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The Impact of COVID-19 Positivity on Quality-of-Life and Musculoskeletal Symptoms

COVID-19 Pozitifliğinin Hayat Kalitesi ve Kas İskelet Semptomları Üzerine Etkisi

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ABSTRACT

Objective: The outbreak of Coronavirus disease-2019 (COVID-19) spread rapidly all over the worldwide and caused a pandemic. There are few studies in the literature that have investigated musculoskeletal symptoms of the disease, other than pulmonary symptoms. This study aimed to evaluate chronic musculoskeletal symptoms, quality of life, physical activity, and fatigue severity scores of patients with COVID-19 infection.

Methods: A total of 235 patients who presented at our clinic between April and June 2021, were separated into two groups according to COVID-19 positivity (Group 1, n=75) and negativity (Group 2, n=160). The groups were compared with respect to demographic data, musculoskeletal pain and location, Visual Analogue Scale scores, Short Form-36 (SF-36) quality of life scores, physical activity scores, and fatigue severity scores.

Results: Back pain, shoulder pain and the pain parameter of the SF-36 quality-of-life scale were significantly higher in the chronic period of COVID-19 patients (Group 1). A significant decrease was determined in the physical activity of COVID-19 patients (Group 1) evaluated with international physical activity scores, and the fatigue severity scores were significantly higher in these patients.

Conclusion: Fatigue decreased activity, diminished quality of life, and especially back pain can be observed in the chronic period of patients with COVID-19. These effects of COVID-19 should be considered during musculoskeletal system examinations.

Keywords: COVID-19, musculoskeletal symptoms, quality of life, fatigue

ÖZ

Amaç: Koronavirüs hastalığı-2019 (COVID-19) hızlıca yayılarak tüm dünyayı etkiledi ve sonuçta pandemi olarak ilan edildi. Literatürde; sıklıkla hastalığın bilinen solunum yolları semptomları haricinde özellikle kas iskelet sistemi semptomlarını araştıran çok az çalışma vardır. Çalışmamızın amacı; COVID-19 geçiren hastaların kronik kas-iskelet sistemi semptomlarını, yaşam kalitesi, fiziksel aktivite ve yorgunluk düzeylerini tespit etmektir.

Yöntem: Nisan-Haziran 2021 tarihleri arasında polikliniğimize başvuran 235 hasta çalışmaya alındı. Hastalar; COVID-19 enfeksiyonu geçirenler Grup 1 (n=75), geçirmeyenler Grup 2 (n=160) olmak üzere iki gruba ayrıldı. Hastaların demografik verileri, kas iskelet sistemi ağrısının şiddeti ve yeri, Vizuel Analog Skala skorları, Kısa Form-36 (SF-36) yaşam kalitesi ölçeği skorları, fiziksel aktivite skorları ve yorgunluk şiddet ölçeği skorları kıyaslandı.

Bulgular: COVID-19 geçirmiş (Grup 1) hastaların kronik dönemde sırt ve omuz ağrıları ile SF-36 hayat kalitesi ölçeğinde ağrı parametresi istatistiksel olarak COVID-19 geçirmeyen hastalara (Grup 2) göre daha anlamlı bulundu. Ayrıca uygulanan fiziksel aktivite ve yorgun şiddeti ölçeklerinde COVID-19 geçiren hastalarda (Grup 1) fiziksel aktivitenin anlamlı derece azaldığını ve bu hastaların anlamlı derecede daha yorgun olduklarını tespit edildi.

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Sonuç: COVID-19 geçiren hastalarda kronik dönemde devam eden yorgunluk, aktivite ve yaşam kalitesinde azalma ve özellikle sırt ağrısı izlenebilir. Kas iskelet sistemi muayenesinde COVID-19 hastalığının bu etkisi göz önünde bulundurulmalıdır.

Anahtar Kelimeler: COVID-19, kas-iskelet sistemi, yaşam kalitesi, yorgunluk

INTRODUCTION

First identified in Wuhan, China in December 2019, the Severe acute respiratory syndrome-Coronavirus-2 (SARS-CoV-2) spread around the globe rapidly. On March 11th, 2020, the Coronavirus disease-2019 (COVID-19) was declared as a pandemic by the World Health Organization.[1] In addition to symptoms such as fever, cough, sore throat, and dyspnea, frequent signs include musculoskeletal symptoms such as myalgia, arthralgia, and fatigue.[2] According to the relevant literature, fatigue has a prevalence of 25.6% and myalgia/arthralgia between 10-50%.[3,4]

After acute COVID-19 infection, some chronic symptoms such as fatigue, dyspnea, pain, physical inability to perform daily activities, depression, stress, anxiety, and insomnia may persist for over 4 weeks, and this condition has been named prolonged-COVID-19. If the aforementioned symptoms last more than 12 weeks, this is classified as post-COVID-19 syndrome.[5] Only a few studies have investigated COVID-19 patients in terms of quality of life [via Short Form-36 (SF-36) survey], physical activity, and fatigue levels in the chronic phase, with pain localization and severity.[6-8]

This study aimed to evaluate pain location and severity, SF-36 quality of life scores, physical activity values, and fatigue levels in patients in the chronic phase of COVID-19 compared with patients with no history of COVID-19, all of whom presented at our outpatient clinic because of musculoskeletal pain.

METHODS

This cross-sectional study was conducted at the İzmir Atatürk Training and Research Hospital between April 2021 and June 2021. A total of 265 patients were enrolled in the study. Following the exclusion of 30 patients who had been hospitalized during the acute infection, the remaining 235 patients (168 females, 67 males; mean age: 48±15.95 years; range, 18 to 85 years) who presented at the outpatient clinics with the complaint of chronic musculoskeletal pain were included in the study. Written informed consent was obtained for participation in the study from the patients. The study was performed according to the principles of the Declaration of Helsinki, and approval was granted by the Local Ethics Committee of the İzmir Kâtip Çelebi University (date: 01.04.2021, no: 169) and the Republic of Turkey Ministry of Health. Patients were excluded from the study if they had any inflammatory disease, bone fracture, sports injury, trauma, or chest pain. The patients included for evaluation were those with the neck, back, lower back, joint, and extremity pain and those with complaints that were not pathologies of organic origin.

The patients were separated into two groups according to whether they had a history of COVID-19 positivity (confirmed with polymerase chain reaction test). Group 1 included patients with COVID-19 infection and Group 2, patients with no history of COVID-19 infection. The demographic data were recorded then all the patients were evaluated with respect to the complaints of musculoskeletal pain, using Visual Analogue Scale (VAS) scores, the SF-36 health quality of life, the International Physical Activity Questionnaire (IPAQ)-short form, and the Fatigue Severity Scale (FSS).

Clinical Evaluations

To determine pain location, the patients were shown an image of the body marked into nine regions of the neck, shoulder, back, elbow, hand/wrist, lower back, hip/thigh, knee, and foot/ankle, and were instructed to indicate the locations of pain.

Pain severity was evaluated using a VAS.[9] The patients were instructed to rate the pain severity from 0 to 10, where 0 indicates no pain and 10 indicates the most severe pain ever experienced in their life, to provide a numerical rating for pain severity.

The SF-36 is a 36-item scale used to evaluate the quality of life, which has undergone reliability and validity studies in Turkish.[10] The SF-36 has 8 subscales: physical functioning, social functioning, mental health, role limitations due to physical health (role physical), role limitations due to emotional problems (role emotional), vitality/energy, bodily pain, and general health. The total score from the scale ranged from 0 to 100, with higher scores indicating better quality of life. The scale evaluated the patient status in the last four weeks.

The IPAQ was developed to determine the physical activity levels. Turkish validity and reliability studies have been conducted.[11] The IPAQ short form consists of 7 items questioning the time spent walking, doing moderate to high-intensity or high-intensity physical activities, and the time spent sitting in 24 h. The total score of MET-minute (Metabolic Equivalent of Task minutes per week) is obtained as the total time (minutes) and frequency (days) of walking, doing moderate to high-intensity physical activity, and doing a high-intensity physical activity. The energy required for each activity is calculated using the MET minute score, and standard MET values have been

established for these activities: 3.3 METs for walking, 4.0 METs for moderate physical activity, 8.0 METs for high-intensity physical activity, and 1.5 METs for sitting. Using these values, the daily and weekly physical activity levels are calculated and then classified in one of three activity levels: Category 1 (C1: Low level: <600 MET-min/week), Category 2 (C2: Moderate level: 600-3000 MET-min/week), or Category 3 (C3: High level: >3000 MET-min/week).

Fatigue severity was evaluated using the FSS. The Turkish validity and reliability studies of the FSS were conducted by Armutlu et al.[12] The FSS consists of 9 items related to fatigue levels in the last month, each scored from 1 to 7. The final score is the average score of all questions, and the cut-off value is 4. A score of ≥4 indicates severe fatigue and a score <4 indicates no fatigue.

Statistical Analysis

The study data were analyzed statistically using Statistical Package for the Social Sciences (SPSS) 22.0 software (IBM SPSS Statistics for Windows, version 22.0. Armonk, NY, USA). The conformity of the data to a normal distribution was assessed using the Shapiro-Wilk test and the Kolmogorov-Smirnov test. Quantitative data were stated as mean±standard deviation and categorical values as number (n) and percentage (%). The mean difference between dependent groups of numerical variables was examined using the Student's t-test and the chi-square test. A value of $p<0.05$ was considered statistically significant.

RESULTS

The evaluation was made of 235 patients: 75 in Group 1 and 160 in Group 2. COVID-19 vaccinations had were received as 1 dose by 16 patients and 2 doses by 23 in Group 1, and as 1 dose in 20 patients and 2 doses in 90 patients in Group 2. The demographic characteristics of the patients are shown in Table 1. No significant difference was determined between the groups with respect to demographic data.

In Group 1, the mean time from COVID-19 diagnosis to presentation at the outpatient clinic was 6.75±2.76 months. The symptoms recorded during COVID-19 infection were fever in 27 patients, cough in 44, fatigue in 58, loss of smell and/or taste in 53, and other symptoms in 71 (Table 1). The mean VAS scores for all 9 anatomic regions of both groups are shown in Table 2. In the comparisons between Groups 1 and 2, shoulder and back pain were determined at a significantly higher rate in Group 1 ($p=0.028$ and $p=0.000$, respectively). No significant difference was determined between the groups in terms of overall VAS scores.

The pain parameter of the SF-36 was significantly higher in Group 1 than in Group 2, but there was no difference in terms of the other parameters (Table 3). The mean IPQA scores showed significantly lower activity levels in Group 1 (Table 4). According to the FSS values, severe fatigue was more common in Group 1 than in Group 2 (Table 4).

DISCUSSION

The most important findings obtained from this study were that patients with a history of COVID-19 infection reported significantly more pain, undertook a significantly less physical activity, and experienced significantly more fatigue after the disease compared with patients with no

Table 1. Patient demographics

	Group 1	Group 2	p
Number of patients	75	165	
Gender (female/male)	52/23 (69.3%/30.7%)	116/44 (72.5%/27.5%)	0.616
Age	49.93±13.69	51.78±15.56	0.493
Height	168.2±10.06 cm	164.93±8.61 cm	0.624
Weight	74.94±15.75 kg	74.09±14.06 kg	0.677
Marital status Single Married	 33 (44%) 42 (56%)	 61 (38.1%) 99 (61.9%)	0.674
Educational status Illiterate Primary school High school University	 2 (2.7%) 33 (44%) 14 (18.7%) 26 (34.6%)	 4 (2.5%) 64 (40%) 40 (25%) 52 (32.5%)	0.696
Concomitant disease: Yes/No	21/54 (28%/72%)	59/101 (36.9%/63.1%)	0.181
How much time passed after COVID-19 infection?	6.75±2.76 (months)		

COVID-19: Coronavirus disease-2019

Table 2. Comparison of Group 1 and Group 2 regarding pain location and VAS scores						
	Group 1 (n)	**Group 2 (n)**	**p[a]**	**VAS Score Group 1**	**VAS Score Group 2**	**p[b]**
Neck	36 (48%)	74 (46.3%)	0.802	6.36±1.97	6.95±1.85	0.123
Shoulder	34 (45.3%)	49 (30.6%)	**0.028**	6.94±1.75	6.65±2.07	0.511
Back	53 (70.7%)	43 (26.9%)	**0.000**	6.90±1.84	6.81±1.85	0.809
Elbow	11 (14.7%)	14 (8.8%)	0.170	6.54±1.21	5.57±2.65	0.272
Lower back	36 (48%)	63 (39.4%)	0.212	6.47±2.10	6.95±2.06	0.272
Hand / wrist	15 (20%)	27 (16.9%)	0.560	5.50±1.82	6.29±1.97	0.218
Hip / thigh	13 (17.3%)	15 (9.4%)	0.079	5.66±3.42	6.73±1.94	0.317
Knee	16 (21.3%)	35 (21.9%)	0.925	5.81±2.71	6.60±1.81	0.227
Foot /ankle	13 (17.3%)	35 (21.9%)	0.421	4.87±1.85	4.85±1.98	0.112
VAS: Visual Analogue Scale [a]: chi-square test, [b]: t-test						

Table 3. SF-36 quality of life scores			
	Grup 1	**Grup 2**	**p***
Physical functioning	67.62±28.05	59.43±33.18	0.066
Social functioning	57.82±23.67	60.34±23.09	0.439
Role physical	42.78±48.09	37.34±46.91	0.412
Mental health	48.88±48.19	60.00±47.40	0.097
Vitality (energy)	50.60±19.72	53.53±19.60	0.287
Role emotional	58.45±16.30	60.02±15.97	0.486
Bodily pain	57.43±22.86	50.17±21.66	**0.019**
General health	65.33±16.03	67.85±15.71	0.257
*: t-test, SF-36: Short Form-36			

Table 4. Comparison of Group 1 and Group 2 regarding IPAQ scores and FSS scores			
	Grup 1 (n)	**Grup 2 (n)**	**p***
IPAQ Category 1 Category 2 Category 3	 43 (57.3%) 23 (30.7%) 9 (12%)	 60 (37.5%) 78 (48.8%) 22 (13.8%)	**0.014**
FSS Score Fatigue Not fatigue	 5.17±1.32 62 (82.7%) 13 (17.3%)	 4.66±1.62 109 (68.1%) 51 (31.9%)	**0.020**
*: chi-square test. IPAQ: International Physical Activity Questionnaire, FSS: Fatigue Severity Scale			

history of COVID-19. There was also a greater likelihood of patients in the chronic phase of COVID-19 having back and shoulder pain.

The SARS-CoV-2 virus is believed to primarily infect type 2 pneumocytes in the respiratory system, which contain ACE 2 (angiotensin converting enzyme 2) and TMPRSS2 (type 2 transmembrane serine protease) receptors.[13] Therefore, it was initially thought that COVID-19 primarily affected the respiratory system, but the observation of viremias originating from the alveolar epithelium suggested that cells of other tissues such as the musculoskeletal system could also be susceptible to COVID-19 infection.[4] These findings suggested that the bone, skeletal muscle, synovium, and partially the articular cartilage, which express ACE 2 and TMPRSS2, are potential sites for SARS-CoV-2 infection.[13] Some hypotheses put forth that the persistence of symptoms after an acute COVID-19 infection is due to immune-mediated triggering of the autonomic nervous system.[8]

Musculoskeletal pain such as myalgia and arthralgia, is common in COVID-19 infection.[3] A previous study of post-COVID syndrome symptoms reported ongoing pain at a rate of 26-33%.[5] In the current study, patients presenting with pain were evaluated, so the patients in the study sample had pain in at least one region of the body. Patients in Group 1, with a history of COVID-19 infection, mostly described back (70.7%), neck (48%), and lower back (48%) pain during the chronic phase after infection, while Group 2, with no history of COVID-19, mostly described neck (46.3%), lower back (39.4%), and shoulder (30.6%) pain. In the comparisons of the groups, a statistically significant difference was observed between Group 1 and Group 2 in terms of back and shoulder pain (p=0.000 and p=0.028, respectively). Numerous studies have shown that COVID-19 infection causes myalgia and arthralgia.[3-5] Although the body regions were evaluated separately in this study, the only regions showing a significant difference were the back and shoulders. The higher incidence of back and shoulder pain in patients with a history of COVID-19 infection may be due to pain related to pulmonary damage.

After a vaccination, patients usually have pain and swelling over the injection area, which usually resolve in 2-3 days after the injection.[14] In the current study, the mean follow-up time was 6.75±2.76 months and chronic pain of patients

was evaluated. If the symptoms do not improve, shoulder injury related to vaccine administration will be considered. In the literature, there are reported cases and they are thought to develop due to improper injection technique.[15] In our study, we stated that shoulder pain was significantly higher in COVID-19 patients whose vaccination rates lower than not infected patients. We believe that shoulder pain may be related to the COVID-19 infection itself.

The SF-36 is used internationally to determine the quality of life. A previous study found no significant difference between hospitalized patients and outpatients with respect to any subscale of the SF-36 in the first month after COVID-19 infection.[16] Another study compared the 6-month SF-36 results between COVID-19 patients who did not require intensive care and the normal population, and a significant difference was found in 5 of the 8 subscales (physical functioning, role physical, bodily pain, vitality/energy, and social functioning).[17] In the current study, there was a significant difference between patients with and without a history of COVID-19 in terms of the bodily pain subscale (p=0.019). The reason for this might be that the patients referred to our clinic had at least one complaint of pain. This may have led to the difference between this and the previously mentioned study in which the patient population was compared with a healthy population.

The IPQA is a questionnaire that determines activity levels using the MET score. In a previous study, a correlation was reported between COVID-19-related hospitalization and physical activity level, and it was shown that high or sufficient physical activity levels decreased COVID-19-related hospitalizations.[18] According to a study on multiple sclerosis patients, physical activity levels were significantly reduced in patients with COVID-19.[19] In the current study, activity levels were observed to be significantly reduced in patients with a history of COVID-19 (Group 1) compared with those with no history of COVID-19 (Group 2), similar to the literature. Performing physical activities at a high level can have a positive effect on the clinical course of COVID-19, while the disease itself can also negatively affect physical activity levels.

An FSS score of ≥4 indicates severe fatigue. In many studies, fatigue has been reported as a symptom in the chronic phase of COVID-19 infection (46-53%).[20] In this study, 82% of the patients in Group 1 and 68% of the patients in Group 2 felt severely fatigued, and significantly more severe fatigue was reported by Group 1 than by Group 2 (p=0.020).

Study Limitations

This study had some limitations, primarily the single-center design and the unequal case numbers in the groups. Additionally, the percentages of vaccination were not similar between the two groups, to a lower vaccination rate in Group 1 than in Group 2. It can be expected that a lower vaccination rate might increase the risk of COVID-19 infection. However, the strength of the study can be deemed the cross-sectional design and that patients with and without a history of COVID-19 were compared.

CONCLUSION

In conclusion, back pain, weakness, and decreased activity levels that persist after the acute phase of COVID-19 infection may be key symptoms that reduce the quality of life and participation in social life. It can be recommended that physicians should pay attention to these complaints during musculoskeletal examinations, and that these effects may be associated with COVID-19 infection.

Ethics

Ethics Committee Approval: The study was performed according to the principles of the Declaration of Helsinki, and approval was granted by the Local Ethics Committee of the İzmir Kâtip Çelebi University (date: 01.04.2021, no: 169) and the Republic of Turkey Ministry of Health.

Informed Consent: Consent form was filled out by all participants.

Peer-review: Externally peer-reviewed.

Authorship Contributions

Concept: H.Z., Ö.D., Design: H.Z., Ö.D., Data Collection or Processing: H.Z., Ö.D., Analysis or Interpretation: H.Z., Ö.D., Literature Search: H.Z., Ö.D., Writing: H.Z.

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REFERENCES

1. Karaarslan F, Demircioğlu Güneri F, Kardeş S. Postdischarge rheumatic and musculoskeletal symptoms following hospitalization for COVID-19: prospective follow-up by phone interviews. Rheumatol Int. 2021;41:1263-71.
2. Tuzun S, Keles A, Okutan D, Yildiran T, Palamar D. Assessment of musculoskeletal pain, fatigue and grip strength in hospitalized patients with COVID-19. Eur J Phys Rehabil Med. 2021;57:653-62.
3. Cipollaro L, Giordano L, Padulo J, Oliva F, Maffulli N. Musculoskeletal symptoms in SARS-CoV-2 (COVID-19) patients. J Orthop Surg Res. 2020;15:178.
4. Paliwal VK, Garg RK, Gupta A, Tejan N. Neuromuscular presentations in patients with COVID-19. Neurol Sci. 2020;41:3039-56.
5. Jimeno-Almazán A, Pallarés JG, Buendía-Romero Á, et al. Post-COVID-19 Syndrome and the Potential Benefits of Exercise. Int J Environ Res Public Health. 2021;18:5329.

6. Lemhöfer C, Gutenbrunner C, Schiller J, et al. Assessment of rehabilitation needs in patients after COVID-19: Development of the COVID-19-rehabilitation needs survey. J Rehabil Med. 2021;53:jrm00183.
7. Chen KY, Li T, Gong FH, Zhang JS, Li XK. Predictors of Health-Related Quality of Life and Influencing Factors for COVID-19 Patients, a Follow-Up at One Month. Front Psychiatry. 2020;11:668.
8. Tabacof L, Tosto-Mancuso J, Wood J, et al. Post-acute COVID-19 Syndrome Negatively Impacts Physical Function, Cognitive Function, Health-Related Quality of Life, and Participation. Am J Phys Med Rehabil. 2022;101:48-52.
9. Wewers ME, Lowe NK. A critical review of visual analogue scales in the measurement of clinical phenomena. Res Nurs Health. 1990;13:227-36.
10. Koçyiğit, H, Ö Aydemir, G Fişek, Ölmez N, Memiş A. Kısa form-36 (SF-36)'nın Türkçe versiyonunun güvenilirliği ve geçerliliği [Reliability and validity of the Turkish version of short form-36 (SF-36)]. İlaç Tedavi Derg. 1999;12:102-6.
11. Craig CL, Marshall AL, Sjöström M, et al. International physical activity questionnaire: 12-country reliability and validity. Med Sci Sports Exerc. 2003;35:1381-95.
12. Armutlu K, Korkmaz NC, Keser I, Sumbuloglu V, Akbiyik DI, Guney Z, et al. The validity and reliability of the Fatigue Severity Scale in Turkish multiple sclerosis patients. Int J Rehabil Res. 2007;30:81-5.
13. Disser NP, De Micheli AJ, Schonk MM, et al. Musculoskeletal Consequences of COVID-19. J Bone Joint Surg Am. 2020;102:1197-204.
14. Chuaychoosakoon C, Parinyakhup W, Tanutit P, Maliwankul K, Klabklay P. Shoulder injury related to Sinovac COVID-19 vaccine: A case report. Ann Med Surg (Lond). 2021;68:102622.
15. Yuen WLP, Loh SYJ, Wang DB. SIRVA (Shoulder Injury Related to Vaccine Administration) following mRNA COVID-19 Vaccination: Case discussion and literature review. Vaccine. 2022;40:2546-50.
16. Temperoni C, Grieco S, Pasquini Z, et al. Clinical characteristics, management and health related quality of life in young to middle age adults with COVID-19. BMC Infect Dis. 2021;21:134.
17. Magdy DM, Metwally A, Tawab DA, Hassan SA, Makboul M, Farghaly S. Long-term COVID-19 effects on pulmonary function, exercise capacity, and health status. Ann Thorac Med. 2022;17:28-36.
18. de Souza FR, Motta-Santos D, Dos Santos Soares D, et al. Association of physical activity levels and the prevalence of COVID-19-associated hospitalization. J Sci Med Sport. 2021;24:913-8.
19. Özkeskin M, Özden F, Karaman B, Ekmekçi Ö, Yüceyar N. The comparison of fatigue, sleep quality, physical activity, quality of life, and psychological status in multiple sclerosis patients with or without COVID-19. Mult Scler Relat Disord. 2021;55:103180.
20. Grover S, Sahoo S, Mishra E, et al. Fatigue, perceived stigma, self-reported cognitive deficits and psychological morbidity in patients recovered from COVID-19 infection. Asian J Psychiatr. 2021;64:102815.