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THE COMPARISON OF THE PHYSICAL AND SOCIAL INFLUENCES OF THE COVID-19 PANDEMIC IN CONVALESCENTS AND CONTROLS: A CASE-CONTROL STUDY

ORIGINAL ARTICLE

ABSTRACT

Purpose: To compare the fatigue and dyspnea level, respiratory function, mental fatigue, sleep quality, and social influence of the COVID-19 pandemic in convalescent and controls and to explore the relationship between these characteristics in both groups.

Methods: A total of 352 participants, including COVID-19 convalescent (n=176) and controls (n=176), participated in this study. The following instruments were used by online technologies: Visual Analog Scale (VAS) to investigate fatigue and dyspnea level, Single Breath Counting (SBC) test to measure respiratory function, Wood Mental Fatigue Inventory (WMFI) to evaluate mental fatigue, Pittsburg Sleep Quality Index (PSQI) to assess the sleep quality and Social Influences Survey Questionnaire (SISQ) to investigate social influences of the pandemic.

Results: COVID-19 convalescents reported higher levels of tiredness, dyspnea, and mental fatigue than controls (p<0.05). In both groups, there was a moderate-low positive relationship between fatigue and dyspnea levels. The respiratory functions and sleep quality of COVID-19 convalescents were lower than controls. There was a positive correlation between mental fatigue and sleep quality for the COVID-19 convalescents (p<0.05). Furthermore, the social influences of the pandemic were comparable in COVID-19 convalescents and controls (p>0.05).

Conclusion: Even after long-term COVID-19 recovery, symptoms like increased fatigue and dyspnea, mental fatigue, poor respiratory function, and sleep disturbances persist. Therefore, it is necessary to develop treatment strategies in order to alleviate these problems.

Keywords: COVID-19, Dyspnea, Fatigue, Sleep, Social Factors

COVID-19 GEÇİRİP İYİLEŞMİŞ KİŞİLER VE KONTROLLERDE COVID-19 PANDEMİSİNİN FİZİKSEL VE SOSYAL ETKİLERİNİN KARŞILAŞTIRILMASI: BİR VAKA KONTROL ÇALIŞMASI

ARAŞTIRMA MAKALESİ

ÖZ

Amaç: COVID-19 pandemisinin hastalığı geçirip iyileşmiş kişiler ve kontrollerde yorgunluk ve dispne düzeyi, solunum fonksiyonu, zihinsel yorgunluk, uyku kalitesi ve sosyal etkilerini karşılaştırmak ve her iki grupta bu özellikler arasındaki ilişkiyi araştırmaktır.

Yöntem: Bu çalışmaya COVID-19 hastalığı geçirip iyileşmiş kişiler (n=176) ve kontroller (n=176) olmak üzere toplam 352 katılımcı katıldı. Aşağıdaki ölçekler çevirim-içi olarak kullanıldı: Yorgunluk ve dispne düzeyini araştırmak için Görsel Analog Skalası (GAS), solunum fonksiyonunu ölçmek için Tek Nefes Sayımı (TNS) testi, zihinsel yorgunluğu değerlendirmek için Wood Mental Yorgunluk Envanteri (WMYE), bireylerin uyku kalitesini değerlendirmek için Pittsburg Uyku Kalitesi İndeksi (PUKİ) ve pandeminin sosyal etkilerini araştırmak için Sosyal Etkiler Anketi (SEA).

Sonuçlar: COVID-19 hastalığı geçirip iyileşmiş kişilerde kontrollere göre daha yüksek düzeyde yorgunluk, dispne ve zihinsel yorgunluk bildirildi (p<0,05). Her iki grupta da yorgunluk ve dispne düzeyleri arasında orta-düşük düzeyde pozitif ilişki tespit edildi. COVID-19 hastalığı geçirip iyileşmiş kişilerde solunum fonksiyonları ve uyku kalitesinin kontrollerden daha düşük olduğu görüldü. COVID-19 hastalığı geçirip iyileşmiş kişilerde zihinsel yorgunluk ile uyku kalitesi arasında pozitif bir ilişki mevcuttu (p<0,05). Ayrıca, pandeminin sosyal etkilerinin COVID-19 hastalığı geçirip iyileşmiş kişilerde ve kontrollerde benzer olduğu bulundu (p>0,05).

Tartışma: Uzun süreli COVID-19 iyileşme süresinden sonra bile yorgunluk ve nefes darlığı, zihinsel yorgunluk, zayıf solunum fonksiyonu ve uyku bozuklukları gibi semptomlar devam etmektedir. Bu nedenle, COVID-19 hastalığı geçirip iyileşmiş kişilerde bu sorunları azaltabilmek amacıyla tedavi stratejileri geliştirilmesi gereklidir.

Anahtar Kelimeler: COVID-19, Nefes Darlığı, Yorgunluk, Uyku, Sosyal Faktörler

INTRODUCTION

The World Health Organization (WHO), has declared the new coronavirus (COVID-19) outbreak a global pandemic on March 11, 2020 (1). COVID-19 has an impact on the immune (cytokine storm) and respiratory systems (pneumonia), as well as the hematological (blood clotting), cardiovascular (myocardial hypertrophy), musculoskeletal (myalgia, rhabdomyolysis), nervous (loss of senses, confusion), and mental health (stress, depression, anxiety) (2,3). While many patients exposed to COVID-19 have recovered completely, prolonged symptoms such as dyspnea, weariness, cough, and dysosmia may last for more than 120 days in COVID-19 convalescents, those who recover from COVID-19 (4,5). According to a recent study, the most common delayed symptom was fatigue, followed by dyspnea, weakness, anxiety, and exercise intolerance (6). The long-term consequences of COVID-19 are a major and significant concern for public health.

Infectious disease outbreaks have a negative influence on patients' physical health as well as their psychological health and well-being (7). Patients diagnosed with COVID-19 should be treated in isolation, and research shows this isolation causes anxiety, depression, panic attacks, mood swings, and sleep disorders (8,9). Although these physical and psychological health issues have been studied in COVID-19 convalescents, no comprehensive studies have been conducted comparing them with healthy people. Therefore, the primary aim of this study was to compare fatigue and dyspnea level, respiratory functions, mental fatigue, sleep quality, and social influence in COVID-19 convalescents and controls. The secondary aim of this study was to investigate the relationship between fatigue and dyspnea level, respiratory functions, mental fatigue, sleep quality, and social influence in both groups.

METHODS

Study design and participants

The sample size was calculated by using the G*Power 3.0 program. Cohen's d was used to calculate the effect size value because no reference data from a similar study were available. Assuming a value for the medium effect size as d=0.4, α= 0.05, β=0.05, and 95% power based on the two-legged Wilcoxon-Mann-Whitney U test, the sample size was calculated to be a minimum of 172 participants in each group. Therefore, a total of 352 international volunteers have been recruited for this study, including COVID-19 convalescents (n=176) and controls (n=176).

Individuals between the ages of 40 and 65 and those who volunteered were included in the study. A confirmed case of COVID-19 was characterized by a positive real-time reverse-transcription polymerase chain reaction (PCR) result on throat swab materials. And persons whose PCR test results were positive but turned negative within the last 14 days were included in the COVID-19 convalescents. Those who had never tested positive on a PCR test were included in the control group. Participants with recurrent COVID-19 infections were excluded from the study. Additionally, lack of internet and mobile phone access, inability to complete the questionnaire list, and neurological, respiratory, or musculoskeletal problems influencing physical activities were among the exclusion criteria for all individuals. The authors assert that all procedures used in this study correspond to the Helsinki Declaration and the ethical norms of all relevant national and institutional authorities. This study was approved by the Eastern Mediterranean University Board of Scientific Research and Publication Ethics (ETK00-2021-0092).

A case-control study was carried out, including COVID-19 convalescent and controls. Those who have had a history of COVID-19 and are currently recovered were assigned to the study group, while those who had never been diagnosed with COVID-19 were assigned to the control group. A convenient sampling method was used to recruit control participants. The aim of the study was described to the participants, and signed informed permission was acquired prior to recruitment. The interviews were conducted using online technologies such as WhatsApp and phone calls. Initially, each participant received a phone call in which the goal of the research was described. Step-by-step instructions were given to those who volunteered to participate in the research. All participants were then instructed to complete the questionnaires and submit them through WhatsApp. All data were collected between October 2021 and January 2022.

Outcome measures

The socio-demographic [age, gender, weight, height] and physical [chronic diseases, time since diagnosis, intensive care unit stay (ICU) stay, ICU length of stay] characteristics of the participants were documented. The presence of fatigue and dyspnea was also recorded. In this study, Visual Analogue Scale (VAS) and Single-Breath Counting (SBC) were the primary outcomes. Wood Mental Fatigue Inventory (WMFI), Pittsburgh Sleep Quality Index (PSQI), and Societal Influences Survey Questionnaire (SISQ) were the secondary outcomes.

Primary Outcomes

Visual Analogue Scale (VAS)

The VAS for fatigue (VAS-fatigue) was used to measure the fatigue level and the VAS (VAS-dyspnea) was used to measure dyspnea. The VAS is a 100-mm horizontal line that is used to quantify symptoms from 0 to 100. The minimum score obtained from the visual analog scale is 0 and the maximum score is 100 mm. The participants were asked to rate their fatigue level (10) and the intensity of their breathlessness (11) "at rest" and "at activity" (12).

Single-Breath Counting (SBC)

The participants were instructed to perform a maximal inhalation and count numbers in ascending order in a single exhalation. This was repeated three times and the best attempt was chosen for analysis (11). Most adults with normal respiratory function are able to count to 50 in a single breath. A single breath count of less than 15 is typically correlated with low forced vital capacity (FVC) and respiratory muscle weakness (13). This valid method can be used to assess the lung function of the individuals in the absence of equipment with a sensitivity (94.44%), specificity (76.62%), and excellent intra-rater reliability (Intraclass Correlation Coefficient 0.976) (14).

Secondary Outcomes

Wood Mental Fatigue Inventory (WMFI)

The participants were asked to rate the frequency of 9 mental fatigue symptoms in the past month. This questionnaire ranges from 0 (not at all) to 4 (very much). Scores range from 0–36, and higher scores indicate greater mental fatigue. WMFI has excellent internal consistency (Cronbach's alpha 0.85) and high test-retest reliability 0.887 (15).

Pittsburgh Sleep Quality Index (PSQI)

The PSQI is a self-reported questionnaire intended to evaluate sleep quality and disturbances during the previous month. It contains 19 items and 7 dimensions each scored 0 (no difficulty) to 3 (severe difficulty), which are summed to produce a global score. The higher the score, the more severe the sleep disturbance (16). The PSQI was developed to discriminate between "good" and "poor" sleepers. The scores range from 0 to 21 and a score >5 is considered a significant sleep disturbance (17,18). This valid and reliable (Cronbach's alpha of 0.85) test which has a high sensitivity (98.7) and specificity (84.4), has been reported to be a good index to distinguish between good sleepers and sleep-disturbed patients (18).

Societal Influences Survey Questionnaire (SISQ)

The SISQ is a self-rated questionnaire to assess the implications of COVID-19. It consists of 15 questions and 5 categories related to their social life during the pandemic. The SISQ comprises a 4-point Likert scale, with scores ranging from 1 (never) to 4 (often). A higher score indicates a greater influence in each category. The SISQ has good validity and reliability (Cronbach's alphas range from 0.57 to 0.76) (13).

Statistical Analysis

The Statistical Package for Social Science (SPSS) 26.0 statistical data analysis package software was used to analyze the data. Scale data such as age, height, and weight were given as median, and interquartile ranges (IQR), which represent the 25th to 75th percentiles of the distribution of data, and categorical data such as gender and diagnosis with COVID-19 were given as percentages (%). The data distribution was examined with histograms, plots, and analytical methods using the Kolmogorov-Smirnov test for normality. The Mann-Whitney

U test was used to compare the non-normally distributed parameters, and the Pearson and Fisher's Exact Chi-Square test was used to compare the categorical parameters. In addition, the Spearman Correlation Test was used in the correlation analysis of the clinical findings. The correlation coefficient was classified as r=0.00-0.30: negligible, r=0.30-0.50: low, r=0.50-0.70: moderate, r=0.70-0.90: high and r=0.90-1.00: very high correlation. P-value<0.05 was accepted as a statistically significant level (19).

RESULTS

Table 1 shows participant distributions, which reveal that the two groups were similar in terms of socio-demographic and physical characteristics.

Findings on the Visual Analogue Scale

On the VAS-fatigue scale [at rest COVID-19 convalescents: 97.2% and Controls: 84.7% and at activity COVID-19 convalescents: 90.3% and Controls: 77.8%] reported the presence of fatigue. On the VAS-dyspnea scale [at rest COVID-19 convalescents: 77.8% and Controls: 58% and at activity COVID-19 convalescents: 90.9% and Controls: 80.1%] reported the presence of dyspnea.

There was a statistically significant difference in VAS-fatigue at rest, VAS-fatigue at activity, VAS-dyspnea at rest, and VAS-dyspnea at activity between COVID-19 convalescents and controls (p<0.001). The controls had lower levels of fatigue and dyspnea level during both rest and activity compared to COVID-19 convalescents (Table 2).

There was a statistically significant difference in VAS-fatigue at rest, VAS-fatigue at activity, VAS-dyspnea at rest, and VAS-dyspnea at activity between COVID-19 convalescents and controls (p<0.001). The controls had lower levels of fatigue and dyspnea level during both rest and activity compared to COVID-19 convalescents (p<0.05) (Table 2).

There was a high-low positive relationship between VAS-fatigue and VAS-dyspnea in both groups. In the COVID-19 convalescents, there was a high positive correlation between VAS-fatigue at rest and VAS-fatigue at activity, and a low positive correlation with VAS-dyspnea at rest, and VAS-dyspnea at activity (p<0.001). Also, there was a moderate

Table 1. Socio-demographic and Physical Characteristics of the Participants

	COVID-19 convalescents (n= 176)	Controls (n= 176)	*P value*
Age (years), median (IQR)	49 (44-54)	49 (44-54)	0.994[a]
Height (cm), median (IQR)	170 (163-178)	170 (163-178)	0.466[a]
Weight (kg), median (IQR)	75.5 (67-85)	75 (65-85)	0.429[a]
Gender, % (n)			
Female	50 (88)	50.6 (89)	1.000[b]
Male	50 (88)	49.4 (87)	
Chronic Diseases, % (n)			
Yes	36.9 (65)	28.4 (50)	0.111[b]
No	63.1 (111)	71.6 (126)	
Chronic Disease type, % (n)			
Diabetes	40.0 (26)	46.0 (23)	0.356[c]
Hypertension	44.6 (29)	32.0 (16)	
Others	15.4 (10)	22.0 (11)	
Time since diagnosis (days), median (IQR)	90 (56-150)	N/A	-
ICU stay (days), % (n)			
Yes	19.3 (34)	N/A	-
No	80.7 (142)		
ICU length of stay (days), Median (IQR)	7 (2-30)	N/A	-

IQR: Interquartile range; n: sample size; %: Percentage; ICU: Intensive care unit, [a]Mann – Whitney U Test; [b]Fisher's Exact Chi – Square Test, [c]Pearson Chi – Square Test.

Table 2. Comparison of Fatigue Level, Dyspnea Level, Respiratory Functions, Mental Fatigue, Sleep Quality, and Societal Influences of the Participants

	COVID-19 convalescents (n= 176) Median (IQR)	Controls (n= 176) Median (IQR)	P value[a]
VAS-fatigue (cm)			
At rest	5(3-8)	2 (1-8)	<0.001*
At activity	4 (2-8)	2 (1-7)	<0.001*
VAS-dyspnea (cm)			
At rest	2 (1-7)	1 (0-6)	<0.001*
At activity	5 (2-8)	3 (1-7)	<0.001*
SBC	39.5 (30-57.13)	43 (38-65)	<0.001*
WMFI	6 (3-21)	4 (1-20)	0.020*
PSQI	7 (5-16)	5 (3-14)	<0.001*
SISQ			
Social Distance	12 (11-16)	12 (10-16)	0.318
Social Anxiety	13 (11-16)	13 (11-16)	0.594
Social Desirability	10 (8- 12)	10 (8.5-12)	0.929
Social Information	6 (5-8)	6 (5-8)	0.568
Social Adaptation	7 (6-8)	7 (6-8)	0.136

IQR: Interquartile range; n: sample size; *p <0.05; VAS: Visual Analogue Scale; SBC: Single Breath Counting; WMFI: Wood Mental Fatigue Inventory; PSQI: Pittsburgh Sleep Quality Index; SISQ: Societal Influences Survey Questionnaires; [a] Mann – Whitney U Test.

positive correlation between VAS-fatigue at activity and VAS-dyspnea at rest and a low positive correlation with VAS-dyspnea at activity. A moderate positive correlation was also found between VAS-dyspnea at rest and VAS-dyspnea at activity (p<0.001) (Table 3).

For the controls, there was a high positive correlation between VAS-fatigue at rest and VAS-fatigue at activity, a moderate positive correlation with VAS-dyspnea at activity, and a low positive correlation with VAS-dyspnea at rest (p<0.001). There was also a moderate positive correlation between VAS-fatigue at activity and VAS-dyspnea at activity and a low positive correlation with VAS-dyspnea at rest (p<0.001). Additionally, a moderate positive correlation was found between VAS-dyspnea at rest and VAS-dyspnea at activity (p<0.001) (Table 3).

Findings on the Single Breath Counting

Although both groups scored within the normal range of SBC (30-50 counts), there was a statistically significant difference between COVID-19 convalescents and controls (p<0.001). The number of breaths per minute was greater among controls than among COVID-19 convalescents (Table 2).

There was no notable relationship between SBC and other outcome measures in both groups. In the COVID-19 convalescents, there was a low negative correlation between SBC and VAS-dyspnea at activity, and a negligible negative correlation with VAS-fatigue at rest, VAS-fatigue at activity, VAS-dyspnea at rest, mental fatigue and sleep quality (p< 0.05) (Table 3).

For controls, there was a negligible negative correlation between SBC and VAS-fatigue at rest, VAS-fatigue at activity, VAS-dyspnea at rest, mental fatigue, and sleep quality (p< 0.05). There was no relationship between SBC and VAS-dyspnea at rest (p> 0.05) (Table 3).

Findings on the Wood Mental Fatigue Inventory

The overall score of the WMFT between COVID-19 convalescents and controls was statistically significant implying that COVID-19 convalescents reported higher levels of mental fatigue than controls (p< 0.05) (Table 2).

Although there was a low-negligible relationship between mental fatigue and other outcome measures, the relationship between mental fatigue and sleep quality was remarkable in COVID-19

Table 3. Relationship of Clinical Findings between COVID-19 Convalescents and Controls

	CLINICAL FINDINGS		CONTROLS						
			VAS-fatigue At rest	VAS-fatigue At activity	VAS-dyspnea At rest	VAS-dyspnea At activity	SBC	WMFI	PSQI
COVID -19 CONVALSCENTS	VAS-fatigue At rest	r		0.812**	0.405**	0.520**	-0.280**	0.349**	0.249**
		p		<0.001	<0.001	<0.001	<0.001	<0.001	0.001
	VAS-fatigue At activity	r	0.714**		0.492**	0.544**	-0.160*	0.376**	0.260**
		p	<0.001		<0.001	<0.001	0.034	<0.001	<0.001
	VAS-dyspnea	r	0.465**	0.530**		0.564**	-0.053	0.281**	0.294**
	At rest	p	<0.001	<0.001		<0.001	0.494	<0.001	<0.001
	VAS-dyspnea At activity	r	0.353**	0.425**	0.650**		-0.157*	0.378**	0.247**
		p	<0.001	<0.001	<0.001		0.037	<0.001	0.001
	SBC	r	-0.220**	-0.255**	-0.250**	-0.339**		-0.115	-0.162*
		p	0.003	0.001	0.001	<0.001		0.130	0.032
	WMFI	r	0.263**	0.171*	0.220**	0.194**	-0.179*		0.282**
		p	<0.001	0.023	0.004	0.010	0.018		<0.001
	PSQI	r	0.270**	0.283**	0.263**	0.287**	-0.178*	0.427**	
		p	<0.001	<0.001	0.001	<0.001	0.018	<0.001	

r: Spearmen correlation test; *p <0.05. **p <0.01; VAS: Visual Analogue Scale; SBC: Single Breath Counting; WMFI: Wood Mental Fatigue Inventory; PSQI: Pittsburgh Sleep Quality Index.

convalescents. There was a low positive correlation between mental fatigue and sleep quality, a negligible positive correlation with VAS-fatigue at rest, VAS-fatigue at activity, VAS-dyspnea at rest, VAS-dyspnea at activity, and a negligible negative correlation with SBC (p< 0.05) (Table 3).

In controls, there was a low positive correlation between mental fatigue and VAS-fatigue at rest, VAS-fatigue at activity, VAS-dyspnea at activity, and a negligible positive correlation with VAS-dyspnea at rest and sleep quality (p<0.001). There was no correlation between mental fatigue and SBC (p< 0.05) (Table 3).

Findings on the Pittsburgh Sleep Quality Index

Both groups scored below the cut-off of 5 for sleep quality, suggesting that they were both poor sleepers. The PSQI global score showed a statistically significant difference between the groups (p<0.001). COVID-19 convalescents had more sleep disturbances than controls (Table 2).

Except for the relationship between mental fatigue and sleep quality in COVID-19 convalescents, there was a low-negligible relationship between sleep quality and other parameters in both groups. In COVID-19 convalescents, there was a low positive correlation between sleep quality and mental fatigue, a negligible positive correlation with VAS-fatigue at rest, VAS-fatigue at activity, VAS-dyspnea at rest, VAS-dyspnea at activity, and a negligible positive correlation with SBC (p< 0.05) (Table 3).

In controls, there was a negligible positive correlation between sleep quality and VAS-fatigue at rest, VAS-fatigue at activity, VAS-dyspnea at rest, VAS-dyspnea at activity, and mental fatigue, and a negligible positive correlation with SBC (p< 0.05) (Table 3).

Findings on the Societal Influences Survey Questionnaires

According to the SISQ, no significant difference was found in "social distance", "social anxiety", "social desirability", "social information" and "social adaptation" sub-parameters of SISQ between the groups (p>0.05). (Table 2).

DISCUSSION

The primary aim of this study was to compare fatigue and dyspnea level, respiratory functions, mental fatigue, sleep quality, and social influence in COVID-19 convalescents and controls. This study revealed that fatigue and dyspnea levels and mental fatigue were higher, whereas respiratory functions and sleep quality were lower in COVID-19 convalescents than in controls. On the other hand, the pandemic had a stronger influence on social adaption in the controls compared to COVID-19 convalescents. In addition, a moderate-low positive relationship between fatigue and dyspnea in both groups and a low positive relationship between mental fatigue and sleep quality in COVID-19 convalescents were found.

According to a previous study, fatigue and dyspnea were the most common symptoms during infection and follow-up (fatigue: 95% vs. 87%; dyspnea: 90% vs. 71%) (20). Similarly, in our study, 97% of patients reported fatigue, and the intensity of fatigue was moderate. Although the prevalence of fatigue and the level of fatigue in COVID-19 convalescents were significantly higher than in controls, it was observed that 85% of controls also reported fatigue. This shows that the fatigue experienced during the pandemic is not only caused by infection. Although our study was conducted in individuals without any neurological disease, the study performed in individuals with multiple sclerosis supports our view. In the study of Özkeskin et al., the fatigue level of individuals with multiple sclerosis with and without Covid-19 was found to be similar, so it was concluded that the level of fatigue in this population may be due to quarantine rather than the virus (21). There is evidence that fatigue and dyspnea in COVID-19 convalescents may result from prolonged cardiovascular disorders during recovery and negative effects on oxygen transport mechanisms, muscle function, and exercise capacity. Long-term physical inactivity during quarantine or COVID-19 infection affects most of these factors adversely (22). A "lock-down fatigue" phenomenon has developed due to the COVID-19 pandemic due to preventive restrictions on movement and fear, and anxiety (23). In a cross-sectional study, dyspnea was reported in 71% of the patients an average of 79 days after COVID-19 (20). The current study found that 77.8% of the patients had dyspnea at rest and 90.9% during activity. The mean level of dyspnea at rest and during activity was moderate. A respiratory disorder, which is clinically manifested as dyspnea in post-COVID-19 syndrome, not only reduces the patient's ability to exercise but also further impairs the muscular energetic state (24). This, in turn, may lead to increased fatigue, increasing physical inactivity, and causing the situation to enter a vicious cycle. The moderate-low correlation found between dyspnea and fatigue levels in our study can be explained by this mechanism.

Lewis et al. showed no difference in pulmonary function tests before and after COVID-19 infection in non-critically ill classified patients whereas patients with lung diseases and increasing age had decreased lung functions (25). In this study, however, SBC revealed a significant reduction in respiratory functioning when COVID-19 convalescents were compared to controls. Furthermore, there was a low negative correlation between dyspnea levels at activity and SBC. This was similar to a study by Liang et al., which revealed that three months after discharge, more than half of the survivors exhibited dyspnea, despite the lung lesions being resolved completely (26).

COVID-19 pandemic lockdown possibly has an influence on mental fatigue (27,28). Torrente et al. found that mental fatigue was not correlated with lock-down adherence but positively correlated with depression and anxiety, implying mental fatigue is closely related to the difficulties of lock-down (27). According to the findings of the current paper, COVID-19 convalescents showed higher mental fatigue than healthy participants. Furthermore, there was a low correlation between mental fatigue and sleep quality in COVID-19 convalescents.

COVID-19 outbreak-related events are associated with reduced sleep quality and an increase in a negative mood. According to the study by Pinto et al., most patients (69.6%) suffered at least one sleep disruption, associated with nonworking house confinement, female gender, and sleep-disordered breathing (29). Zhang et al. reported that 90% of patients with COVID-19 have worse sleep quality after infection than before infection. Although several studies investigated the impact of the COVID-19 outbreak on sleep quality (29–31), no study has been conducted to the best of our knowledge comparing sleep disturbances in COVID-19 convalescents and healthy people. According to the findings of this study, both groups had poor sleep quality, with COVID-19 convalescents having poorer sleep quality than controls.

Although physical distancing slows the transmission of the virus, it also restricts people's face-to-face social interactions, perhaps reducing their feeling of social connectedness (32). In addition to social isolation, the pandemic's uncertainty and threat cause people to experience mental health issues like anxiety (13). Li et al. found that older age was associated with higher scores on the SISQ's "social distance," "social desirability," and "social information," with females scoring higher than males on "social distance" (13). In the current study, the SISQ scores of COVID-19 convalescents and controls were comparable in all sub-parameters. Higher SISQ scores indicate a greater social impact of the pandemic on social activities, hence the outcomes of our research were unexpected since no difference was revealed across the groups, suggesting that COVID-19 convalescents reported equal social sufficiency as controls. Due to the lack of a cutoff value for the SISQ, the effects of COVID-19 on the social dimension cannot be discussed further.

Limitations

There are also some limitations of this study that should be noted when interpreting the results. Firstly self-selection bias may have influenced the subjects. A subset of participants may have a bias toward following and being interested in COVID-19, making them more likely to be knowledgeable about the topic and/or eager to cooperate. As a result, the sampled participants may not accurately reflect the target population. Furthermore, the evaluations were completed online due to the difficulty of conducting face-to-face evaluations during the pandemic. This study focused on internet users and was not intended to collect data from people who did not use such technology resulting in a bias towards representativeness, particularly among the elderly. Lower education and income level have been linked to a decreased chance of being vaccinated against COVID-19 (33). Even though the demographic characteristics of our participants were identical in both groups, we were unable to adjust the sampling procedure according to the education and income level. These limitations can serve as an important opportunity for possible improvements in future studies.

CONCLUSION

When compared to controls, COVID-19 convalescents had greater degrees of fatigue and dyspnea, and mental fatigue, as well as reduced respiratory functioning and sleep quality. The social influences of the pandemic were comparable in COVID-19 convalescents and controls indicating that COVID-19 convalescents reported equal social sufficiency as controls. In both groups, there was a moderate-low positive relationship between fatigue and dyspnea levels. Furthermore, sleep disturbances are associated with mental fatigue in COVID-19 convalescents. The results indicate that COVID-19 convalescents continue to experience symptoms such as fatigue and dyspnea, mental fatigue, poor respiratory functions, and sleep disturbances even after long-term recovery. To address these concerns, treatment strategies for post-COVID-19 conditions must be developed.

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