

## Original Article

# Are Sleep Quality, Physical Activity Levels, and Fear of Movement of Obstructive Sleep Apnea Syndrome Patients Different From Healthy People During the Coronavirus Disease 2019 Pandemic?

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## Abstract

**OBJECTIVE:** The sleep quality and physical activity levels of patients with obstructive sleep apnea syndrome during the lockdown period have not yet been investigated. The aim of this study was to evaluate the sleep quality, physical activity level, and fear of movement in patients with obstructive sleep apnea syndrome and healthy individuals during the coronavirus disease 2019 pandemic.

**MATERIAL AND METHODS:** Patients with obstructive sleep apnea syndrome (n = 33) and healthy individuals (n = 30) were included in the study. Physical activity levels, sleep quality, and fear of movement were evaluated.

**RESULTS:** The total physical activity amount of patients with obstructive sleep apnea syndrome and healthy individuals was lower than the acceptable levels. The obstructive sleep apnea syndrome group had significantly lower leisure-time physical activity ( $P = .006$ ) and higher sitting time ( $P = .008$ ) than the healthy individuals. Patients with obstructive sleep apnea syndrome had significantly more sleep disturbances, daytime dysfunction, and daytime sleepiness than healthy people ( $P < .001$ ). Fear of movement was negatively correlated with the amount of vigorous ( $r = -0.395$ ,  $P = .023$ ) and leisure activities ( $r = -0.557$ ,  $P = .001$ ) in the obstructive sleep apnea syndrome group.

**CONCLUSION:** During the coronavirus disease 2019 pandemic, patients with obstructive sleep apnea syndrome and healthy individuals had lower physical activity levels. Physical activity counseling is an important strategy for increasing the physical activity of patients with obstructive sleep apnea syndrome and healthy individuals during and after the coronavirus disease 2019 pandemic.

**KEYWORDS:** Obstructive sleep apnea, sleep quality, physical activity, fear of movement

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## INTRODUCTION

Mandatory restrictions, such as the limitations dictated by epidemiologic strategies such as curfews, home quarantine, and social distancing due to the coronavirus disease 2019 (COVID-19) outbreak, have resulted in altered lifestyles of people in Turkey and many other countries. The time spent outside decreased, whereas the duration and pattern of physical activity (PA) habits and sleep quality were affected.<sup>1-3</sup> Additionally, social restrictions are generally accepted as a risk factor for sedentary lifestyle, thus negatively affecting sleep quality.<sup>4</sup> Physical activity potentially causes unwanted side effects, including symptoms related to extra effort, pain, and cardiac dysfunction, in patients with obstructive sleep apnea syndrome (OSAS) and obesity.<sup>5</sup> Otherwise, the increased total amount of PA in patients with OSAS is closely related to decreased excessive daytime sleepiness and the effects of fatigue on physical and psychosocial functions.<sup>6</sup>

As long as home lockdown due to the COVID-19 outbreak occurs, OSAS patients can be assumed to continue to suffer from restricted PA, like everyone else, and disruptions in staying asleep. Although there have been some studies on the changes in healthy lifestyle and PA behavior during the COVID-19 quarantine in different populations, such as older individuals and patients with cardiovascular disease<sup>7</sup>, there are limited data on OSAS patients during the pandemic. Low PA has been shown to be associated with higher OSAS.<sup>8</sup> Fatigue and a decreased desire to act due to daytime sleepiness cause obesity and many other chronic diseases in patients with OSAS.<sup>5</sup> Obstructive sleep apnea syndrome is associated with hypertension, arrhythmia, hyperlipidemia, depression, and many chronic psychological diseases.<sup>9</sup> The reason for the fear of movement mentioned in OSAS may not be orthopedic problems but also the responses that occur with movement.<sup>5</sup> Causes of inactivity include daytime sleepiness and fatigue as well as early cardiac responses to activity.<sup>5</sup> No previous studies have evaluated the PA level, sleep quality, and fear of movement in patients during the COVID-19 pandemic.

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Therefore, our aim was to evaluate the sleep quality, PA, and fear of movement levels in patients with OSAS and compare the findings of healthy individuals during the home detention required by the COVID-19 pandemic.

## MATERIAL AND METHODS

### Participants

The study was conducted between May 2020 and September 2020 at the Department of Chest Diseases and Sleep Disorders of the Ahi Evren Thoracic and Cardiovascular Surgery Training and Research Hospital. The individuals consisted of patients aged 18-70 years diagnosed with OSAS and age- and sex-matched healthy individuals.

Individuals between the ages of 18 and 70 years, with a body mass index (BMI) of  $<40 \text{ kg/m}^2$ , who volunteered to participate in the study, whose native language was Turkish, and who did not have mental problems that would prevent their cooperation were included in the study. Patients with severe orthopedic, neurological, or cardiovascular disorders or cognitive problems were excluded from the OSAS group. Similarly, individuals with any orthopedic, cardiovascular, neurological, psychiatric, or pulmonary diseases were excluded from the healthy group.

Verbal consent for the study protocol on the phone was obtained from individuals who participated in the study. After the participants sent a written consent to us via e-mail, they answered the questionnaires by phone. The study was approved by the Hacettepe University Non-Interventional Clinical Research Ethics Committee (protocol number: 2020 GO 11/31), and all patients signed an informed consent form. The trial was registered at ClinicalTrials.gov (NCT04451993).

### Data Collection Tools

Physical characteristics, occupation status, educational level, chronic diseases, sleep symptoms, total working time, and working status of individuals during the pandemic were recorded. Disease severity was evaluated according to polysomnography apnea-hypopnea index recordings and classified as mild OSAS (5-15 events/hour), moderate OSAS (15-30

events/hour), or severe OSAS (over 30 events/hour).<sup>10</sup> The presence of a fear of COVID-19 was questioned as yes or no. Sleep quality, daytime sleepiness, PA, fear of movement, and health literacy (HL) were evaluated using questionnaires.

**Sleep Quality.** The Pittsburgh Sleep Quality Index (PSQI) was used to assess sleep quality. The total PSQI score ranges from 0 to 21. A PSQI total score  $>5$  indicates poor sleep quality.<sup>11</sup>

### Daytime Sleepiness

Daytime sleepiness was evaluated using the Epworth Sleepiness Scale (ESS) consisting of 8 questions. An ESS score  $>10$  has high sensitivity and specificity for daytime sleepiness.<sup>12</sup>

### Physical Activity

The Turkish version of the long form of the International Physical Activity Questionnaire (IPAQ) was used to evaluate PA levels. The IPAQ-long form consists of 27 questions related to PA in the last 7 days.<sup>13</sup> The first score is special scoring for work, transportation, home-garden work, and leisure activities and the second is an intensity of activity-specific score (walking, moderate activity, and vigorous activity). The total score was the sum of the walking, moderate activity, and vigorous activity scores. The "metabolic equivalent (MET)-minutes/week" value was obtained by multiplying the days and minutes by the MET, and the values used for the calculation were 3.3 MET for light PA, 4.0 MET for moderate PA, 5.5 MET for moderate-to-vigorous PA, 6.0 MET for vigorous PA, and 8.0 MET for very vigorous PA. Sitting time was recorded as the total duration of sitting in a day. Physical activity levels are classified as inactive, minimally active, and active according to the total PA score.<sup>13</sup>

### Fear of Movement

The Tampa Scale of Kinesiophobia (TSK) is a 17-question checklist for evaluating the fear of movement. The total TSK score ranges from 17 to 68. A score of 37 or above confirms the presence of fear of movement.<sup>14</sup>

### Health Literacy

The Turkish Health Literacy Scale-32 (TSOY-32) was used to evaluate HL. This scale included 8 components. Each component has 2 dimensions. A total TSOY-32 score of 0 indicates the lowest level of literacy and 50 indicates the highest HL. Additionally, the total score was classified into 4 subcategories. These are as follows: 0-25 points: insufficient HL, 25-33: problematic limited literacy, 33-42: adequate HL, 42-50: excellent HL.<sup>15</sup>

### Statistical Analysis

For sample size calculation, the sleep quality scores of patients with OSAS and healthy individuals reported in the study by Calik-Kutukcu et al<sup>16</sup> were used as the primary outcome. The sample size was calculated as at least 15 individuals for each group with %90 power of the study, using the G\*Power statistical program (G\*Power ver. 3.1, Heinrich-Heine-University, Dusseldorf, Germany).<sup>17</sup> Statistical evaluation was performed using the Statistical Package for the Social Sciences 23.0 for Windows (version 18.0, IBM Inc., Armonk, NY, USA). Descriptive variables are expressed as mean  $\pm$  SD, median (minimum-maximum), frequency, and

## MAIN POINTS

- During the coronavirus disease 2019 (COVID-19) pandemic, compared to healthy subjects, obstructive sleep apnea syndrome (OSAS) patients first reduced their leisure-time and moderate-intensity activities.
- The total physical activity (PA) level was lower than the recommended levels in patients with OSAS and healthy individuals during the COVID-19 pandemic.
- The sleep quality of healthy individuals was higher than that of OSAS patients during the COVID-19 pandemic.
- High body mass index, daytime sleepiness level, and the presence of relevant symptoms with deterioration of sleep quality were associated with low PA levels in the OSAS group.
- Low health literacy levels and fear of movement should be considered during physical activity counseling in patients with OSAS.

percentage. The Kolmogorov–Smirnov test was used to determine whether they were normally distributed. The Mann–Whitney *U*-test was used for the non-normally distributed parameters and the Student’s *t*-test was used for the normally distributed parameters to compare the parameters between the OSAS patients and healthy individuals. The chi-square test was used to analyze the qualitative variables. The 2-way analysis of variance test or the Kruskal–Wallis test was used to compare the levels of sleep quality, PA, fear of movement, and daytime sleepiness between patients with various OSAS severities during the pandemic. The level of significance was set at  $P < .05$ .<sup>18</sup>

## RESULTS

This study included 33 patients with OSAS and 30 healthy individuals. Age, sex, and height values were similar between the groups ( $P > .05$ ), but there was a significant difference in body weight and BMI ( $P < .05$ ) (Table 1). The marital status, educational level, profession, HL status, and chronic diseases of the participants are presented in Table 1. The TSOY-32 total score of the OSAS patients was significantly lower than that of healthy individuals ( $P = .045$ , Table 1). The OSAS severity was mild in 30.3% of patients ( $n = 10$ ), moderate in 33.3% ( $n = 11$ ), and severe in 36.4% ( $n = 12$ ). At the time of our study, Continuous Positive Airway Pressure (CPAP) therapy was recommended for 42% of the patients ( $n = 14$ ), but they had not yet begun active therapy.

The working status and symptom perception of individuals during the pandemic are shown in Table 2. There was no significant difference in the total daytime and nighttime work status during the COVID-19 pandemic between the groups ( $P > .05$ , Table 2). Worry about COVID-19 infection was similar between the 2 groups ( $P > .05$ , Table 2). The mean TSK score of the OSAS patients was  $38.21 \pm 9.21$ . Fear of movement was present in 60.6% ( $n = 20$ ) of the patients with OSAS.

The total IPAQ PA scores of OSAS patients and healthy individuals were similar ( $P > .05$ , Table 3). The ratios of inactive/minimal active/active individuals in each group were statistically comparable ( $P > .05$ , Table 3). The leisure-time PA score ( $P = .006$ , Table 3) was significantly lower and the sitting time ( $P = .008$ , Figure 1) was higher in patients with OSAS than in healthy individuals during the pandemic. Sleep quality was normal in healthy individuals, according to the total PSQI score. The PSQI sleep disturbance, daytime dysfunction, total scores ( $P < .001$ , Table 3, Figure 2), and ESS scores ( $P = .039$ , Table 3) of the OSAS patients were significantly higher than those of healthy individuals.

The IPAQ moderate PA and total PA scores were significantly different according to disease severity among the patients with OSAS ( $P = .023$ ,  $P = .004$ , respectively, Figure 3). The IPAQ moderate PA and total PA scores of severe OSAS patients were significantly lower than those of moderate OSAS patients ( $P = .004$  and  $P < .001$ , respectively). There was no significant difference between the mild, moderate, and severe OSAS patients in terms of PSQI, TSK, and ESS total scores during the pandemic ( $P > .05$ ). Additionally, the TSK score was significantly related to the IPAQ vigorous PA score ( $r = -0.395$ ,  $P = .023$ ) and leisure-time PA score ( $r = -0.557$ ,

$P = .001$ ) in patients with OSAS. The total PA score was also related to the PSQI total score ( $r = -0.365$ ,  $P = .037$ ), whereas the PA sitting time was not correlated with HL ( $r = 0.597$ ,  $P = -0.095$ ), TSK ( $r = 0.260$ ,  $P = .202$ ), or PSQI total ( $r = 0.831$ ,  $P = .039$ ) scores in the OSAS group.

## DISCUSSION

The main finding of this study was that the total PA level was low in both patients with OSAS and healthy individuals during the pandemic. The sleep quality of patients with OSAS was worse than that of healthy individuals during the COVID-19 pandemic. Lower PA levels were associated with poor sleep quality, and a higher level of fear of movement was related to lower vigorous and leisure-time PA levels in the OSAS. When evaluated according to the severity of the disease, the moderate and total PA levels of patients with severe OSAS were significantly lower than those of patients with moderate OSAS.

The recommended PA level is a minimum of 3000 MET-minutes/week for adults, corresponding to a combination of 7 or fewer days of walking and moderate or vigorous activity.<sup>13</sup> A prospective cohort study showed that the leisure activity score of patients with OSAS was considerably lower than that of healthy individuals.<sup>19</sup> Such low PA levels in patients with OSAS are also thought to be associated with daytime sleepiness, obesity, the presence of concomitant diseases, a higher anxiety level, fatigue, pain, and fear of movement.<sup>5,6</sup> Additionally, home restrictions and social distance warnings during the COVID-19 pandemic decreased the level of PA in patients with OSAS as well as in healthy individuals, and the total weekly PA amount of patients with OSAS and healthy individuals was lower than the recommended threshold levels in our study. A study of Spanish adults showed that home restrictions during the COVID-19 pandemic negatively affected the amount of PA and sleep quality.<sup>1</sup> Reduced working hours because of one of the infection’s spread prevention strategies during COVID-19 may also be associated with lower PA levels in both OSAS patients and healthy individuals.<sup>1</sup>

Although the rate of fear of movement was higher in patients with OSAS than in healthy individuals, the presence of fear of movement in patients with OSAS negatively affected participation in leisure and vigorous activities. In our study, OSAS patients’ sitting times were also significantly greater than those of healthy individuals; however, PA sitting time in the OSAS group was not correlated with HL, fear of movement, or sleep quality. A previous study found that excessive sitting or screen time was not associated with OSAS.<sup>20</sup> Studies have reported that the average duration of immobility per day was 5–6 hours according to self-reports or 7 hours and 39 minutes based on an accelerometer for the general population.<sup>21</sup> The sitting time for OSAS patients, as reported by an accelerometer, was 9 hours and 55 minutes per day.<sup>5</sup> In the current study, the sitting time per day, excluding the periods spent asleep, was 7 hours for OSAS patients and 6 hours for healthy individuals. A study reported that the pandemic significantly reduced the activity durations of active workers, whereas inactive workers did not change their activity duration.<sup>1</sup> Another study found that patients did not engage

**Table 1.** Characteristics of Patients with OSAS and Healthy Individuals

Variables	OSAS (n = 33)	Healthy (n = 30)	P
Physical			
Age (years)	48.78 ± 9.24	44.23 ± 9.16	.056
Height (cm)	168.45 ± 10.14	167.24 ± 11.33	.708
Weight (kg)	91.23 ± 11.28	75.20 ± 12.12	<.001*
BMI (kg/m <sup>2</sup> )	32.22 ± 3.98	26.72 ± 2.72	<.001*
Gender (male/female)	19/14	13/17	.259
AHI (events/h)	28.02 ± 17.79	—	—
Marital status			
Married	25 (75.8%)	22 (73.3%)	.825
Single	8 (24.2%)	8 (26.7%)	
Educational level			
Literate	1 (3.0%)	1 (3.3%)	.097
Primary school	6 (18.2%)	1 (3.3%)	
Middle school	1 (3.0%)	3 (10.0%)	
High school	11 (33.3%)	4 (13.3%)	
Graduate	9 (27.3%)	15 (50.0%)	
Postgraduate	5 (15.2%)	6 (20.0%)	
Profession			
Unemployed	1 (3.0%)	2 (6.7%)	.143
Housewife	9 (27.3%)	3 (10.0%)	
Officer	4 (12.1%)	6 (20.0%)	
Health employee	4 (12.1%)	8 (26.7%)	
Academician	1 (3.0%)	1 (3.3%)	
Teacher	2 (6.1%)	1 (3.3%)	
Engineer/architect	7 (21.2%)	1 (3.3%)	
Self-employed	1 (3.0%)	0 (0.0%)	
Retired	3 (9.1%)	3 (10.0%)	
Other	1 (3.0%)	5 (16.7%)	
Health literacy level			
TSOY-32 total score (0-50)	30.00 ± 16.80	38.92 ± 9.10	.045*
HL level classification			
Inadequate	14 (42.4%)	2 (6.7%)	.007*
Problematic	2 (6.1%)	7 (23.3%)	
Adequate	5 (15.2%)	7 (23.3%)	
Excellent	12 (36.4%)	14 (46.7%)	
Chronic diseases			
Hypertension	9 (27.3%)	0 (0.0%)	—
Diabetes mellitus	6 (18.2%)	0 (0.0%)	
Dysrhythmia	2 (6.1%)	0 (0.0%)	
Psychiatric disorders (depression and panic attacks)	4 (12.1%)	0 (0.0%)	
Asthma	2 (6.1%)		
Goiter	4 (12.1%)		

\*P &lt; .05.

AHI, apnea-hypopnea index; BMI, body mass index; HL, health literacy; OSAS, obstructive sleep apnea syndrome; TSOY-32, The Turkish Health Literacy Scale-32.

**Table 2.** Working Status and Symptom Perceptions of Patients with OSAS and Healthy Individuals During Pandemic Process

Variables	OSAS (n = 33)	Healthy (n = 30)	P
Working status			
He/she is not working	14 (42.4%)	9 (30.0%)	.345
He/she was working, is not working now	1 (3.0%)	0 (0.0%)	
He/she is working in shifts	3 (9.1%)	8 (26.7%)	
He/she is working at home or at work from time to time	3 (9.1%)	5 (16.7%)	
He/she is managing her/his business from the workplace	11 (33.3%)	7 (23.3%)	
He/she is working from home	1 (3.0%)	1 (3.3%)	
Total working time			
Daytime (hours/week)	22.36 ± 26.96	26.57 ± 21.86	.410
Nighttime (hours/week)	5.90 ± 14.36	8.47 ± 17.95	.416
Worry related with COVID-19			
Yes	20 (60.6%)	24 (80%)	.094
No	13 (39.4%)	6 (20%)	
Symptom perceptions			
Difficulty in falling asleep	7 (21.2%)	7 (23.3%)	.840
Waking up at night (n)			<b>.004*</b>
0-1	10 (30.3%)	21 (70.0%)	
2-4	20 (60.6%)	9 (30.0%)	
5-8	3 (9.1%)	0 (0.0%)	
Debility	17 (51.5%)	5 (16.7%)	<b>.004*</b>
Forgetfulness	18 (54.5%)	6 (20.0%)	<b>.005*</b>
Difficulty in making decisions	9 (27.3%)	1 (3.3%)	<b>.014*</b>
Night sweats	17 (51.5%)	0 (0.0%)	<b>&lt;.001*</b>
Lack of concentration	10 (30.3%)	1 (3.3%)	<b>.005*</b>
Morning headache	10 (30.3%)	2 (6.7%)	<b>.017*</b>
Dry mouth	17 (51.5%)	2 (6.7%)	<b>&lt;.001*</b>
Hearing loss	4 (12.1%)	0 (0.0%)	.115
Drowning sensation in sleep	13 (39.4%)	1 (3.3%)	<b>.001*</b>
Nighttime cough	7 (21.2%)	0 (0.0%)	<b>.011*</b>
Poor memory	8 (24.2%)	0 (0.0%)	<b>.004*</b>

\**P* < .05.

COVID-19, coronavirus disease 2019; OSAS, obstructive sleep apnea syndrome.

in recreational activities such as dancing, sports, or gardening and did not move unless they had to.<sup>5</sup> The combination of anxiety and depression caused by the pandemic and social isolation, daytime sleepiness, disease symptoms, and fatigue<sup>22</sup> of OSAS patients are reported reasons for such a worsening PA level.<sup>23</sup> A recent US cohort study reported that higher PA levels and lower sedentary duration were associated with a lower incidence of OSAS. The potential mediating role of metabolic factors in the association between sedentary behavior and OSAS incidence may depend on the type of sedentary behavior.<sup>24</sup> These results suggest that promoting an active lifestyle can reduce the incidence of OSAS. A previous study suggested that a healthy lifestyle is inversely associated with OSAS risk. Strategies leading to an active lifestyle may be more appropriate for preventing OSAS.<sup>25</sup>

Age, sex, hypertension, BMI, and waist circumference were associated with OSAS.<sup>20</sup> According to the second hypothesis, high BMI, daytime sleepiness level, and the presence of relevant symptoms with the deterioration of sleep quality were associated with low PA levels in the OSAS group. A systematic review has shown that most observational studies consistently report a relationship between PA and HL, and individuals with a more active lifestyle tend to have higher HL than those with a more sedentary lifestyle.<sup>26</sup> Our patients with OSAS in this study also had at least 1 cardiovascular disease. Increased expression of angiotensin-converting enzyme 2 and renin-angiotensin system dysregulation were observed in untreated OSAS patients due to chronic intermittent hypoxia. Otherwise, they may have cardiovascular comorbidities that are risk factors for mortality in COVID-19.<sup>27</sup> Although the HL level was lower in the OSAS group than in the healthy group,

**Table 3.** The Physical Activity, Sleep Quality, Daytime Sleepiness Levels of Patients with OSAS and Healthy Individuals

Variables	OSAS (n = 33)	Healthy (n = 30)	P
IPAQ PA scores			
Total PA (MET-minutes/week)	2772 (0-12264)	2804.3 (0-23471.5)	.397
Vigorous PA (MET-minutes/week)	0 (0-6720)	247.5 (0-9845.5)	.069
Moderate PA (MET-minutes/week)	960 (0-8520)	1290 (0-14580)	.271
Walking PA (MET-minutes/week)	540 (0-5544)	792 (0-6237)	.367
Occupational PA (MET-minutes/week)	0 (0-10878)	198 (0-15192)	.152
Transportation PA (MET-minutes/week)	232.5 (0-4518)	280.5 (0-2079)	.646
House yard work PA (MET-minutes/week)	435 (0-11520)	765 (0-8820)	.306
Leisure-time PA (MET-minutes/week)	0 (0-2880)	639.8 (0-6488)	<b>.006*</b>
Sitting time (minutes)	420 (0-960)	300 (60-780)	<b>.008*</b>
Physical activity category			
Low	16 (48.5%)	12 (40.0%)	.367
Moderate	12 (36.4%)	9 (30.0%)	
High	5 (15.2%)	9 (30.0%)	
Sleep quality			
Sleep duration (0-3)	1.12 ± 1.11	0.58 ± 0.95	.038
Sleep disturbance (0-3)	2.00 ± 0.75	0.62 ± 0.73	<b>&lt;.001*</b>
Sleep onset latency (0-3)	1.27 ± 1.23	0.89 ± 0.90	.277
Daytime dysfunction (0-3)	1.36 ± 1.08	0.35 ± 0.67	<b>&lt;.001*</b>
Sleep efficiency (0-3)	1.03 ± 1.31	0.41 ± 0.95	.036
Sleep quality (0-3)	1.82 ± 0.98	0.79 ± 0.82	.097
Hypnotic drugs (0-3)	0.55 ± 1.18	0.14 ± 0.58	.167
Total score (0-21)	9.12 ± 4.82	3.79 ± 3.79	<b>&lt;.001*</b>
Daytime sleepiness			
ESS score (0-24)	8.06 ± 5.92	5.20 ± 4.43	<b>.039*</b>
Daytime sleepiness classification			
Lower normal daytime sleepiness	11 (33.3%)	6 (60.0%)	.092
Higher normal daytime sleepiness	12 (36.4%)	8 (26.7%)	
Mild excessive daytime sleepiness	1 (3.0%)	2 (6.7%)	
Moderate excessive daytime sleepiness	4 (12.1%)	0 (0.0%)	
Severe excessive daytime sleepiness	5 (15.2%)	2 (6.7%)	

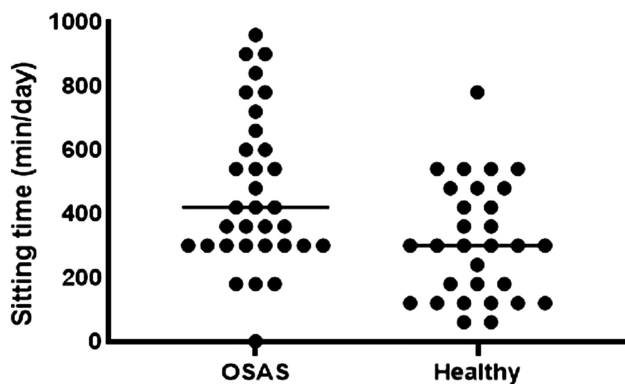
\*P &lt; .05.

ESS, Epworth Sleepiness Scale; IPAQ, International Physical Activity Questionnaire; MET, metabolic equivalent; PA, physical activity.

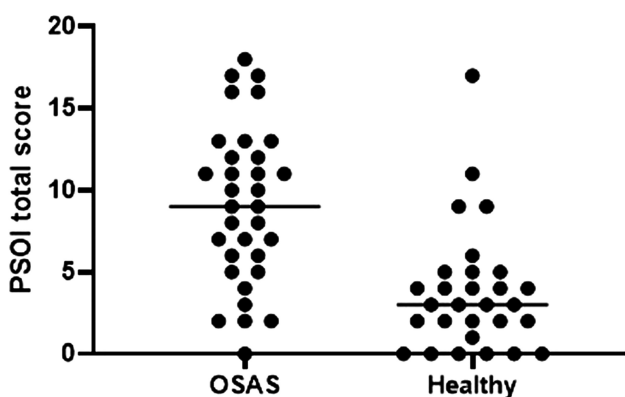
patients have restricted PA duration because of increased awareness about the relationship between the time spent outside and prolonged contact in crowded environments and the risk of COVID-19 infection and increased number of comorbidities. Moreover, OSAS patients have protected themselves by reducing their PA outside as the disease severity increases because of the increase in the frequency of comorbidities associated with OSAS, which makes the patient's condition related to a COVID-19 infection more dangerous. During the COVID-19 pandemic, compared with healthy individuals, patients with OSAS first had reduced leisure-time and moderate-intensity activities. This may be due to home restrictions, increased daytime sleepiness, low HL, or the presence of cardiovascular symptoms. The common point between healthy

and OSAS patients in our study was the continuation of their working status during the COVID-19 pandemic.

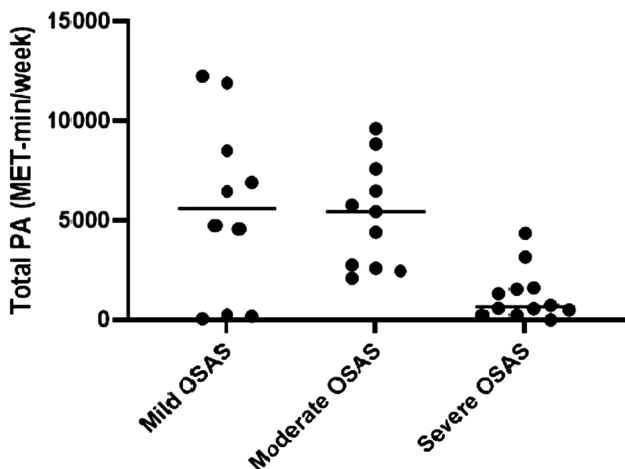
Research has shown that the social isolation due to the COVID-19 pandemic increases physical inactivity and sedentary lifestyles globally.<sup>28,29</sup> The pernicious consequences of the physical inactivity pandemic were also mentioned before the COVID-19 pandemic.<sup>30</sup> Physical inactivity is the primary factor that increases the risk of cardiovascular disease, especially obesity and hypertension, in both patients and healthy individuals.<sup>31,32</sup> For patients with OSAS, both physical inactivity and the burden of cardiovascular disease increase the rate of mortality and morbidity, and these paradoxes may be exacerbated by the COVID-19 pandemic.<sup>28,33</sup>



**Figure 1.** The comparison of the sitting times during the pandemic between OSAS patients and healthy individuals. OSAS, obstructive sleep apnea syndrome.



**Figure 2.** The comparison of sleep quality during the pandemic between OSAS patients and healthy individuals. OSAS, obstructive sleep apnea syndrome; PSQI, Pittsburgh Sleep Quality Index.



**Figure 3.** The differences in the IPAQ total PA scores of the OSAS patients according to disease severity. IPAQ, International Physical Activity Questionnaire; MET, metabolic equivalent; OSAS, obstructive sleep apnea syndrome; PA, physical activity.

Various studies have evaluated the impact of the COVID-19 pandemic on sleep quality in adults.<sup>1,34</sup> Findings related to sleep quality during pandemics have yielded conflicting results. Although there was a significant decrease in sleep quality in a study that used the PSQI,<sup>1</sup> another study found that home restriction did not affect sleep quality.<sup>34</sup> Patients with OSAS and healthy people in our study had similar concerns about COVID-19 infection, but the sleep quality of

OSAS patients was lower during the pandemic period, as expected. Otherwise, healthy people's sleep quality was normal and not adversely affected.

The first limitation of this study was that we did not have information on the PA levels and sleep quality of the participants before the COVID-19 pandemic. Therefore, we were unable to compare it with the pre-pandemic situation. Another limitation was that, despite the observation of anxiety and depression caused by social restrictions in patients with OSAS, we did not evaluate anxiety and depression levels. Moreover, the restrictions of the pandemic made it impossible to evaluate PA using objective criteria. Another overlooked factor was the absence of data on screen (blue light) exposure in patients with OSAS. The increase in the time spent in front of the television, phone, and tablet until late reduces the time spent sleeping and may cause problems in falling asleep. The strength of this study is that it compared sleep quality and PA levels of patients with OSAS and healthy individuals during the pandemic. This research is important and valuable as a guide for taking action for PA interventions in patients with OSAS.

## CONCLUSION

The results of this study indicate that patients with OSAS and healthy individuals had lower PA levels, worse sleep quality, and lower HL than their healthy counterparts during the pandemic. Additionally, patients with more severe OSAS had a greater reduction in the amount of PA. Physical activity counseling is an important strategy for increasing PA levels in patients with OSAS, particularly during the pandemic period. Informative initiatives should be implemented to reduce sitting time and increase PA. Future studies considering screen (blue light) exposure, with detailed evaluation of sleep times with objective measurements, and determining the relationship with PA are necessary for patients with OSAS.

**Data Access Statement:** All relevant data are within the paper.

**Ethics Committee Approval:** This study was approved by the Hacettepe University Non-Inerventional Clinical Research Ethics Committee with protocol number 2019/11. All procedures performed in studies involving human participants were in accordance with the ethical standards of the institutional and/or national research committee and with the 1964 Helsinki Declaration and its later amendments or comparable ethical standards (trial registration number and date of registration: NCT04451993/30.06.2020).

**Informed Consent:** Verbal consent for the study protocol on the phone was obtained from individuals who participated in the study. After the participants sent a written consent to the authors via e-mail, they answered the questionnaires by phone.

**Peer-review:** Externally peer-reviewed.

**Author Contributions:** Concept – N.E., E.Ç.K.; Design – N.E., E.Ç.K.; Supervision – E.Ç.K., N.V.Y.; Resources – N.E.; Materials – N.E.; Data Collection and/or Processing – N.E., A.Ç.; Analysis and/or Interpretation – E.Ç.K.; Literature Search – N.E.; Writing – N.E.; Critical Review – E.Ç.K., N.V.Y., N.E.

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