DOI 10.4149/BLL_2024_90

Bratisl Med J 2024; 125 (9):
580–586

COHORT STUDY

Evaluation of functional status and quality of life of patients in the 1st and 6th months post-COVID in the light of radiological influence

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ABSTRACT

OBJECTIVE: The aim of the study is to evaluate the functional status and quality of life parameters of patients in the 1st and 6th months post-COVID and to determine contributing factors.

BACKGROUND: The effects of COVID-19 can continue in the post-COVID period. The most common post-COVID symptoms are weakness, fatigue, nonproductive cough and exertional dyspnea.

METHOD: The radiological findings of the patients at diagnosis, post-COVID 1st and 6th months; functional status and quality of life parameters at the 1st and 6th months of the post-COVID period were compared, and the factors affecting them were evaluated. The relationship between radiological involvement, quality of life and functional status parameters was investigated.

RESULTS: Six months after the COVID infection, inpatient's resting oxygen saturation and effort capacity were comparable, even though they were significantly lower in the first month post-COVID. There was a correlation between functional and quality of life measures at 1 and 6 months after COVID-19 infection. In all patients, a significant improvement was found in the functional status and quality of life scales at 6 months after post-COVID infection compared to the 1st month. Even though radiological findings of both groups improved within the first month after COVID-19 infection, there remained a difference between them that disappeared after six months.

CONCLUSION: It was found that in the post-COVID period, the severity of the disease had a negative effect on functional measurements and quality of life; however, regardless of the severity of the disease, after six months improvements in radiological findings, effort capacity, and quality of life measures were noted *(Tab. 2, Fig. 5, Ref. 20)*. Text in PDF www.elis.sk

KEY WORDS: post-COVID, quality of life, functional measurements, chest x-ray.

Introduction

COVID-19 is a pandemic associated with high morbidity and mortality risk classified as Coronavirus Disease 2019 by the World Health Organization in February 2020 (1). As COVID-19 can be asymptomatic, it can also cause severe pneumonia and multiple organ failures (2).

The term "acute COVID" refers to the period of time that COVID-19 symptoms last from the beginning of the illness to 4 weeks; "subacute COVID" is the period that lasts from 4 to 12 weeks; and "post-COVID" is the period beyond 12 weeks. Long-term COVID-19 syndrome refers to the symptomatic period following acute COVID-19 (3). In 10% to 20% of patients diagnosed with COVID-19, symptoms lasted longer than one month, while in 2.3% of patients, the symptoms continued for more than 12 weeks (4). The severity of the disease in the acute period and the presence of comorbidities such as chronic lung disease, diabetes, and hypertension are associated with deterioration in functional state parameters in the post-COVID period (5). Although the underlying biological mechanisms of post-COVID syndrome are unknown, it is believed that the rise of macrophage activation syndrome plays an important role (4, 6). The most common symptoms are fatigue, dyspnea, anxiety, depression, attention deficit, memory loss, and sleep problems (6).

It was aimed to assess the radiological findings, functional status, and quality of life parameters of patients in the 1st and 6th months of the post-COVID period and identify the factors affecting these parameters in this study.

Method

Design of the study

Between April 2020 and June 2021, patients who applied to the Clinic of Breast Diseases at the University of Manisa Celal Bayar, Hafsa Sultan Hospital, who were diagnosed with SARS-CoV-2 infection and who had a chest x-ray in the 1st and 6th months,

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6MWT, and surveys conducted to evaluate quality of life in the first and sixth months when the disease was diagnosed were included in the study. Patients under the age of 18 and pregnant patients who did not prove infection with PCR were excluded from the study.

Short Form-36 (SF-36), Pittsburgh Sleep Quality Index (PSQI), Visual Analog Scale for pain (VAS), Fatigue Severity Score (FSS), and Hospital Anxiety and Depression Scale (HAD) were used to evaluate quality of life parameters. 6-minute walking test (6MWT) and distance (6MWD), the Borg dyspnea scale, and mMRC were used to assess functional parameters. Chest x-rays were evaluated using the Modified Brixia Score in COVID-19 diagnosis and post-COVID 1st and 6th months.

485 patient records were examined; 188 patients were excluded from the study when they were diagnosed with COVID-19, 83 patients in the post-COVID 1 month period, and 128 patients in the post-COVID 6-month period due to the lack of chest x-ray. Of the 86 patients diagnosed with COVID-19 and who had a chest x-ray, 22 were not included in the study due to the lack of data in surveys of functional status or quality of life parameters in the 1st or 6th month post-COVID. A total of 64 patients were included in the study. The flow diagram of our work is presented in Figure 1.

This study was approved by the Clinical Research Ethics Board Committee of the Faculty of Medicine on July 25, 2022, by Decision No. 313.

Data collection

Sociodemographic data of patients (age, gender, smoking status, comorbidities, body mass index, treatment form, and steroid treatment) were recorded. The Short Form-36 (SF-36), Pittsburg Sleep Quality Index (PSQI), Visual Analog Scale for pain (VAS), Fatigue Severity Score (FSS), and Hospital Anxiety and Depression Score (HAD) were used to evaluate patient's quality of life parameters in the 1st and 6th months after COVID. The short Form-36 evaluated a person's health status over the last 4 weeks using 8 subparameters of a total of 36 items. The subparameters include physical function, physical role, pain, general health perception, vitality, social function, emotional role, and mental health. The highest number ("100") is the lowest number ("0"). High scores indicate good health (7). The Pittsburgh Sleep Quality Index is a 19-point scale that evaluates sleep quality and interruptions over the past month. It consists of 24 questions: 19 to answer and 5 to be answered by your spouse or roommate. The 18 questions on the scale consist of 7 components: subjective sleep quality, sleep latency, sleep time, usual sleep performance, sleep disorders, sleep medication use, and daytime dysfunction. Each component is rated from 0 to 3. The total score of 7 components gives the total scale score. The total score varies from 0 to 21. A total score greater than 5 indicates poor sleep quality (8,9). The Visual Analog Scale was applied to all patients in post-COVID 1 and 6 months to subjectively evaluate myalgia. The patient marks the point he feels represents his perception of his current condition on a 10-cm line (10). The Fatigue Severity Score was applied in the 1st and 6th months post-COVID to determine fatigue levels. The scale consists of nine items, and each item is rated between "I totally disagree" and "I absolutely agree". Patients are asked to rate the scale based on their condition from the previous week, and the total scores are divided by nine after that; >4 points indicate pathological fatigue (11). The Hospital Anxiety and Depression Scale is a scale that is frequently used in a hospital environment to scan for symptoms of anxiety or depression. Of the 14 components, seven are for anxiety and seven for depression. The lowest score for each item is 0, and the highest score is 3. High scores are in the disease's favor (12).

Chest x-rays of patients diagnosed with COVID-19 were evaluated using the Modified Brixia Score, a semi-quantitative scoring system at the time of diagnosis and in the 1st and 6th months post-COVID diagnosis, with significant prognostic value. Modified Brixia Scoring is an 18-point pulmonary chart scoring system developed to facilitate clinical evaluation of the severity of COVID-19 in patients. The lungs are divided into six distinct regions based on identified anatomical points; each area of the lungs is rated 0–3 based on the prevalence of the disease. The score for the lack of pulmonary abnormalities is 0, interstitial infiltrates are 1, interstitial and alveolar infiltrates are 2, and interstitially predominant alveolar infiltrates are 3, respectively. The modified Brixia score of 6 and above has a sensitivity of 77% and a specificity of 73% in estimating intubation needs. This value has been found to provide optimum sensitivity and specificity. Higher Brixia scores are associated with higher mortality (13). The 6-minute walking test (6MWT) and distance (6MWD), the Borg dyspnea scale, and the mMRC were used to assess the functional characteristics. The Modified Medical Research Council Dyspnea Scale (mMRC) is a five-digit scale with a 0–4 score system that questions the patient's dyspnea status (14). The Modified Borg Scale is a scale used to assess the intensity of effort and rest dyspnea. It has ten components that categorize the severity of dyspnea (15). The results of chest x-rays performed in patients at the time of diagnosis of COVID-19 and the progression of radiological findings in the first and sixth

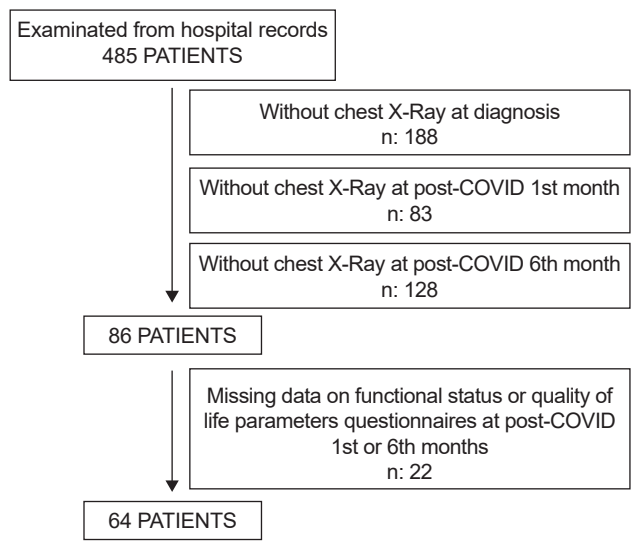

Fig. 1. Flow Diagram.

Tab. 1. Sociodemographic and clinical data.

Gender, n (%)	
Male	39 (60.9)
Age, n (%)	
<40 years	11 (17.2)
40–60 years old	40 (62.5)
>60 years	13 (20.3)
BMI, n (%)	
25.0–29.9	28 (43.8)
30.0–39.9	24 (37.5)
>40	1 (1.6)
Cigarette pack-year, n (%)	
Smoker	21 (32.8)
Comorbidity, n (%)	
with comorbidity	31 (48.4)
DM	19 (29.7)
HT	20 (31.3)
CAD	3 (4.7)
COPD	2 (3.1)
Asthma	7 (10.9)
Treatment Method, n (%)	
Outpatient	21 (32.8)
Service	39 (60.9)
Intensive care unit	4 (6.3)
Treatment, n (%)	
Steroids	38 (59.4)
Pulse steroids	5 (7.8)

BMI – Body Mass Index, DM – Diabetes mellitus, HT – hypertension, CAD – Coronary artery disease, COPD – Chronic obstructive pulmonary disease

months after COVID were evaluated, as were the relationships between treatment patterns, radiological results, functional status, and quality of life parameters in the first and sixth months, as well as the factors affecting these parameters.

Statistical analysis

The study included 64 patients with 80% strength and 5% statistical significance. The data obtained in the study were evaluated statistically using the "SPSS Statistics 21" program. As defining statistics, frequency, percentage values, median (inter-quarter gap), mean, and standard deviation values were determined. First, it was assessed whether the data were normally distributed with the Kolmogorov–Smirnov test. There were no data points that did not match the normal distribution. Comparisons of numerical variables that fit the normal distribution were made using the Student T-Test. The Ki-quarters test was utilized to compare categorical variables. A linear regression analysis was performed to determine variable factors. To identify the factors influencing the quality of life, a comparative Pearson correlation analysis was performed. $p<0.05$ was considered statistically significant.

Results

Of the 64 patients included in the study, 25 (39.1%) were female and 39 (60.9%) were male. The number of patients in the 40–60 age group was 40 (62.5%), and 31 (48.4%) of the patients had at least one comorbidity. Hypertension (31.3%) was the most common comorbidity. Most of the patients were inpatients, and most of them were given steroid therapy. Sociodemographic and clinical characteristics of the patients are presented in Table 1.

The average total COVID score in the 1st month post-COVID was significantly higher in women ($p=0.02$) whereas in the 6th month post-COVID it was similar in both sexes ($p=0.96$). In the post-COVID 1st and 6th months, the average fatigue severity score was significantly higher in women ($p=0.05$ and $p<0.001$ respectively). Post-exercise Borg dyspnea scores were significantly higher in women after the 1st and 6th months post-COVID ($p<0.001$ and $p=0.01$ respectively) (Fig. 2a).

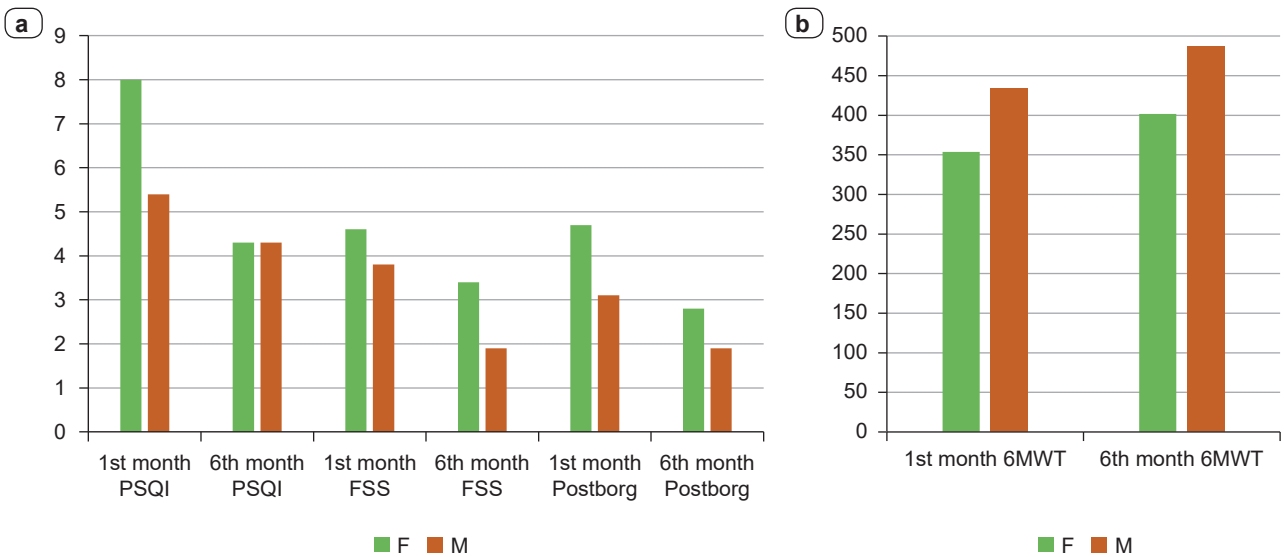

Fig. 2. The relationship between sex and quality of life and functional status at 1st and 6th months post-COVID (1a) and the relationship between sex and 6MWM at 1st and 6th months post-COVID (1b).

Although age, BMI, and the average Brixia scores in the beginning, post-COVID 1st and 6th months were similar in both sexes, when assessing the capacity to exercise, 6DYM in women was observed to be significantly lower in the 1st month ($p<0.001$) and in the 6th ($p<0.001$) (Fig. 2b).

In the first month of post-COVID treatment, when the relationship between treatment method and quality of life and functional status parameters was assessed, the physical role score from the SF-36 parameters was significantly lower in patients treated while hospitalized ($p=0.04$). Also, in the group of patients receiving hospital-based treatment, 6DYM ($p=0.01$) and average oxygen saturation (SaO_2) at rest ($p<0.001$) were significantly lower; the VAS score ($p=0.02$) was significantly higher. In the sixth month post-COVID, all functional conditions and quality of life parameters were similar among outpatients and inpatients (Fig. 3).

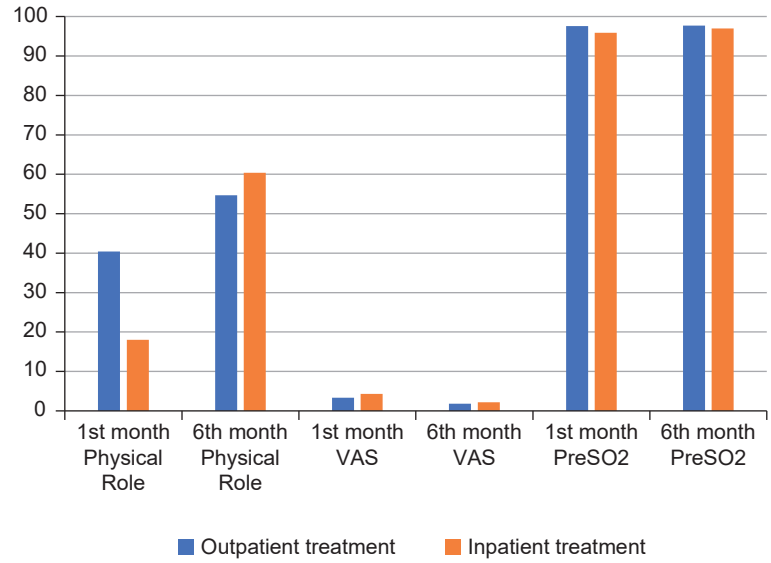

Fig. 3. Comparison of quality-of-life parameters and functional status at 1st and 6th months post-COVID in outpatients and inpatients.

All patients' quality of life parameters were compared in the 1st and 6th months post-COVID. The post-COVID average total score was 6.4 in the first month and 4.3 in the sixth month, with a significant improvement in the total score ($p=0.01$). Significant improvement was observed in the subparameters of the PSQI: subjective sleep quality ($p=0.01$), sleep latency ($p=0.01$), insomnia ($p<0.001$), sleep medication use ($p=0.04$), daytime dysfunction ($p=0.04$). The average overall health score in the first month after COVID improved significantly by 41.0 and 50.8 in the sixth month ($p<0.001$). Significant improvements were observed in the subparameters of SF-36: physical function ($p<0.001$), physical role score ($p<0.001$), pain ($p<0.001$) and vitality ($p<0.001$). Chronic fatigue was observed in 11 patients in the 1st month post-COVID and only in 2 in the 6th month. The average fatigue severity score for patients in the 1st month post-COVID was 4.1, and the average fatigue severity in the 6th month after COVID improved significantly to 2.42 ($p<0.001$). The mean score for anxiety ($p=0.02$) and the average score for depression ($p<0.001$) both showed significant improvement (Fig. 4a).

Patients with post-COVID demonstrated a considerable improvement in exercise capacity, with an average 6MWD of 402.5 meters in the first month and 453.7 meters in the sixth month ($p<0.001$). The average SaO_2, Borg dyspnea score throughout the rest and post-effort tests, and mMRC score all showed significant increases after the exercise test (Fig. 4b).

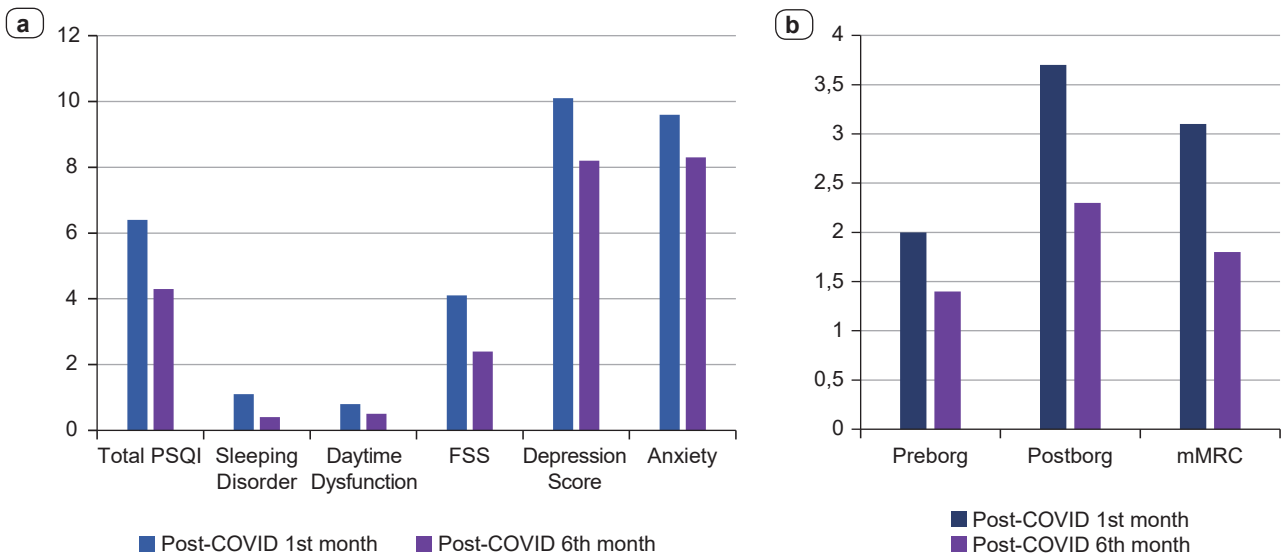

Fig. 4. Comparison of quality-of-life parameters at 1st and 6th months post-COVID (a) and comparison of functional status parameters at 1st and 6th months post-COVID (b).

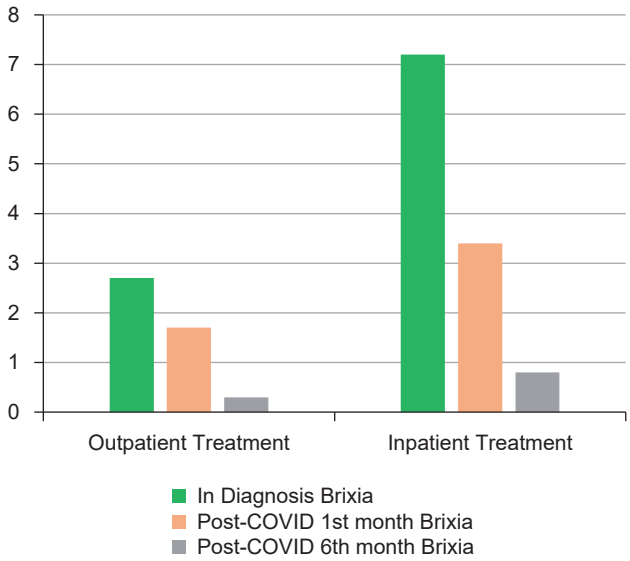

Fig. 5. Relationship between treatment modality and Brixia scores in the diagnosis of COVID-19 and post-COVID 1st and 6th months.

The measures of the patient's quality of life were compared to their functional state. A correlation was observed between total PSQI score and mMRC score, rest, and post-exercise Borg dyspnea score in post-COVID 1st month. ($p<0.001$, r:0.408, $p=0.01$, r:0.322, $p<0.001$ and r:0.418, respectively). A negative correlation between total PSQI score and 6MWT was found in the 6th month post-COVID ($p=0.05$, r:–0.242). Negative correlation between subjective sleep quality, need for sleeping medication, and daytime dysfunction score from the PSQI subparameters and 6MWT at 1st and 6th months of post-COVID; physical function score from the SF-36 subparameter, correlated with an average of 6MWT, rest, and post-exercise SaO2. At the 1st and 6th months post-COVID, the physical function score from the SF-36 subparameter was correlated with an average of 6MWT, rest, and post-exercise SaO2. A negative correlation was observed between the fatigue severity score and 6MWT in the post-COVID 1st and 6th months ($p=0.01$, r:–0.333; $p<0.001$, r:0.592 respectively). In addition, chronic fatigue was detected in most functional state parameters. A negative correlation was found between the presence of depression and post-exercise SaO2 and between the presence of anxiety and post-exercise SaO_2 and 6MWT.

The highest Modified Brixia Score in the first month of post-COVID treatment was in the patient group treated at the ICU, with an average of 7.7. The average Modified Brixia Score was 2.9 and 1.7, respectively, for inpatient and outpatient groups. In the sixth month post-COVID, the modified brixia score showed significant improvement in all patient groups ($p<0.001$) (Fig. 5).

When all patients were evaluated, the mean Brixia score in the chest x-ray at the time of diagnosis of COVID-19 was 5.8, in the first month post-COVID it was 2.8, and in the sixth month it was 0.7. Significant improvement was observed when comparing Brixia scores at the time of diagnosis of COVID-19 and in the first month post-COVID ($p<0.001$). Furthermore, when compared with Brixia scores at the first and sixth months post-COVID, the improvement in chest x-ray continued, and this improvement was statistically significant ($p<0.001$) (Tab. 2).

Tab. 2. Comparison of Brixia scores at the time of diagnosis of COVID-19 and at the 1st and 6th months of post-COVID according to the type of treatment.

(mean ± SD)	Brixia score in diagnosis of COVID-19	Post-COVID 1st month Brixia score	Post-COVID 6th month Brixia score
Outpatient	2.7 ± 3.7	1.7 ± 2.5	0.3 ± 1.2
Inpatient	7.2 ± 4.4	3.4 ± 3.1	0.8 ± 1.3
p	<0.001	0.04	0.21

Discussion

Our study investigated the relationships between the functional conditions of patients and quality of life parameters in the subacute and post-COVID periods and the factors that influenced these relationships. Chronic fatigue scores were higher in post-COVID women in the first and sixth months; post-exercise dyspnea was more pronounced, and exercise capacity was lower. In a study that evaluated a total of 487 patients with SARS-CoV-2 RT-PCR positivity with a chest x-ray and 6MWT at an average of 75 days, dyspnea was reported more frequently in women, and effort capacity was found to be low (16). In a third-month follow-up of 538 patients with SARS-CoV-2 infection, women showed more physical loss, fatigue, and post-exercise dyspnea (17), and another cohort analysis showed greater pain and emotional strength in women in the first month post-COVID (18). These differences in the post-COVID process in women are thought to be due to many factors, such as the different effects of viral infection on both sexes, the different immune response and treatment response in women and men, social isolation in women during the acute infection period, and more frequent observation of anxiety and depression (19).

Quality of life was similar in inpatients and outpatients at the first and sixth months post-COVID. Effort capacity was lower in the first month post-COVID in patients requiring hospitalization; there was no difference in functional parameters between inpatients and outpatients at the sixth month. When all patients were evaluated in the sixth month, improvements were observed in the quality of sleep, reduced need for sleeping pills, shortened time for falling asleep, and decreased daytime dysfunction as compared to the first month post-COVID. Improvements in overall health scores, emotional state, mental health, physical function, and pain complaints were observed. Average fatigue severity, anxiety, and depression scores improved. Increases in exercise capacity, improvements in average post-exercise oxygen saturation, reductions at rest, and post-exercise dyspnea were also detected. As a result, a significant improvement in both functional parameters and quality of life parameters was observed in the sixth month compared to the first month post-COVID.

In the first month post-COVID, there was an improvement in chest radiography findings in all patients. Although the radiological findings improved in relation

to the severity of the disease in the inpatient group, the findings continued. In those patients with high lung involvement in the 1st month post-COVID, oxygen saturation and exercise capacity were lower, and dyspnea was more common. In the sixth month post-COVID, most patients showed improvement in lung radiogram results, and functional condition and quality of life parameters were better than in the first month after COVID. This suggests that a substantial recovery has been achieved in the sixth month after COVID-19.

In a study that compared radiologically patients diagnosed with post-COVID lung injury developed at least 12 weeks after the acute infection period and patients diagnosed with idiopathic pulmonary fibrosis; patients with post-COVID lung injury had higher ground glass opacity scores, while patients with idiopathic pulmonary fibrosis had higher pulmonary fibrosis scores. In evaluating the effect of radiological involvement on functional status parameters, patients with high fibrosis scores had a shorter 6-minute walk distance and lower pre- and post-test oxygen saturation levels; mMRC scores were higher. The ground glass opacity score was not found to be associated with functional parameters (20).

In a study of post-COVID patients, the patient's capacity to exercise in monitoring decreased as the hospital stay extended. Abnormal chest x-ray findings were found in the majority of patients with the diagnosis of COVID-19, and none of the outpatients were found to have permanent abnormal radiogram findings in the 75-day follow-up; persistent infiltrates or atelectasis were observed on the radiograph in some of the hospitalized patients (16).

In post-COVID patients who had poor sleep quality in the first and sixth months and had a high score of fatigue severity, dyspnea was more frequent and exercise capacity was lower. The post-COVID functional impairment observed in our patients at the 1st and 6th months also negatively affected their quality of life. A cohort study involving a total of 361 patients with a predominantly mild patient group showed a deterioration in health-related quality of life in the 1st month post-COVID and a negative correlation between the severity of the disease and the physical function, overall health, and mental health scores from the SF-36 subparameters; the more severe the disease, the more serious the effect on physical health, emotional well-being, and mental well-being after being discharged from the hospital (18).

Our study is a cohort study where patients were evaluated in the 1st and 6th months post-COVID by both quality-of-life scales and functional state parameters. In addition, patients were evaluated in terms of lung involvement at the time of diagnosis, at the 1st and 6th months post-COVID, and the relationship between radiological findings and functional status and quality of life parameters was investigated. The strengths of our study are the relatively long follow-up period from diagnosis of COVID-19 to the 6th month post-COVID and the radiological evaluation with the Brixia score, which is an important prognostic value.

The limitations of our study are the inability to evaluate the efficacy of corticosteroid therapy since it was performed in a single center; the number of patients included in the study was relatively low as a result of the lack of files of the patients followed up as post-COVID; and the dose and duration of corticosteroid therapy in inpatients could not be clearly obtained from the file records. In addition, this patient group could not be included in the study due to the small number of patients hospitalized in the intensive care unit.

Learning points

In our study, it was observed that the severity of the disease in COVID-19 adversely affected the quality of life and functional parameters in the post-COVID period, and this effect was higher in women. Despite this negative effect, regardless of disease severity, improvements in exercise capacity and quality of life and improvements in radiological findings were observed at 6 months compared to 1 month.

All patients diagnosed with COVID-19, a multisystemic disease, should be followed up in the post-COVID period. We think that informing the patients that their complaints will regress, and their physical functions and quality of life will improve within a period of approximately six months may contribute to the healing process of the disease.

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Received August 18, 2023.
Accepted March 14, 2024.