data for publication purposes (Date of Approval: 15.03.2021; Reference number/Protocol No:2021/71).

Assessments

The tests were performed by using a standard spirometer (Care Fusion Germany 234 GmbH/ SentrySuite Software version 2.7) according to American Thoracic Society criteria, while the patients were at rest and seated in the upright position.(6) A minimum of 3 satisfactory forced expiratory manoeuvers was required for each subject. Forced vital capacity (FVC), forced expiratory volume in the first second (FEV1), FEV1/FVC (%) and Forced expiratory flow between 25% and 75% of vital capacity ($FEF_{25-75\%}$), DLCO were measured. Results were expressed as absolute values and as percentages of predictive values.

Statistical Analysis

Data were entered into the SPSS 21.0 Program (Statistical Package for Social Sciences for Windows, Chicago IL USA). For the paired comparison numerical data, the Student's test was used. Chi square was used in the comparison of categorical data. Pearson correlation test was used for correlation analysis. A P value less than 0.05 was considered to be the statistically significant.

Results

Demographic And Clinical Characteristics

A total of 53 healthcare professionals, 29 female (54.7%) and 24 male (45.3%), were included in the study. Of the participants, 22% were smokers and 35.8% (19 patients) had comorbidities. The most prevalent symptoms were weakness (88.7%), muscle aches (67.9%), inability to smell/taste (60.4%), headache (54.7%), fever (45.3%), cough (41.5%), and shortness of breath (37.7%). The demographic and clinical characteristics of the healthcare professionals are shown in Table 1.

Of the participants, 14 (26.4%) were classified as moderate/severe and 39 (73.6%) as mild cases, and 9 (17%) were hospitalized. Decreased DLCO levels (<80%) were reported in 21 participants (39.6%). The most common treatments included favipiravir (92.5%), low-molecular-weight heparin (LMWH) (66%), antibiotic therapy (41.5%), and corticosteroids (18.9%). During the control visits, 47.2% (25) of the participants had persistent symptoms. The most common persistent symptoms were shortness of breath/effort dyspnea (24.6%), weakness (9.5%), and muscle aches (7.5%) (Table 2).

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The mean length of stay of the 9 hospitalized patients was 9 ± 4 days (mean ± standard deviation). The mean age of the participants was 38 ± 10 years (min: 24 years and max: 71 years). The average time among post-diagnosis pulmonary function, 6MW, and DLCO tests was 89 ± 36 days (min: 15 days and max: 205 days). The mean time to return to work after a positive PCR test result for COVID-19 was 18 ± 13 days (Table 3). The healthcare professionals' pulmonary function test and 6MWT results are shown in Table 4.

The rate of decreased DLCO was significantly higher in women than in men (25% vs. 55.2%, p = 0.026). There was no significant difference among the participants in terms of smoking status, comorbidities, severity of disease, and treatment location (Table 5).

There was no significant difference between the participants with and without decreased DLCO levels at the control visit in terms of the initial symptoms, including weakness, muscle pain, loss of smell/taste, headache, fever, cough, dyspnea, and sore throat. Although participants with shortness of breath had a higher incidence of low DLCO levels than those without this symptom, the difference was not statistically significant (55% vs. 45%, p = 0.156). The proportion of participants who reported diarrhea and had lower DLCO levels was significantly higher than that of those who did not report diarrhea (77.8% vs. 22.2%, p = 0.025) (Table 6).

A comparison of the treatment parameters revealed no significant difference between the participants with and without lower DLCO levels at the control visit (Table 7).

A comparison of the laboratory parameters revealed no significant difference between the participants with and without lower DLCO levels at the control visit. The FEV1 (%) and $FEF_{25-75\%}$ levels were significantly lower in participants with decreased DLCO levels than in those with normal DLCO levels (p = 0.014, p = 0.021, respectively) (Table 8).

A comparison of the time to return to work and DLCO values indicated that the later the return to work, the lower the DLCO value (r = −0.290, p = 0.035) (Figure 2).

The 6MWT distance was positive correlated with hemoglobin (r = 0.299, p = 0.039) and lymphocyte (r = 0.352, p = 0.014) levels when patients tested positive for SARS-CoV-2 but negatively correlated with D-dimer levels (r = −0.391, p = 0.010) (Figure 3).

Discussion

Significant persistent complaints (47.2%) in healthcare professionals at control visits at a mean period of 3 months after COVID-19 infection included shortness of breath/effort dyspnea (24.6%), weakness (9.5%), and muscle aches (7.6%). Decreased DLCO levels were observed in 40% of the cases. The $FEF_{25-75\%}$ and FEV1 (%) levels were significantly lower in participants with decreased DLCO levels than in those with normal DLCO levels.

Healthcare professionals who care for patients are the most vulnerable to COVID-19 transmission. Therefore, to ensure uninterrupted healthcare services, one of the top priorities in the fight against the pandemic is to protect healthcare professionals (9).

The present study aimed to investigate whether the effects of COVID-19 infection persisted in healthcare professionals who returned to work after being isolated and those who were assigned to priority duty during the pandemic.

At the beginning of the pandemic, the only information available about the potential damage of the infection was based on the long-term consequences of SARS-CoV-2 infection in 2003 and Middle East respiratory syndrome (MERS) ion in 2012. Further studies are required to determine the long-term effects of SARS-CoV-2 infection.

In a study by Jenny et al. (10) that reported the results of 55 patients who were followed up for 2 years, it was shown that 52% of the SARS survivors had impaired DLCO levels. Even 24 months after the disease, exercise capacity and health status were significantly lower than in the control group. In that study, 27 of the individuals included in the patient group were healthcare professionals. In addition, 29.6% of the healthcare professionals and 7.1% of the non-healthcare professionals could not return to work 2 years after the onset of the disease. The study suggested that the deep psychological trauma because of the SARS outbreak, which affected a substantial number of employees in the study's institution, accounted for the lower percentage of healthcare professionals returning to work when compared to non-healthcare professionals. Another study on the permanent pulmonary effects of surviving healthcare professionals 15 years after SARS-CoV infection assessed the pulmonary function tests and lung tomography results of 58 healthcare professionals. More than 30% of the SARS survivors had impaired DLCO levels, and more than 30% had small airway dysfunction 15 years after the onset of SARS. Abnormalities in CT scans persisted in more than 20% of the patients with SARS. It was reported that SARS infection could cause permanent damage, and health authorities should provide further support for early pulmonary rehabilitation (11). Although 14 (26.4%) participants had moderate/mild infection in the present study, decreased DLCO levels were observed in 39% of the cases, and small airway functions and FEV1 (%) were significantly lower in participants with decreased DLCO levels. Based on the study that

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reported permanent abnormalities in pulmonary function even 15 years after the onset of SARS infection, healthcare professionals can be scheduled to undergo pulmonary function tests when they return to work after being infected with SARS-CoV-2, and the same can be repeated at certain intervals in those with lower rates.

Although many studies have been conducted on the pathogenesis and treatment of acute SARS-CoV-2 disease, the medium- and long-term outcomes have not yet been fully understood, especially in survivors who had a severe prognosis. Güler et al. included 113 patients in their study, which was the first in Europe to report post-SARS-CoV-2 infection follow-up results. There were 66 severe/critical and 47 mild/moderate cases. They assessed the pulmonary functions 4 months after the onset of the COVID-19 infection. In patients with severe/critical disease, the DLCO level was impaired and significantly lower than in those with mild/moderate disease. As a result, they suggested that the lower DLCO levels (%) at month 4 was the most important factor associated with severe/critical COVID-19 infection (12).

A study by Liang et al. (13) with 76 participants, which investigated the sequelae in patients discharged in the third month after COVID infection, included 65 healthcare professionals. During follow-up in the 3 months after hospital discharge, 15 (20%) patients had fever, 45 (60%) patients complained of cough, 33 (43%) had increased sputum production, 47 (62%) had chest tightness and palpitations during activity, 45 (60%) complained of fatigue and 20 (26%) patients had diarrhea. Similarly, in the present study, the most common persistent symptom was shortness of breath. The frequency of cough was not as high as in the aforementioned study because most of our followed-up patients were mild outpatients. Liang et al. demonstrated that lymphocyte count was significantly correlated with symptoms of chest tightness and palpitations after patients were discharged from the hospital. In the present study, the 6MWT value had a positive correlation with lymphocyte count and hemoglobin levels. Liang et al. identified 21 patients (27%) with impaired pulmonary function at 3 months following discharge. In the present study, 21 (39.6%) patients had decreased DLCO levels and the rate of decrease was significantly higher in female participants than in male participants. Low DLCO levels were also significantly associated with participants who had persistent complaints and returned to work at a later time.

Zhao et al. (14) investigated 55 patients who recovered from COVID-19 infection in the third month after COVID and reported that 25% of them had abnormal findings on pulmonary function tests, although most patients did not have any respiratory symptoms. They reported

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anomalies in total lung capacity (TLC) in 7% of patients, FEV1 in 11%, FVC in 10%, DLCO in 16%, and small airway function in 13%. In the present study, there was a decrease in pulmonary function (DLCO). Although the majority of patients did not have respiratory symptoms, lower DLCO levels suggested that a pulmonary function screening be performed upon return to work and at regular intervals.

Wu et al. (15) investigated pulmonary functions at 3, 6, 9, and 12 months after discharge in 83 patients with severe COVID-19 who did not require mechanical ventilation. After 1 year, 9 (11%) patients had low FVC levels and 27 (33%) had impaired DLCO values. Although most of our participants had mild infections, the rate of decreased DLCO level was similar in the present study.

At 6 months after recovery from infection, George et al. (16) screened healthcare professionals with mild COVID-19 infection for cardiovascular anomalies. The study included 74 seropositive and 75 seronegative cases that were compatible in terms of age, gender, and ethnicity. There was no difference in terms of cardiovascular complications, and they suggested that cardiac screening was not indicated in asymptomatic patients after mild COVID-19 infection. The present study found a decrease in DLCO levels but did not screen the participants for cardiac anomalies.

The present study had certain limitations. Firstly, the study included 53 patients with only confirmed SARS-CoV-2 infection. A larger sample size would be ideal for further studies. Secondly, we could not measure pulmonary function tests in critically ill patients because such patients were not included in this study. This was a single-center study. The control period of the patients we included in the study was not standardized and it included a wide range. Further studies should be planned to investigate long-term pulmonary status (impairment or improvement) based on a larger sample size and groups involving an equal number of patients.

Conclusion

Significant persistent complaints (47.2%) and low DLCO (39.6%) levels were observed in healthcare professionals during the control visits at a mean time of 3 months after COVID-19 infection. Symptoms and spirometry measurements, including DLCO, may be useful in the follow-up of healthcare professionals with COVID-19 infection. In particular, 6MWT and DLCO measurements may aid in the decision to return to work for healthcare professionals with persistent complaints after COVID-19 infection. Healthcare professionals with impaired

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pulmonary function should be evaluated on a regular basis. Further comprehensive studies with long-term follow-up periods are required.

References:

1. Zhu N, Zhang D, Wang W, Li X, Yang B, Song J et al. A novel coronavirus from patients with pneumonia in China, 2019. N Engl J Med 2020; 382: 727–733.

2. Eren E, Çelik İ, Yıldız M, Topaloğlu US, Toker AK, Fırat EA et al. Evaluation of Health Care Workers With COVID-19. Klimik Journal 2020; 33:230-234.

3. Xiong Y, Zhang Q, Sun D, Zhu W. Clinical and CT characteristics of healthcare workers with COVID-19: A single-centered, retrospective study. Medicine (Baltimore). 2020;99(30):e21396.

4. Krystal JH. Responding to the hidden pandemic for healthcare workers: stress. Nat Med. 2020 May;26(5):639.

5. Ashton R, Ansdell P, Hume E, Maden-Wilkinson T, Ryan D, Tuttiett E et al. COVID-19 and the long-term cardio-respiratory and metabolic health complications. Rev Cardiovasc Med. 2022 Feb 9; 23: 53.

6. Mahase E. Covid-19: What do we know about "long covid"? British Medical Journal. 2020; 370: m2815.

7. Graham BL, Steenbruggen I, Miller MR, Barjaktarevic IZ, Cooper BG, Hall GL et al. Standardization of Spirometry 2019 Update. An Official American Thoracic Society and European Respiratory Society Technical Statement. Am J Respir Crit Care Med. 2019; 200 :e70-e88.

Journal Pre-proof

8. Rao S, Amara V, Chaudhuri S, Rao BK, Todur P. "Post-COVID-19 syndrome:" The New Pandemic Affecting Healthcare Workers and How the Frontline Warriors Are Battling it. Indian J Palliat Care. 2021 Apr-Jun;27(2):313-318.

9. Centers for Disease Control and Prevention. Interim U.S. guidance for risk assessment and public health management of health care personnel with potential exposure in a health care setting to patients with 2019 novel coronavirus (2019-nCoV). Available from: www.cdc.gov/coronavirus/2019-ncov/hcp/guidance-riskassesment-hcp.html. Accessed date: 1 November 2020

10. Ngai JC, Ko FW, Ng SS, To KW, Tong M, Hui DS. The long-term impact of severe acute respiratory syndrome on pulmonary function, exercise capacity and health status. Respirology. 2010; 15: 543-550.

11. Li J, Zheng Y, Zhao L, Yue Z, Pan F, Chen Y et al. Investigation of the impact of SARS-CoV infection on the immunologic status and lung function after 15 years. BMC Infect Dis. 2021 Nov 24; 21: 1183.

12. Guler SA, Ebner L, Aubry-Beigelman C, Bridevaux PO, Brutsche M, Clarenbach C et al. Pulmonary function and radiological features 4 months after COVID-19: first results from the national prospective observational Swiss COVID-19 lung study. Eur Respir J. 2021 Apr 29;57:2003690.

13. Liang L, Yang B, Jiang N, Fu W, He X, Zhou Y et al. Three-month Follow-up Study of Survivors of Coronavirus Disease 2019 after Discharge. J Korean Med Sci. 2020 Dec 7; 35: e418.

14. Zhao YM, Shang YM, Song WB, Li QQ, Xie H, Xu QF et al. Follow-up study of the pulmonary function and related physiological characteristics of COVID-19 survivors three months after recovery. EClinicalMedicine. 2020 Aug; 25: 100463.

15. Wu X, Liu X, Zhou Y, Yu H, Li R, Zhan Q et al. 3-month, 6-month, 9-month, and 12-month respiratory outcomes in patients following COVID-19-related hospitalisation: a prospective study. Lancet Respir Med. 2021 Jul; 9: 747-754.

16. Joy G, Artico J, Kurdi H, Seraphim A, Lau C, Thornton GD et al. Prospective Case-Control Study of Cardiovascular Abnormalities 6 Months Following Mild COVID-19 in Healthcare Workers. JACC Cardiovasc Imaging. 2021; 14:2155-2166.

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Table legends:

Table 1. Demographic and clinical characteristics of healthcare professionals who contracted COVID-19

Table 2. Disease severity. treatment. prolonged symptoms. and DLCO values of the healthcare professionals who had COVID-19

Table 3. Age laboratory parameters. and time to return to work in healthcare professionals who had COVID-19

Table 4. Pulmonary function tests and 6MWTs of healthcare professionals who Table 5. A comparison of cases with and without lower DLCO levels at the control visit had COVID-19

Table 6. A comparison of the initial symptoms of the cases with and without decreased DLCO levels at the control visit

Table 7. A comparison of treatment and persistent COVID-19 complaints in cases with and without lower DLCO levels at the control visit

Table 8. A comparison of laboratory and pulmonary function test parameters of the cases with and without decreased DLCO levels at the control visit

Figure legends:

Figure 1.The characteristics of the study population

Figure 2. Correlation between the time to return to work and DLCO value

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Figure 3. Correlation between 6MWT and hemoglobin, lymphocyte, and D-dimer levels

Figure 1.The characteristics of the study population

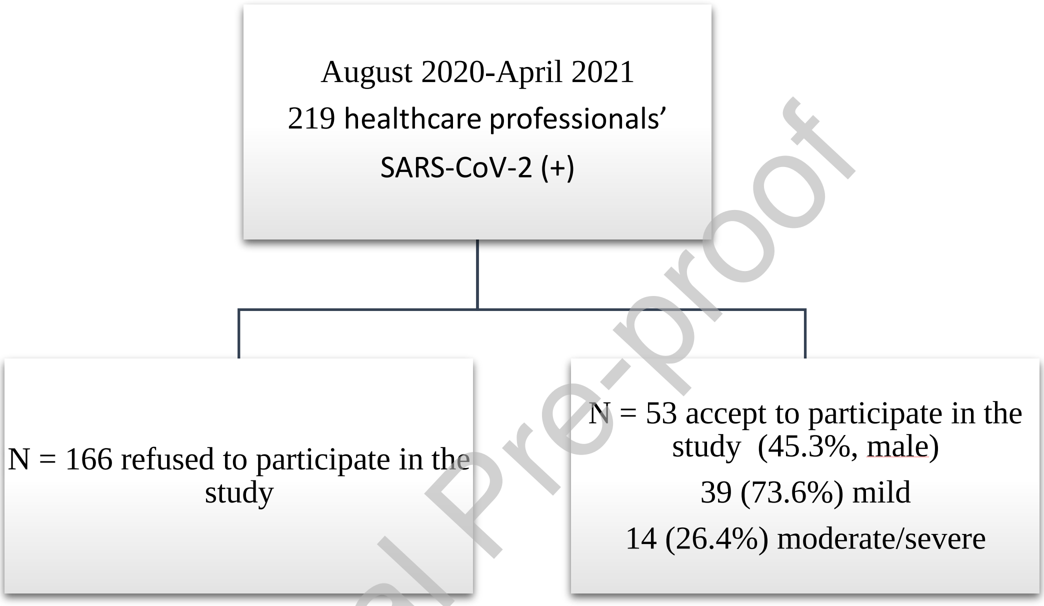

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Figure 2 : Correlation between the time to return to work and DLCO value

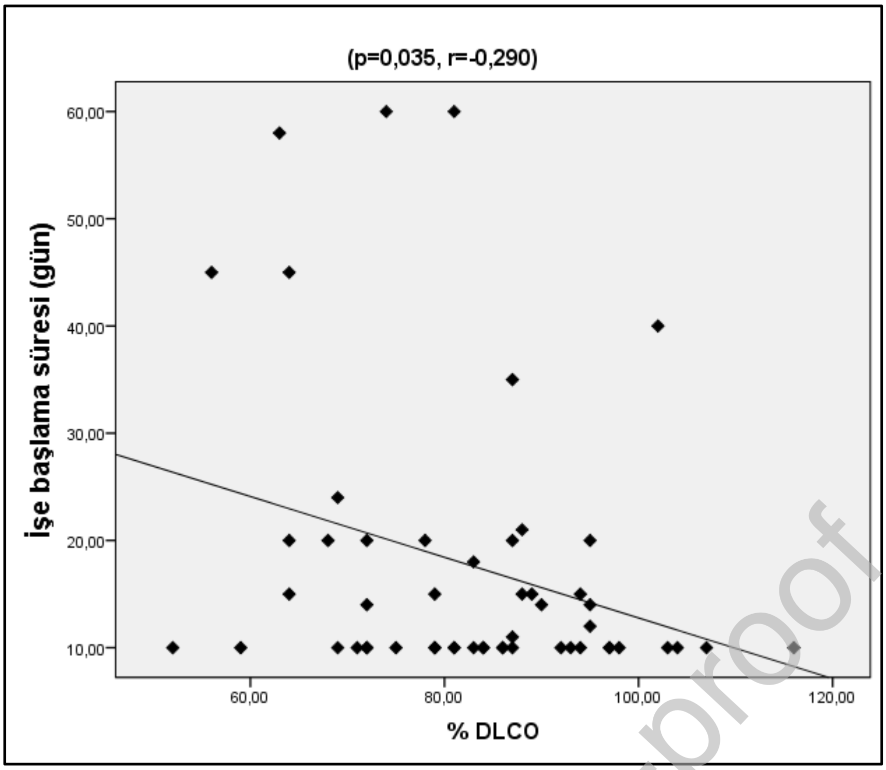

Figure 3. Correlation between 6MWT and hemoglobin, lymphocyte, and D-dimer levels

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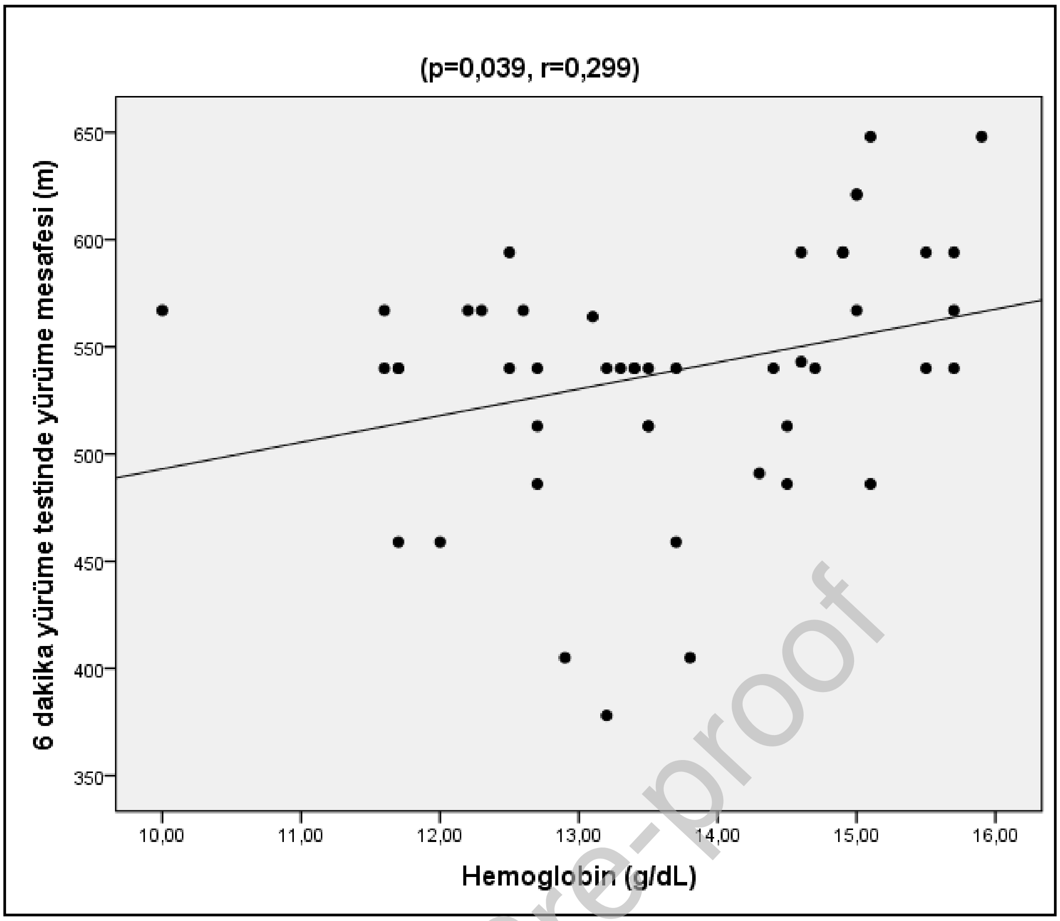

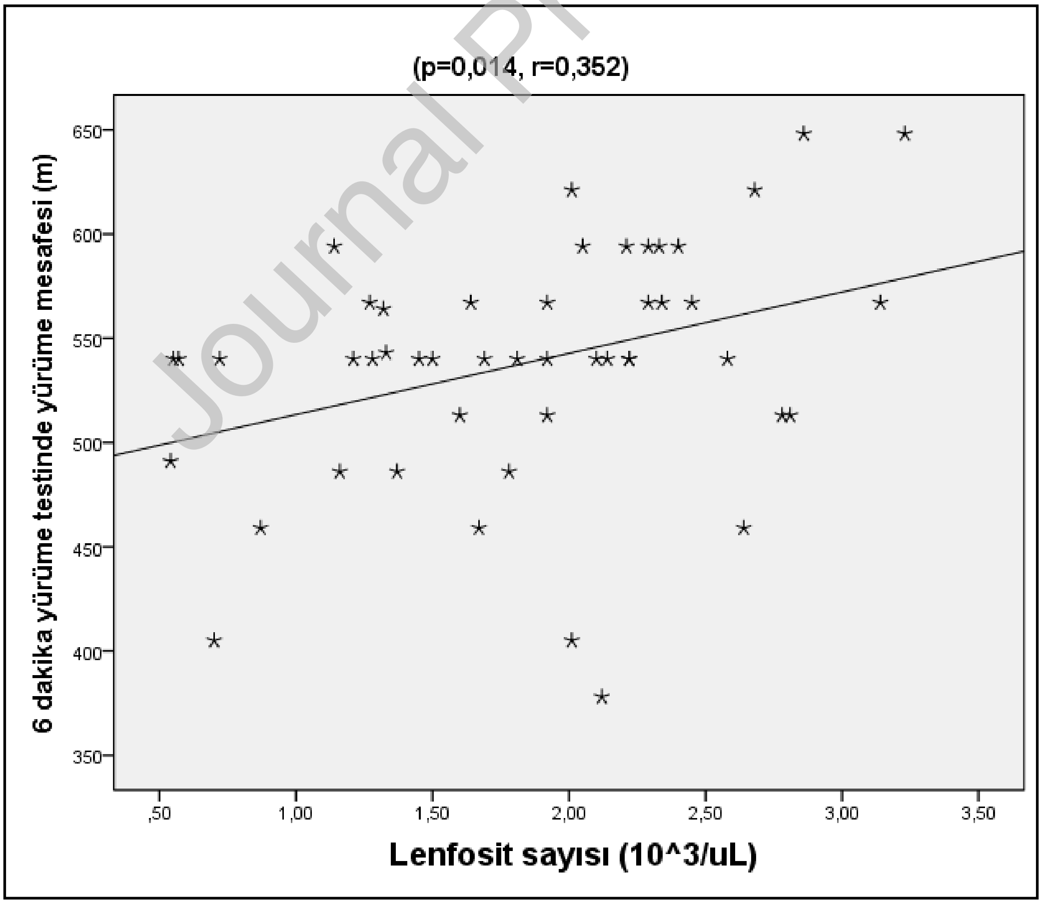

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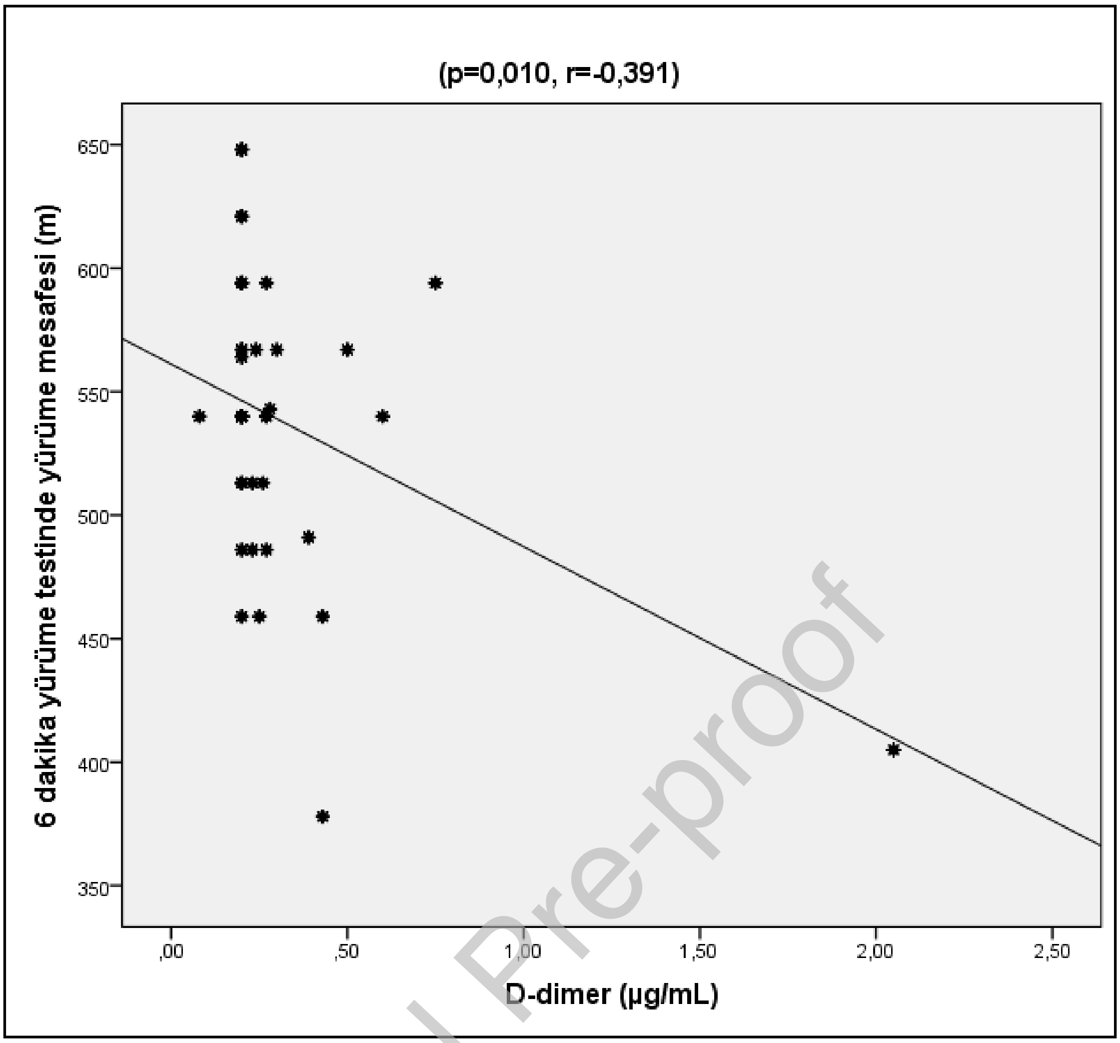

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Table 1. Demographic and clinical characteristics of healthcare professionals who contracted COVID-19

	N (%)
Gender	
Male	24 **(45.3)**
Female	29 **(54.7)**
Smoker	12 **(22.6)**
Comorbidity	19 **(35.8)**
Comorbidities	
None	42 **(79.2)**
Hypertension	4 **(7.5)**
Asthma	4 **(7.5)**
Other	11 **(20.8)**
Symptoms	

Weakness	47 **(88.7)**
Muscle pain	36 **(67.9)**
Odor-taste loss	59 **(60.4)**
Headache	29 **(54.7)**
Fever	24 **(45.3)**
Cough	22 **(41.5)**
Dyspnea	20 **(37.7)**
Sore throat	10 **(18.9)**
Diarrhea	9 **(17.0)**

Table 2. Disease severity. treatment. prolonged symptoms. and DLCO values of the healthcare professionals who had COVID-19

	N (%)
COVID-19 disease severity	
Mild	39 **(73.6)**
Modarete/Severe	14 **(26.4)**
Treatment	
Outpatient	44 **(83.0)**
Inpatient	9 **(17.0)**
Treatment Features	
Favipiravir	49 **(92.5)**
LMWH	35 **(66.0)**
Antibiotic	22 **(41.5)**
Steroid therapy	10 **(18.9)**
Oxygen support	7 **(13.2)**
Tocilizumab	3 **(5.7)**
NIMV	2 **(3.8)**
Prolonged ongoing symptoms	25 **(47.2)**
Dyspnea	13 **(24.6)**
Weakness	5 **(9.5)**
Muscle pains	4 **(7.5)**
Other	3 **(5.7)**
DLCO (low*<%80)*	21 **(39.6)**

LMWH: low molecular weight heparin **NIMV:** Non invasive mechanical ventilation **DLCO:** diffusing capacity of carbon monoxide

Table 3. Age laboratory parameters. and time to return to work in healthcare professionals who had COVID-19

	Mean ± SD	**(min-max)**
Age (year)	38±10	(24-71)

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Hospitalization (day)	9±4	(3-18)
Ferritin (ng/mL)	204±312	(8-1789)
D-dimer (µg/mL)	0.30±0.30	(0.08-2.05)
CRP (mg/dL)	1.66±2.93	(0.06-12.40)
SPO_2 (%)	96±1	(90-98)
LDH (IU/L)	215±89	(118-471)
Hemoglobin (g/dL)	13.7±1.4	(8.4-16.8)
Leukocyte (10^3/uL)	6.525±1.985	(2.300-10.900)
Lymphocyte (10^3/uL)	1.850±0.690	(0.540-3.23)
Control time (day)	89±35	(15-205)
Back to work (day)	18±13	(10-60)

CRP: C reactive protein **± SD:** standard deviation **LDH:** lactate dehydrogenase **min-max:** minimum-maximum

Table 4. Pulmonary function tests and 6-minute walk test of healthcare professionals who had COVID-19

	Ortalama ± SD	**(min-max)**
Spirometry		
FVC (%)	102±13	(73-130)
FEV1 (%)	99±12	(74-129)
FEV1/FVC	81±5	(63-92)
FEF_{25-75} (%)	88±20	(40-144)
DLCO (%)	82.7±13,7	(52.0-116.0)
6 minutes walking test		
Walking distance (m)	538±57	(378-648)
Pre-oxygen Saturation (%)	97±2	(93-99)
Post-oxygen Saturation (%)	97±2	(87-99)
Pre-systolic blood pressure (mmHg)	110±10	(90-140)
Post-systolic blood pressure(mmHg)	115±20	(80-160)
Pre-pulse rate/min	82±11	(62-110)
Post-pulse rate/min	115±16	(85-160)

± SD: standard deviation **min-max:** minimum-maximum **FVC:** Forced vital capacity FEV1: Forced expiratory volume in the first second $FEF_{25-75\%}$: Forced expiratory flow between 25% and 75% of vital capacity

Table 5. A comparison of cases with and without lower DLCO levels at the control visit

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	DLCO normal	*DLCO düşük*	***p***
	n (%)	***n (%)***	
Gender			
Male	18 (75.0)	6 (25.0)	***0.026***
Female	13 (44.8)	16 (55.2)	
Smooker			
No	25 (61.0)	16 (39.0)	*0.524*
Yes	6 (50.0)	6 (50.0)	
Comorbidity			
No	22 (64.7)	12 (35.3)	*0.256*
Yes	9 (47.4)	10 (52.6)	
Disease severity			
Mild	15 (65.2)	8 (34.8)	*0.732*
Modarete/Severe	8 (57.1)	6 (42.9)	
Treatment			
Outpatient	27 (61.4)	17 (38.6)	0.464
Inpatient	4 (44.4)	5 (55.6)	

DLCO: diffusing capacity of carbon monoxide

Table 6. A comparison of the initial symptoms of the cases with and without decreased DLCO levels at the control visit

	DLCO normal	*DLCO low*	***p***
	n (%)	***n (%)***	
Weakness			
No	3 (50.0)	3 (50.0)	*0.683*
Yes	28 (59.6)	19 (40.4)	
Muscle pain			
No	9 (52.9)	8 (47.1)	*0.769*
Yes	22 (61.1)	14 (38.9)	
Loss of smell/taste			
No	11 (52.4)	10 (47.6)	*0.572*
There İs	20 (62.5)	12 (37.5)	
Headache			
No	15 (62.5)	9 (37.5)	*0.780*
Yes	16 (55.2)	13 (44.8)	
Fever			
No	19 (65.5)	10 (34.5)	*0.278*
Yes	12 (50.0)	12 (50.0)	
Cough			
No	20 (35.5)	11 (64.5)	*0.398*
There İs	11 (50.0)	11 (50.0)	

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Dyspnea			
No	22 (66.7)	11 (33.3)	*0.156*
Yes	9 (45.0)	11 (55.0)	
Throat ache			
No	26(60.5)	17(39.5)	*0.724*
Yes	5 (50.0)	5 (50.0)	
Diarrhea			
No	29 (65.9)	15 (34.1)	***0.025***
Yes	2 (22.2)	7 (77.8)	

DLCO: diffusing capacity of carbon monoxide

Table 7. A comparison of treatment and persistent COVID-19 complaints in cases with and without lower DLCO levels at the control visit

	DLCO normal	***DLCO low***	***p***
	n (%)	***n (%)***	
Favipiravir			
No	2 (50.0)	2 (50.0)	*0.720*
Yes	29 (59.2)	20 (40.8)	
LMWH treatment			
No	8 (44.4)	10 (55.6)	*0.155*
Yes	23 (65.7)	12 (34.3)	
Antibiotic treatment			
No	20 (35.5)	11 (64.5)	*0.398*
Yes	11 (50.0)	11 (50.0)	
CS treatment			
No	26 (60.5)	17 (39.5)	*0.780*
There İs	5 (50.0)	5 (50.0)	
Pulse-Steroid treatment			
No	30 (62.5)	18 (37.5)	*0.066*
There İs	1 (20.0)	4 (80.0)	
O2 treatment			
No	29 (63.0)	17 (37.0)	*0.113*
Yes	2 (28.6)	5 (71.4)	
High Flow O_2 treatment			
No	30 (62.5)	19 (37.5)	*0.294*
Yes	1 (25.0)	3 (75.0)	
Tociluzimab			
No	31(62.0)	19 (38.0)	*0.724*
Yes	- (0)	3 (100)	
NIMV			
No	30 (58.8)	21 (41.2)	*0.804*

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Yes	1 (50.0)	1 (50.0)

LMWH: low molecular weight heparin **NIMV:** Non-invasive Mechanical Ventilation

DLCO: diffusing capacity of carbon monoxide **CS:** corticosteroid

Table 8. A comparison of laboratory and pulmonary function test parameters of the cases with and without decreased DLCO levels at the control visit

	DLCO normal	***DLCO low***	**p**
	Mean ± SD	**Mean ± SD**	
Age (year)	38±10	38±10	*0.731*
Hospitalization (day)	6±4	11±4	*0.133*
Ferritin (ng/mL)	267±390	129±158	*0.146*
D-dimer (µg/mL)	0.27±0.14	0.34±0.43	*0.707*
CRP (mg/dL)	1.73±2.76	1.55±2.25	*0.794*
SPO_2 (%)	97±2	95±8	*0.951*
LDH (IU/L)	211±85	220±95	*0.793*
Hemoglobin (g/dL)	14.0±1.3	13.2±1.4	*0.096*
Leukocyte (10^3/uL)	6.425±1.976	6.652±2.038	*0.568*
Lymphocyte (10^3/uL)	1.823±0.230	1.885±0.650	*0.701*
Visit time (day)	67±38	71±41	*0.465*
Back to work (day)	14±7	23±18	*0.052*
Spirometry			
FVC (%)	104±13	97±13	*0.083*
FEV1 (%)	102±11	94±13	***0.014***
FEV1/FVC	82±4	81±6	*0.533*
FEF25-75 (%)	92±16	81±24	***0.021***
6 minutes walking test *(m)*	541±62	533±51	*0.362*

CRP: C reactive protein **± SD:** standard deviation **LDH:** lactate dehydrogenase **DLCO:** diffusing capacity of carbon monoxide

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