

Post-Acute Sleep Disturbances Following COVID-19 and Associated Factors: A Single-Center Study

Selvi Ceran¹ , Gonca Aşut¹ , Bilge Ağar² , Güler Almıla Güllü² , Dilan Değer² ,
Selin Saka² , Yağmur Azra Bilçen² , Umut Barış Çalışkan²

¹ Başkent University Faculty of Medicine, Department of Psychiatry
Ankara, Türkiye

² Başkent University Faculty of Medicine, Medical student
Ankara, Türkiye

Selvi CERAN
0000-0002-7984-2440
Gonca AŞUT
0000-0002-7064-558X
Bilge AĞAR
0009-0008-3248-1052
Güler Almıla GÜLLÜ
0009-0006-7287-0656
Dilan DEĞER
0009-0002-3334-0960
Selin SAKA
0009-0004-3428-2488
Yağmur Azra BİLÇEN
0009-0009-0785-4889
Umut Barış ÇALIŞKAN
0009-0006-1579-2858

Correspondence: Gonca Aşut
Baskent University Faculty of
Medicine, Department of Psychiatry,
Ankara, Türkiye
Phone: +90 312 203 68 68 - 2980
E-mail: goncaasut@hotmail.com
gasut@baskent.edu.tr

Received: 05.07.2024

Accepted: 21.02.2025

ABSTRACT

Purpose: The long-term effects of COVID-19 infection on survivors' mental health and its relationship with COVID-19 severity remain undetermined. We aimed to investigate the post-COVID sleep disturbances (poor sleep quality and insomnia) that persist beyond four weeks after acute COVID-19 infection and up to six months after the acute illness and the related factors.

Methods: We enrolled 188 participants 1-6 months after COVID-19 infection in this descriptive study. All participants were asked to complete a sociodemographic data form, the Beck Anxiety Scale (Beck-A), the Beck Depression Scale (Beck-D), the Pittsburgh Sleep Quality Index (PSQI), and the Insomnia Severity Index (ISI).

Results: 43.6% and 41% of participants reported experiencing poor sleep quality and insomnia, respectively. Sociodemographic factors such as marital and employment status, education level, household size, smoking, alcohol consumption, follow-up time, and comorbidities did not significantly impact sleep quality and insomnia rates. However, our results showed that higher anxiety and depression scores were associated with worse sleep quality and insomnia.

Conclusions: Our study highlights the critical situation of sleep disturbances, anxiety, and depression risk in post-COVID-19 patients. Although the first COVID-19 pandemic has ended, analyzing worldwide data about the last pandemic is crucial for preparing for potential scenarios globally.

Keywords: Anxiety, COVID-19, depression, insomnia, sleep quality

ÖZET

Amaç: COVID-19 enfeksiyonunun hayatta kalanların ruh sağlığı üzerindeki uzun vadeli sonuçları ve bunun hastalık şiddeti ile ilişkisi belirsizdir. Bu çalışmada, akut COVID-19 enfeksiyonundan dört hafta - altı ay sonrasına kadar devam eden COVID-19 sonrası uyku bozukluklarını (kötü uyku kalitesi ve uykusuzluk) ve ilgili faktörleri araştırmayı amaçladık.

Yöntem: Bu tanımlayıcı çalışmaya COVID-19 enfeksiyonundan 1-6 ay sonra, 188 katılımcı dahil edilmiştir. Tüm katılımcılardan sosyodemografik veri formu, Beck Anksiyete Ölçeği (Beck-A), Beck Depresyon Ölçeği (Beck-D), Pittsburgh Uyku Kalitesi İndeksi (PSQI) ve Uykusuzluk Şiddeti İndeksi (ISI) doldurmaları istenmiştir.

Bulgular: Katılımcıların sırasıyla %43,6'sı ve %41'i kötü uyku kalitesi ve uykusuzluk yaşadığını bildirmiştir. Medeni durum, çalışma durumu, eğitim düzeyi, hane halkı büyüklüğü, sigara kullanımı, alkol tüketimi, takip süresi ve eşlik eden hastalıklar gibi sosyodemografik faktörler uyku kalitesi ve uykusuzluk oranlarını önemli ölçüde etkilememiştir. Bununla birlikte, çalışmamızın sonuçları anksiyete ve depresyon puanlarının daha kötü uyku kalitesi ve uykusuzluk ile ilişkili olduğunu göstermiştir.

Sonuç: Çalışmamız, COVID-19 sonrası hastalarda uyku bozuklukları, anksiyete ve depresyon riskinin ne kadar önemli olduğunu vurgulamaktadır. İlk COVID-19 pandemisi sona ermiş olsa da, son pandemiyle ilgili dünya çapındaki verilerin analiz edilmesi, küresel olarak potansiyel senaryolara hazırlanmak için çok önemlidir.

Anahtar Kelimeler: Anksiyete, COVID-19, depresyon, uykusuzluk, uyku kalitesi

The novel coronavirus (SARS-CoV-2) will result in acute respiratory syndrome (COVID-19), which is associated with potentially fatal pneumonia. Studies suggest that about one-third of infected people remain asymptomatic, while 15% of symptomatic cases progress to severe, potentially fatal complications, particularly in the elderly population (1). The terms post-COVID, long COVID, or post-acute sequelae of SARS-CoV-2 refer to continuous, recurring, or new symptoms or other health problems that appear after the acute phase of SARS-CoV-2 infection (2). Neurological and psychiatric symptoms such as peripheral neuropathy, dizziness, headache, cognitive impairment, sleep disturbances, depression, and anxiety may be present in patients with post-COVID-19 syndrome (3). Alkodaymi et al. (2022) found that the most prevalent symptoms at 3 to <6 months follow-up, including fatigue, dyspnea, sleep disturbance, and concentration problems, were significantly influenced by factors such as COVID-19 disease severity, diabetes mellitus, male sex, world region, and overall study quality score (4).

A meta-analysis showed an increased risk of depression and anxiety in COVID-19 patients compared with other inpatients, highlighting the need for long-term mental health assessment (5). In a cross-sectional study, factors such as female sex, diabetes, need for oxygen or mechanical ventilation, and elevated neutrophil-to-lymphocyte ratio (NLR) were found to increase vulnerability to post-COVID-19 psychopathologies (6).

COVID-19-related sleep disorders, including sleep apnea, poor sleep quality, and insomnia, have become widespread, affecting up to 50-75% of acute COVID-19 patients and 30-35% of the general population according to Kalamara et al. (7). A meta-analysis revealed that 32.9% of individuals experienced sleep disorders after COVID-19 infection (8). These disturbances often persist even after other symptoms have resolved (9). In hospital settings, a Turkish study found that patients with poor sleep quality had extended hospital stays and higher rates of depression (10).

Research indicates that circadian disruptions following COVID-19 infection may contribute to higher rates of anxiety disorders and insomnia (11), and depression and insomnia (12). Female sex and severe/critical COVID-19 significantly increase the risk of post-COVID sleep disturbances, with no substantial impact observed based

on the duration of hospitalization (13). These findings highlight the complex interplay between COVID-19 and sleep disturbances, emphasizing the need for further investigation into their mechanisms and potential interventions. Although anxiety, depression, and sleep disturbances are frequently reported in the post-COVID period (14), the literature on their relationship is insufficient. The close link between post-COVID-19 syndrome and symptoms of depression, anxiety, and sleep disturbances highlights the need for additional research in this area and underscores the importance of assessing the depth of these interactions.

Therefore, this study was conducted to determine the post-COVID sleep disturbances (poor sleep quality and insomnia) that persist beyond four weeks after acute COVID-19 infection and up to six months after the acute illness and the related factors.

We hypothesized that hospitalization and increased anxiety and depression scores would be associated with sleep quality and that these associations would be stronger in women than men.

Material and Methods

The study included patients aged 18-65 years who applied to the COVID-19 Outpatient Clinic of Baskent University Faculty of Medicine Ankara Hospital and were diagnosed with COVID-19 from December 2020 to April 2021 (the period when the Delta variant was dominant) by using real-time PCR method in throat swab specimens. Patients with ongoing hospitalization, illiteracy, visual or hearing loss, cognitive impairment (mental retardation, dementia, etc.), or psychotic disorders (schizophrenia and other psychotic disorders) were excluded from the study. Attempts were made to contact 783 patients who met the inclusion criteria by telephone between 1 and 6 months after COVID-19 diagnosis. One hundred eighty-five patients could not be reached, and 410 did not agree to participate in the study. The 188 (24%) patients who agreed to participate in the study and gave verbal consent after being informed were included. Data were collected using Google Forms.

Participants were asked to complete a socio-demographic form, the Beck Anxiety Scale (Beck-A), the Beck Depression Scale (Beck-D), the Pittsburgh Sleep Quality Index (PSQI), and the Insomnia Severity Index (ISI).

Sociodemographic and clinical data form: Included questions on age, sex, marital status, educational level, smoking and alcohol consumption history, and chronic systemic disorders such as diabetes mellitus (DM), hypertension (HT), and cardiovascular disease (CVD). It also covered COVID-19 treatment modality (inpatient or outpatient), duration of hospital stay, and information about household and bedroom partners. The treatment modality was used to assess the severity of COVID-19.

The Pittsburgh Sleep Quality Index (Turkish version): A 7-dimension scale that evaluates sleep quality and disturbances. The PSQI consists of 24 questions, 19 of which are self-reported, and 5 are answered by a partner or roommate. Scores range from 0 to 21, with total scores over 5 indicating poor sleep quality (15).

Insomnia Severity Index (Turkish version): A self-reported, five-point Likert scale comprising seven items designed to measure the severity of insomnia symptoms. Each item is scored from 0 to 4, with total scores ranging from 0 to 28. Scores from 0 to 7 indicate clinically insignificant insomnia, 8 to 14 suggest subthreshold insomnia, 15 to 21 indicate moderate clinical insomnia, and 22 to 28 represent severe clinical insomnia (16). A total score of 10 or more is recommended as the cut-off for identifying insomnia cases in community samples (17).

Beck Depression Scale (Turkish version): The scale consists of 21 questions that patients answer based on their feelings over the past week. The cut-off score is 17, with the highest possible score being 63. Higher scores reflect more severe depressive symptoms (18).

Beck Anxiety Scale (Turkish version): The scale consists of 21 self-reported questions about the severity of anxiety symptoms. Total scores range from 0 to 63, with scores from 0-7 indicating minimal anxiety, 8-15 mild anxiety, 16-25 moderate anxiety, and 26-63 severe anxiety (19).

Statistical analyzes

The data were analyzed using SPSS 17.0 (Statistical Package for the Social Sciences, IBM). Before univariate comparisons, Kolmogorov-Smirnov test and visual tests were conducted. Sociodemographic descriptive statistics were expressed as frequencies and percentages for categorical variables and medians with interquartile ranges (IQR) for continuous variables. Univariate analyses

were performed using the Pearson chi-square test for categorical variables and the Mann-Whitney U test for continuous variables. Logistic regression was used to assess the relationship between independent variables and sleep quality (dichotomous PSQI scores) and insomnia (dichotomous ISI scores).

Results

The study involved 188 participants, with a mean age of 37 ± 12.5 years, and on average, it had been 3 months (min-max 1- 6 months) since the onset of their COVID-19 symptoms. More than half were female (55.3%) and married (55.3%). Most of them were employed (74.5%), and held at least a university degree (77.6%). Only 17% lived alone, and 46% stated that they slept alone in their bedroom. Most of them did not smoke (74.5%) or drink alcohol (68.1%). 27% had a chronic medical disease (DM, HT, etc). Twenty-two patients (11%) received inpatient treatment for COVID-19, while the remaining patients were treated as outpatients.

Only 15% of participants reported experiencing sleep problems before COVID-19. In the post-COVID period, 43,6% of participants (n=82) reported poor sleep quality according to the global PSQI scores. Univariate analysis revealed that female patients had significantly worse sleep quality than men (67.1% vs. 32.9%) ($p = 0.004$), and those who had experienced bereavement also had significantly worse sleep quality compared to those who had not (77% vs. 23%) ($p = 0.027$). Sleep quality was significantly worse in those who had poor sleep quality also before COVID-19 (73% vs. 27%) ($p = 0.002$). Factors such as marital status, employment status, education level, household size, smoking, alcohol consumption, follow-up duration, treatment modality (inpatient/outpatient treatment for COVID-19), and comorbidities did not significantly affect sleep quality. Additionally, participants with poor sleep quality had significantly higher anxiety (median (IQR) 15(10-23), 5(2-10)) and depression scores (median (IQR) 13(8-20), 3(1-9) compared to those with good sleep quality ($p < 0.001$ for both comparisons).

The sociodemographic, COVID-19-related, and clinical characteristics of the patients and the comparison of the good and poor sleepers according to these characteristics are presented in Table 1.

Table 1: Comparison of the sociodemographic, COVID-19 related and clinical characteristics of good and poor sleepers

Characteristics		Total	Good sleepers (PSQI≤5) (n:126) n (%) / median (IQR)	Poor sleepers (PSQI>5) (n:82) n (%) / median (IQR)	Chi-square /Z	p
Age (years)			39 (19)	31 (20)	-2.512	0.012^a
Sex	Male	84	57 (53.8%)	27 (32.9%)	8.129	0.004^b
	Female	104	49 (46.2%)	55 (67.1%)		
Marital Satus	Single/divorced	84	43 (40.6%)	41 (50%)	1.665	0.197 ^b
	Married	104	63 (59.4%)	41 (50%)		
Employment	Full or part time	140	82 (77.4%)	58 (70.7)	1.068	0.301 ^b
	Not employed	48	24 (22.6%)	24 (29.3)		
Households size	Alone	33	21 (19.8%)	12 (14.6%)	0.856	0.355 ^b
	Living with 2 or more	155	85 (80.2%)	70 (85.4%)		
Are you sleeping alone in your bedroom?	Alone	101	56 (52.8)	45 (54.9%)	0.078	0.780 ^b
	Not alone	87	50 (47.2%)	37 (45.1%)		
Smoking	Yes	48	22 (20.8%)	26 (31.7%)	2.917	0.088 ^b
	No	140	84 (79.2%)	56 (68.3%)		
Bereveament due to COVID	Yes	30	11 (10.4%)	19 (23.2%)	5.642	0.018^b
	No	158	95 (89.6%)	63 (76.8%)		
COVID-19 Treatment modality	Inpatient	22	14 (13.2%)	8 (9.8%)	0.533	0.465 ^b
	Outpatient	166	92 (86.8%)	74 (90.2%)		
Comorbidity	Yes	45	28 (26.4%)	17 (20.7%)	0.820	0.365 ^b
	No	143	78 (73.6%)	65 (79.3%)		
Sleep problems before COVID-19	Yes	29	9 (9.4%)	20 (27%)	9.203	0.002^b
	No	141	87 (90.6%)	54 (73%)		
Time to assement (months)		188	4 (1-6)	5 (1-6)	-0.708	0.479 ^a
Beck-D scores		188	3 (1-9)	13 (8-20)	1544	<0.001^a
Beck-A scores		188	5 (2-10)	15 (10-23)	1762.5	<0.001^a
^a Poor sleep quality refers to Pittsburgh sleep quality index scores > 5 Beck-A: Beck Anxiety Scale, Beck-D: Beck Depression Scale, PSQI: Pittsburgh Sleep Quality Index a: Mann Whitney U test, b: Pearson chi-square test n: number, %: percent, IQR: interquartile range						

According to the ISI scores, 41% of participants were identified as experiencing insomnia. Univariate analysis revealed significant differences in sex, employment status, and pre-existing sleep problems before COVID-19 between individuals with and without insomnia.

However, factors such as marital status, education level, household size, smoking, alcohol consumption, presence of comorbidities, COVID-19 treatment modality, and follow-up duration did not significantly affect insomnia.

Table 2: Comparison of the sociodemographic, COVID-19 related, and clinical characteristics of groups with and without insomnia

Characteristics		Insomnia (ISI<10) (n:111) n (%) / median (IQR)	Without insomnia (ISI≥10) (n:77) n (%) / median (IQR)	Chi-square/Z	p
Age (years)		37 (21)	33 (20)	-1.639	0.101 ^a
Sex	Male Female	58 (52.3%) 53 (47.7%)	26 (33.8%) 51 (66.2%)	6.286	0.012
Marital Status	Single/divorced Married	51 (45.9%) 60 (54.1%)	33 (42.9%) 44 (57.1%)	0.175	0.675
Employment	Full or part-time Not employed	90 (81.1%) 21 (18.9%)	50 (64.9%) 27 (35.1%)	6.234	0.013
Households size	Alone Living with 2 or more	20 (18%) 91 (82%)	13 (16.9%) 64 (83.1%)	0.040	0.841
Are you sleeping alone in your bedroom?	Alone Not alone	64 (57.7%) 47 (42.3%)	37 (48.1%) 40 (51.9%)	0.687	0.194
Smoking	Yes No	25 (22.5%) 86 (77%)	23 (29.9%) 54 (70.1%)	1.291	0.256
Alcohol consumption	Yes No	35 (31.5%) 76 (68.5%)	25 (32.5%) 52 (67.5%)	0.018	0.892
Bereavement due to COVID	Yes No	16 (14.4%) 95 (85.6%)	14 (18.2%) 63 (81.8%)	0.481	0.488
COVID-19 Treatment modality	Inpatient Outpatient	11 (9.9%) 100 (90.1%)	11 (14.3%) 66 (85.7%)	0.842	0.359
Comorbidity	Yes No	32 (28.8%) 79 (71.2%)	13 (16.9%) 64 (83.1%)	3.563	0.059
Sleep problems before COVID-19	No Yes	96 (94.1%) 6 (5.9%)	45 (66.2%) 23 (33.8%)	22.513	<0.001
Time to assesment (months)		4 (1.5-6)	5 (6-1)	-0.28	0.977 ^a
Beck-D score		4 (1-10)	12 (7-20)	-6.715	<0.001^a
Beck-A score		6 (3-11)	16 (9-24)	-6.737	<0.001^a

* Insomnia (+) refers to patients whose Insomnia Severity Index scores are ≥10 Beck-A: Beck Anxiety Scale, Beck-D: Beck Depression Scale, ISI: Insomnia Severity Index

a: Mann Whitney U test, b: Pearson chi-square test

n: number, %: percent, IQR: interquartile range

Furthermore, participants with insomnia exhibited significantly higher levels of anxiety (median (IQR) 16 (9-24)vs 6 (3-11)) and depression scores (median (IQR)

12 (7-20), 4 (1-10)) compared to those without insomnia (p <0.001 for both comparisons). Detailed results are presented in Table 2.

Table 3: Logistic regression coefficients for predicting sleep quality and insomnia

	Dependent variable poor sleep quality (PSQI score > 5)		Dependent variable insomnia (ISI score ≥ 10)	
Variable	OR (95% CI)	<i>p</i>	OR (95 % CI)	<i>p</i>
Age	0.99 (0.96-1.03)	0.805		
Sex (female)	1.12 (0.49-2.56)	0.789	1.04 (0.46-2.36)	0.923
Bereavement due to COVID (yes)	1.66 (0.55-4.99)	0.365		
Sleep problems before COVID-19 diagnose (yes)	1.25 (0.42-3.70)	0.685	4.36 (1.40-13.51)	0.011
Beck-D score	1.135 (1.06-1.21)	<0.001	1.102 (1.04-1.17)	0.001
Beck-A score	1.08 (1.02-1.14)	0.005	1.102 (1.043-1.165)	0.001

Beck-A: Beck Anxiety Scale, Beck-D: Beck Depression Scale, PSQI: Pittsburgh Sleep Quality Index, ISI: Insomnia Severity Index
OR: Odds ratio, CI: confidentiality interval

Logistic regression analysis revealed that anxiety and depression scores are independent risk factors for both sleep quality and insomnia. Sleep problem before being diagnosed with COVID-19 are also independent risk factors for insomnia. Detailed results are presented in Table 3.

Discussion

This study aimed to assess sleep quality and insomnia in COVID-19 survivors up to six months after the acute illness and the factors influencing them. We found that approximately half of the patients experience sleep problems (poor sleep quality and insomnia at rates of 43.6% and 41%, respectively) after one to six months post-infection. However, only 15% of participants reported experiencing sleep problems before the onset of the COVID-19 disease.

A recent meta-analysis found a pooled prevalence of sleep disturbances of 47%, similar to our study (20). In a comprehensive analysis involving 9944 participants across 36 studies, Pinzon et al. found that 32.9% experienced sleep disorders within six months of COVID-19 infection (8). Additionally, a recent meta-analysis showed that one-year post-discharge, 47.1% of 535 COVID-19 survivors had poor sleep quality (21). In a study conducted by Ahmed et al. (2021) in Egypt, it was observed that poor sleep quality, at around 65%, persisted up to 6 months after discharge

(6)—higher than our study's findings. A recent meta-analysis was found that the prevalence of post-COVID sleep disturbances significantly influenced by geographic location. Research conducted in Europe, Africa, and the Americas showed a higher prevalence of post-COVID sleep disturbances compared to studies in Asian regions, particularly Southeast Asia (21). In addition, using of different measurement tools for assessing sleep quality and insomnia at various stages of the COVID-19 pandemic may contribute to variations in the results of studies.

Furthermore, we found that notable risk factors for poor sleep quality and insomnia were psychological factors such as anxiety and depression, rather than medical characteristics like comorbidities and the severity of infection (measured by treatment modality) as well as sociodemographic features such as age, sex, marital status, household size, or employment status. While our univariate analyses revealed associations between poor sleep quality and variables such as age, sex, and bereavement, these associations lost their significance when adjusted. In terms of insomnia, a notable statistical difference was observed among groups concerning sex and employment status. However, after adjustment, only anxiety and depression scores, along with pre-COVID-19 sleep problems, remained significant predictors. In the literature, conflicting results regarding sociodemographic factors and post-COVID sleep disturbance relations have been presented.

Some studies pointed out that younger patients have a higher prevalence of post-COVID-19 sleep disturbances (9). A study from Greece discovered that women have a higher prevalence and experience more severe insomnia compared to men. However, no significant differences related to sex were observed concerning poor sleep quality (7). In their meta-analysis, Alkodaymi et al. reported that at the 3-to <6-month follow-up, sleep disorders (24%) are one of the most commonly observed psychological problems, and world region, male sex, DM comorbidity, and COVID-19 severity are identified as significant effect modifiers (4). According to the last meta-analysis by Linh et al., female sex and severe/critical acute COVID-19 were associated with a significantly higher risk of post-COVID sleep disturbances (22). Similar to our results, Ahmed et al. (2021) found no significant difference between good and poor sleepers in terms of COVID-19 severity and demographics such as age and sex (6). This discrepancy could be due to sample size limitations, population-specific characteristics, or other unmeasured variables that may have influenced the results. Additionally, it's possible that the impact of gender was mediated by other factors such as comorbidities, psychosocial stressors, or the severity of COVID-19 symptoms, which could have attenuated the observed association.

Conflicting results were found regarding comorbidities, such as DM, HT and cardiovascular diseases. However, dementia and chronic obstructive pulmonary diseases/asthma were not identified as risk factors for post-COVID sleep problems. The relationship between smoking or drinking habits and post-COVID sleep problems also showed inconsistent results (21).

A longitudinal study from Italy reported that 41% of patients exhibited poor sleep quality during both the 2nd-month and 10th-month evaluations, similar to our study. In contrast to our study, in the second-month evaluation, only inflammatory factors were identified as risk factors for poor sleep quality rather than anxiety and depression scores. However, by the ten-month evaluation, female sex, higher levels of inflammatory factors, along with elevated scores for anxiety and depression, were identified as risk factors, similar to our study (22). In a large-scale retrospective cohort study conducted with outpatient cases in the UK, female sex and comorbidities were found to be associated with long COVID. Additionally, anxiety and depression were identified as the most common accompanying comorbidities (23).

A study focusing on non-hospitalized COVID-19 survivors reported a significant correlation between depression and anxiety and the development of long-term insomnia (24). Meanwhile, a study with hospitalized COVID-19 survivors revealed that symptoms of anxiety and depression, along with poor sleep quality, fluctuated throughout the first year after recovery. Notably, this study did not identify any risk factors related to these conditions (25). A recent meta-analysis showed that mental health problems, such as anxiety, stress, and depression, were positively associated with post-COVID sleep disturbances, which aligns with our findings. The impact of hospitalization for COVID-19 on sleep problems was not statistically significant (22). Taquet et al., in their study examining the symptoms of long COVID-19, noted that anxiety and depression were more frequently observed after the first three months, with anxiety gradually increasing beyond the third month (11).

Both sleep disturbances and anxiety/depression are more frequent in women than men. That is why gender could be a confounder (26). An international COVID sleep study, which controlled for pre-pandemic insomnia, found a 46% incidence of insomnia post-COVID and a relation with depression scores. Additionally, a meta-analysis reported that the association between insomnia and long COVID is bidirectional and remained significant even after controlling for other health conditions (such as attention and memory problems, chronic fatigue, sleep apnea, depression, and anxiety) (27). Notably, insomnia tends to persist even after the resolution of other symptoms (9).

Insomnia may be linked to the persistence of chronic COVID-19 symptoms (28). A study in the USA utilizing an extensive federated electronic health record system revealed that individuals who survived COVID-19 exhibit notably elevated occurrences of psychiatric disorders, dementia, and insomnia (11).

There is a lack of research on this subject in our country. Given the variations in results reported from various parts of the world, findings from our country, situated at the crossroads of three continents, hold significance. Our study is noteworthy as it is the first to investigate the long-term effects of COVID-19 on sleep disturbances in both inpatients and outpatients in Turkey during the pre-vaccine era, when a single strain (Delta variant) was dominant.

Our study has several limitations. First, the absence of pre-COVID-19 data restricts our ability to establish a baseline for comparison of anxiety and depression. Second, there is a potential for recall bias, as information on sleep problems before COVID-19 obtained from patients' evaluations relied solely on self-administered questionnaires instead of diagnostic interviews or objective measurements. Additionally, other variables, like vaccination status and different viral variants, could influence the connection between insomnia and long COVID (29). We collected our data during a period when COVID-19 vaccinations had not yet begun in our country. The dominant strain was the Delta variant. Therefore, we can discuss a homogeneous sample in this regard. The limited generalizability of our findings is influenced by the single-center design and a relatively low participation rate. Finally, since our study has a descriptive design, there is no control group; therefore, making causal inferences is not possible. To investigate the possible effects of long-term COVID on sleep disturbances, more longitudinal studies are required.

Conclusion

Our study highlights the critical issue of sleep disturbances, anxiety and depression risk in post-COVID-19 patients. We strongly recommend a multidisciplinary approach involving psychiatrists in the post-COVID care. Although the first COVID-19 pandemic has ended, new mutations of the COVID-19 virus and future pathogens will again cause diseases that require global action. Additionally, it is evident that the geographical location of studies can influence the lasting impacts of COVID-19; thus, analyzing worldwide data about the last pandemic is crucial for preparing for potential scenarios globally. Further research is needed to understand the persistent and long-term effects of COVID-19 on sleep disturbances.

Declarations

Ethics approval and Funding

This study was approved by Baskent University Institutional Review Board (Project no: KA21/193) and supported by Baskent University Research Fund.

Conflicts of interest

The authors declare no potential conflict of interest.

Availability of data

The datasets used and/or analyzed during the current study are available from the corresponding author upon reasonable request.

Authors' contributions

Literature Search: SC, GA, BA, GAG, DD, SS, YAB, UBÇ

Protocol writing: SC, GA, BA, GAG, DD, SS, YAB, UBÇ

Data collection: BA, GAG, DD, SS, YAB, UBÇ

Statistical analysis: SC, GA

Manuscript draft writing: SC, GA

All authors contributed and have approved the final manuscript.

References

1. Yuki K, Fujiogi M and Koutsogiannaki S. COVID-19 pathophysiology: A review. *Clin Immunol.* 2020;215:108427.
2. Centers for Disease Control and Prevention (CDC). Long COVID or Post-COVID Conditions. 03.03.2024, <https://www.cdc.gov/coronavirus/2019-ncov/long-term-effects/index.html>
3. Shah W, Hillman T, Playford ED, et al. Managing the long term effects of covid-19: summary of NICE, SIGN, and RCGP rapid guideline. *BMJ.* 2021;372
4. Alkodaymi MS, Omrani OA, Fawzy NA, et al. Prevalence of post-acute COVID-19 syndrome symptoms at different follow-up periods: a systematic review and meta-analysis. *Clin Microbiol Infect.* 2022;28(5):657-66.
5. Deng J, Zhou F, Hou W, et al. The prevalence of depression, anxiety, and sleep disturbances in COVID-19 patients: a meta-analysis. *Ann N Y Acad Sci.* 2021;1486(1):90-111.
6. Ahmed GK, Khedr EM, Hamad DA, et al. Long term impact of Covid-19 infection on sleep and mental health: A cross-sectional study. *Psychiatry Res.* 2021;305:114243.
7. Kalamara E, Pataka A, Boutou A, et al. Persistent sleep quality deterioration among post-COVID-19 patients: results from a 6-month follow-up study. *J Pers Med.* 2022;12(11):1909.
8. Pinzon RT, Wijaya VO, Al Jody A, et al. Persistent neurological manifestations in long COVID-19 syndrome: A systematic review and meta-analysis. *J Infect Public Health.* 2022;15(8):856-69.
9. Steardo Jr L, Steardo L, Verkhatsky A, et al. Post-COVID-19 neuropsychiatric syndrome: Is maladaptive glial recovery to blame? *Acta Physiol (Oxf).* 2021;233(2)
10. Akıncı T, Başar HM. Relationship between sleep quality and the psychological status of patients hospitalised with COVID-19. *Sleep Med.* 2021;80:167-70.
11. Taquet M, Luciano S, Geddes JR, et al. Bidirectional associations between COVID-19 and psychiatric disorder: retrospective cohort studies of 62 354 COVID-19 cases in the USA. *Lancet Psychiatry.* 2021;8(2):130-40.

12. Xu F, Wang X, Yang Y, et al. Depression and insomnia in COVID-19 survivors: a cross-sectional survey from Chinese rehabilitation centers in Anhui province. *Sleep Med.* 2022;91:161-165.
13. Lin Y, Liu S, Li S, et al. Relationships between the changes in sleep patterns and sleep quality among Chinese people during the 2019 coronavirus disease outbreak. *Sleep Med.* 2022;91:154-60.
14. Mazza MG, De Lorenzo R, Conte C, et al. Anxiety and depression in COVID-19 survivors: Role of inflammatory and clinical predictors. *Brain Behav Immun.* 2020;89:594-600.
15. Ağargün MY, Kara H, Anlar Ö. The validity and reliability of the Pittsburgh Sleep Quality Index. *Türk Psikiyatri Derg.* 1996;7(2):107-15.
16. Boysan M, Güleç M, Besiroglu L, et al. Uykusuzluk Siddeti İndeksi'nin Türk örneklemiindeki psikometrik özellikleri. *Anadolu Psikiyatri Derg.* 2010;11(3):248.
17. Morin CM, Belleville G, Bélanger L, et al. The Insomnia Severity Index: psychometric indicators to detect insomnia cases and evaluate treatment response. *Sleep.* 2011;34(5):601-608.
18. Hisli N. Validity and reliability of the Beck Depression Inventory for university students. *Psikoloji dergisi.* 1989;7:3-13.
19. Ulusoy M, Sahin NH, Erkmen H. Turkish version of the Beck Anxiety Inventory: psychometric properties. *J Cogn Psychother.* 1998;12(2):163.
20. Chinvararak C and Chalder T. Prevalence of sleep disturbances in patients with long COVID assessed by standardised questionnaires and diagnostic criteria: A systematic review and meta-analysis. *J Psychosom Res.* 2023;111535.
21. Linh TTD, Ho DKN, Nguyen NN, et al. Global prevalence of post-COVID-19 sleep disturbances in adults at different follow-up time points: A systematic review and meta-analysis. *Sleep Med Rev.* 2023;101833.
22. Pellitteri G, Surcinelli A, De Martino M, et al. Sleep alterations following COVID-19 are associated with both neuroinflammation and psychological disorders, although at different times. *Front Neurol.* 2022;13:929480.
23. Subramanian A, Nirantharakumar K, Hughes S, et al. Symptoms and risk factors for long COVID in non-hospitalized adults. *Nat Med.* 2022;28:1706-14.
24. Hoang HTX, Yeung WF, Truong QTM, et al. Sleep quality among non-hospitalized COVID-19 survivors: a national cross-sectional study. *Front Public Health.* 2024;11:1281012.
25. Fernández-de-Las-Peñas C, Arias-Navalón JA, Martín-Guerrero JD, et al. Trajectory of anxiety/depressive symptoms and sleep quality in individuals who had been hospitalized by COVID-19: The LONG-COVID-EXP multicenter study. *J Psychosom Res.* 2024;179:111635.
26. Mangion K, Morrow AJ, Sykes R, et al. Post-COVID-19 illness and associations with sex and gender. *BMC Cardiovasc Disord.* 2023;23(1):389.
27. Merikanto I, Dauvilliers Y, Chung F, et al. Sleep symptoms are essential features of long-COVID—Comparing healthy controls with COVID-19 cases of different severity in the international COVID sleep study (ICOSS-II). *J Sleep Res.* 2023;32(1):e13754.
28. Vargas I, Muench A, Grandner MA, et al. Insomnia symptoms predict longer COVID-19 symptom duration. *Sleep Med.* 2023;101:365-72.
29. Byambasuren O, Stehlik P, Clark J, et al. Effect of covid-19 vaccination on long covid: systematic review. *BMJ Med.* 2023;2(1)