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Investigating the Prevalence of COVID-19-Related Sleep Disorders Among Individuals Recovering from COVID-19: A Cross-Sectional Analytical Study

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Abstract

Background: Sleep disorders, as psychological manifestations of COVID-19, have been correlated with a decreased quality of all aspects of individuals' well-being, even after COVID-19 recovery.

Objectives: Due to the persistence of sleep disorders even after the recovery from COVID-19, along with their significant consequences on the quality of life of individuals suffering from these disorders, this study was conducted to determine the prevalence and predictive power of sleep disorders and their correlation with socio-demographic and health disparities among COVID-19 recovered individuals in Iran.

Methods: In this cross-sectional analytical investigation, a total of 300 individuals participated from 3 hospitals in different regions of Tehran. Participants were selected based on inclusion criteria and simple random sampling. They were then evaluated using the "Questionnaire of Clinical and Demographic Information" and the "Pittsburgh Sleep Quality Index (PSQI)." Additionally, the "Depression, Anxiety and Stress Scale 21 (DASS21)," "The Obsessive-Compulsive Inventory-Revised (OCI-R)," and "Posttraumatic Stress Disorder Checklist for DSM-5 (PCL-5)" were used to assess other related disorders in the prevalence and predictive power of sleep disorders among the participants. Statistical tests, including the analysis of variance (ANOVA), chi-square, and Bayesian linear regression, were implemented using SPSS v. 26 to analyze the obtained data.

Results: Among the total of 300 participants, 198 individuals (66%) demonstrated sleep disorders. The majority were female (54.54%), married (88.38%), employed (56.56%), from Tehran (96.96%), and covered by hospital C (36.86%). Ultimately, depression (BF = 0.01 and P-value = 0.0001), anxiety (BF = 0.02 and P-value = 0.0001), obsessive-compulsive disorder (OCD) (BF = 0.02 and P-value = 0.001), and post-traumatic stress disorder (PTSD) (BF = 0.0001 and P-value = 0.001) were the most powerful predictors of the presence of sleep disorders among individuals recovered from COVID-19.

Conclusions: COVID-19-related sleep disorders were found in more than half of the COVID-19-recovered individuals, with mild severity. Furthermore, the reported prevalence, severity, and significance varied among the participants in accordance with sociodemographic and health disparities.

Keywords: Sleep Disorder, COVID-19, Recovery, Mental Health

1. Background

Coronavirus disease 2019, also known as COVID-19, is considered a global emergency with symptoms resembling pneumonia. It was first observed in Wuhan, China, in December 2019 and subsequently spread rapidly worldwide. The complications of COVID-19 range from asymptomatic conditions to severe critical conditions, sometimes resulting in death (1). According to the World Health Organization (WHO), as of October 25, 2023, there have been an estimated 771,549,718 confirmed cases of COVID-19 globally, with 6,974,473 reported deaths. In Iran, there have been 7,619,981 confirmed cases, with 146,480 reported deaths (2).

While many COVID-19-infected individuals have recovered from the acute phase and its severe consequences, including acute respiratory distress syndrome (ARDS), they continue to experience

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persistent aftereffects. That is, many of them suffered an abnormal or even catastrophic medical condition following discharging the medical center (3, 4). On this subject, the COVID-19-related psychological consequences are particularly significant (5, 6). Several studies have shown that individuals who have recovered from COVID-19 continue to exhibit psychological issues long after the initial symptoms have subsided (7, 8). Evidence has also emerged suggesting the presence of various psychotic spectrum disorders among COVID-19 survivors, which may be attributed to the disease itself, the treatment process, or the psychosocial distress during the pandemic (9). Additionally, other research has indicated that these individuals are susceptible to disorders such as depression, anxiety, and insomnia (10). However, based on other investigations, most COVID-19 survivors are able to regain their previous levels of psychological and interpersonal well-being (11).

Insomnia, a sleep disorder, is one of the psychological consequences of COVID-19 that persists among some individuals long after recovery. Sleep disorders encompass various conditions, including excessive somnolence, difficulties in initiating and maintaining sleep (insomnias), disturbances in sleep-wake schedules, and issues related to sleep stages or partial arousals, such as parasomnias (12). Studies have consistently shown that poor sleep quality can lead to a reduced quality of life and disruptions in all aspects of an individual's well-being (13-15). Moreover, sleep disorders are not isolated psychological conditions; they are directly associated with other psychological disorders, such as anxiety and depression. Individuals with depression and anxiety disorders tend to experience more severe sleep disorders (12, 16).

Furthermore, disparities in sociodemographic status and access to healthcare services can influence the prevalence and severity of these disorders (17, 18). Research indicates that such disparities have a broad impact on the management and treatment of COVID-19 consequences (19, 20).

Despite limitations in the existing studies in this field, which have yielded varying conclusions, the persistence of sleep pattern disturbances among COVID-19 survivors underscores the need for further investigation (3, 10). Additionally, the importance of psychological evaluation for COVID-19 survivors is highlighted by the fact that these disorders often go undiagnosed until they lead to significant functional limitations (3, 4). Recognizing the significance of this issue, The Lancet has called for the establishment of community-based mental health services to screen and develop long-term infrastructure for providing psychological support to COVID-19 survivors (21). Lastly, it is worth noting that most similar studies have focused solely on linear correlations between COVID-19 and its consequences, whereas studies examining correlations between variables in a network correlational system have been limited, a gap addressed in this current study.

2. Objectives

After observing the continued prevalence of COVID-19-related sleep disorders even long after recovery, it has become evident that there is a need to investigate the psychological well-being of individuals who have recuperated from COVID-19. The goal is to develop suitable community-based supportive interventions. Furthermore, the impact of predictors related to sociodemographic and health disparities on the persistence and severity of psychological consequences following COVID-19 underscores the significance of this current study. Therefore, the objective of this investigation is to assess the prevalence and predictive factors of COVID-19-related sleep disorders, along with their associations with sociodemographic and health disparities, among individuals who have recovered from COVID-19 in Iran.

3. Methods

3.1. Design and Sites

The current cross-sectional analytical investigation was conducted from May 2021 to July 2022 to determine the prevalence and predictive factors of sleep disorders, as well as their correlation with socio-demographic and health disparities among Iranian individuals who had recovered from COVID-19 and were covered by Shahid Beheshti University of Medical Sciences (SBMU).

3.2. Participants

The study population included individuals who had recovered from COVID-19 and had been discharged from either the hospital wards or emergency departments of SBMU. Initially, 11 337 potential participants were identified from hospital records, of whom 2117 were randomly selected based on the investigation's inclusion and exclusion criteria. Out of these, 1103 participants provided their consent after receiving the necessary information and meeting the inclusion criteria. Ultimately, only 339 participants completed the entire questionnaire. To ensure geographical representation, we randomly selected 100 participants

selected from each of the aforementioned hospitals, resulting in a total of 300 participants.

3.3. Interventions and Procedures

The sample size was calculated using G-Power v. 3.1 software based on a pilot study and the lowest likelihood of occurrence of any psychological disorders. Three hospitals were selected by lottery from different regions in the south, central, and north of Tehran to ensure geographical diversity. The chosen hospitals were Loghman Hakim Hospital in the south, Imam Hossein Hospital in the center, and Shahid Taleghani Hospital in the north (referred to as A, B, and C, respectively). It is important to note that these regions of Tehran are socioeconomically divided, with the northern residents having a higher socioeconomic status, the southern residents having the lowest, and those in the central region falling in between.

The research proposal was approved by the SBMU Ethics Committee, and the necessary ethical clearance was obtained. After identifying the hospitals and securing the required permissions for site access, participants were randomly selected from each hospital based on their medical records using a simple random sampling method generated by a random number table. They were then screened according to the inclusion and exclusion criteria of the study. Those who met the eligibility criteria were contacted via telephone to provide them with detailed information about the research. After obtaining their consent, an informed consent form was sent to them electronically via WhatsApp, and their electronically signed forms were collected. This process was repeated until the desired sample size (n = 100) was reached in each of the aforementioned hospitals.

The inclusion criteria required participants to be between 18 and 65 years of age, have a documented medical diagnosis of COVID-19 from their hospital or treatment center records, exhibit moderate to critical severity of COVID-19 (as defined in Appendix 1), and have been symptomatic for at least 12 weeks (3 months) but no longer than 60 weeks (18 months) from the onset of symptoms. Additionally, participants needed to voluntarily participate in the study and have no severe or disabling physical or mental impairments. Emotional distress was also an exclusion criterion. Furthermore, participants were excluded if more than 10% of their questionnaires were left unanswered or if they expressed a desire to withdraw from the study.

Following the selection of the final sample, participants were contacted by phone, provided with additional details about the investigation, and informed of their rights. Subsequently, each participant received a digital version of the consent form via WhatsApp, and their digital signature was obtained. Data collection in the current investigation utilized self-report questionnaires along with brief phone interviews. The questionnaires were created as online digital forms in the "Porsa Irandoc" system. Links and additional information were then sent to each participant via WhatsApp. The questionnaires were designed for clarity, with each question presented on a separate page. Additionally, short telephone interviews were conducted to complete the supplementary assessment.

The main research tools used in the current study were the "Clinical Demographic Information Questionnaire" and the "Pittsburgh Sleep Quality Index (PSQI)". The "Clinical Demographic Information Questionnaire," developed by the authors, collected specific individual information, including sex, age, marital status, level of education, occupation, economic situation, place of birth, place of residence, state of health, history of illnesses, history of medication, minimum arterial oxygen saturation (SaO_2) during hospitalization, number of days spent in the hospital due to COVID-19, and the number of days recovered from COVID-19. The qualitative content validity approach was employed to assess the validity of the "Clinical Demographic Information Questionnaire."

Another tool used was the PSQI, which was created by Dr. Buysse at the Institute of Pittsburgh Psychiatric in 1989. The questionnaire comprises 9 core items, with the fifth question having 10 sub-items, resulting in a total of 19 items. Each item is rated on a Likert scale from 0 to 3, with scores ranging from "never in the past week" (0), "once a week" as (1), "twice a week" as (2) and "3 or more times a week" (3). Questions 1 and 3 do not receive individual scores but are used in calculating other scales. Question 2 is scored based on time intervals, ranging from "less than 15 minutes" (score 0) "16 to 30 minutes" as (score 1), "31 to 60 minutes" as (score 2), "more than 60 minutes" (score 3). Question 4 was "more than 7 hours" as (score 0), "6 to 7 hours" as (score 1), "5 to 6 hours" as (score 2) "16 to 30 minutes" as (score 1), "31 to 60 minutes" as (score 2), and "less than 5 hours" (score 3). The questionnaire also includes 7 subscales covering "daytime dysfunction," "sleep duration," "subjective sleep quality," "habitual sleep efficiency," "sleep latency," and "sleep disruptions." The overall score for these subscales falls between 0 and 21, with a total score exceeding 5, indicating poor sleep quality. The validity of this questionnaire was confirmed by comparing it to the "12-item General Health Questionnaire" (GHQ-12) using the Spearman rank correlation coefficient,

yielding a value of 0.74 ($P < 0.001$). Additionally, the internal consistency was assessed using Cronbach's alpha coefficient, which produced a value of 0.77 (22).

To assess the correlation and predictive power of variables such as "stress," "anxiety," "depression," "OCD," and "PTSD," we employed the tools "Depression, Anxiety and Stress Scale 21 (DASS21)," "The Obsessive-Compulsive Inventory-Revised (OCI-R)," and "Posttraumatic Stress Disorder Checklist for DSM-5 (PCL-5)". These tools demonstrated acceptable reliability and validity. The reliability values (based on Cronbach's Alpha) for all examined variables in the current study ranged from 0.65 to 0.87. Moreover, the validity values (based on Pearson and Spearman correlation coefficients) for these variables were all above 0.7 ($P < 0.001$) (23-25)

3.4. Statistical Analysis

After the data were collected, they underwent analysis employing both descriptive and inferential statistics using SPSS v. 26 (IBM Corp., Armonk, NY, USA). A significance level of 0.05 and a test power of 0.95 were taken into consideration, and the testing procedure aligned with the nature of the variables and the research objectives. Qualitative variables of participants' frequency were expressed as relative frequency, while quantitative variables were represented as means and standard deviations. Associations between sociodemographic and health disparities and sleep disorders were examined using statistical values from the analysis of variance (ANOVA) and chi-square tests. Furthermore, the association and predictive capacity between sleep disorders and sociodemographic and health disparities were assessed using the Bayesian linear regression test.

3.5. Ethical Considerations

This investigation received approval from the SBMU Ethics Committee (IR.SBMU.PHARMACY.REC.1400.068), adhering to the essential ethical norms inherent in any research project. Authorization from the SBMU Vice Chancellor for Research Affairs was also obtained. Participants were granted the right to withdraw from the research at any point, in accordance with ethical guidelines. The researcher was responsible for maintaining the confidentiality of participants' information and was prohibited from disclosing it, except in situations where disclosure was deemed necessary, in which case participants were to be informed beforehand. The first author's phone number was provided to participants to address any study-related concerns. Throughout the sampling, data collection, and analysis processes, fidelity and accuracy were upheld. Finally, the study's methodologies and organizational framework were aligned with the cultural and religious norms of both the participants and society.

4. Results

4.1. Sociodemographic and Health Characteristics of Participants

A total of 300 individuals participated in the current investigation, with an equal distribution of 100 participants in each of the 3 hospitals (A, B, and C), making up 33.3% of the sample individually. The majority of participants were female (55.3%), had higher educational levels (59.7%), were employed (53.3%), married (88%), and had a history of hospitalization (79.3%) (Table 1).

4.2. Prevalence of Sleep Disorders

Based on the PSQI, 198 (66%) participants demonstrated sleep disorders in the current investigation. Meanwhile, the severity of the aforementioned disorders among the participants was mild (mean = 5.96) (Table 2).

4.3. Sociodemographic, Health, and Psychological Disparities Among Participants with and Without Sleep Disorders

Differences in demographic variables were observed among participants with and without sleep disorders. However, only the difference in the "hospital" variable was found to be statistically significant (Table 3). Additionally, the prevalence of other psychological disorders among participants was assessed, revealing significant differences in psychological status between participants with and without sleep disorders (Table 4).

4.4. Predictors of Sleep Disorders Among Participants

According to Bayesian analysis, depression, anxiety, OCD, PTSD, higher educational status, and hospital C were identified as the most influential predictors of sleep disorders among the participants ($P < 0.01$). It is worth noting that the Bayesian Factor (BF) for these variables varied (Table 5).

5. Discussion

The aim of this investigation was to determine the prevalence of sleep disorders and their associated

Table 1. Sociodemographic and Medical Characteristics of Recovered COVID-19 Individuals [a]

	N	Hospital A	Hospital B	Hospital C
Sex				
Male	134 (44.7)	53 (53.0)	36 (36.0)	45 (45.0)
Female	166 (55.3)	47 (47.0)	64 (64.0)	55 (55.0)
Education Level				
Primary	66 (22.0)	21 (21.0)	17 (17.0)	28 (28.0)
Secondary	55 (18.3)	21 (21.0)	13 (13.0)	21 (21.0)
Higher	179 (59.7)	58 (58.0)	70 (70.0)	51 (51.0)
Occupational Status				
Unemployed	124 (41.4)	65 (65.0)	44 (44.0)	51 (51.0)
Employed	160 (53.3)	32 (32.0)	49 (49.0)	43 (43.0)
Retired	16 (5.3)	3 (3.0)	7 (7.0)	6 (6.0)
Marital Status				
Unmarried	36 (12.0)	9 (9.0)	13 (13.0)	14 (14.0)
Married	264 (88.0)	91 (91.0)	87 (87.0)	86 (86.0)
Hospitalization				
Yes	238 (79.3)	75 (75.0)	83 (83.0)	80 (80.0)
No/Referred to home	62 (20.7)	25 (25.0)	17 (17.0)	20 (20.0)
Admission to the ICU				
Yes	34 (11.3)	13 (13.0)	10 (10.0)	11 (11.0)
No	266 (88.7)	87 (87.0)	90 (90.0)	89 (89.0)
Intubation				
Yes	24 (8.0)	13 (13.0)	4 (4.0)	7 (7.0)
No	276 (92.0)	87 (87.0)	96 (96.0)	93 (93.0)
Time elapsed since the onset of symptoms				
3 to 6 months	100 (33.3)	36 (36.0)	17 (17.0)	47 (47.0)
6 months to 1 year	100 (33.3)	31 (31.0)	22 (22.0)	47 (47.0)
1 year to 1.5 years	100 (33.3)	33 (33.0)	61 (61.0)	6 (6.0)

Abbreviation: ICU, Intensive Care Unit.

[a] Values are presented as No. (%).

Table 2. Frequency and Severity of Sleep Disturbances Among COVID-19 Recovered Individuals

PSQI Level			
Valid	**No. (%)**	**Valid Percent**	**Cumulative Percent**
Normal sleep quality (below 5)	102 (34.0)	34.0	34.0
Poor sleep quality (5 and above)	198 (66.0)	66.0	100.0
Total	300 (100.0)	100.0	
Total PSQI			
N	**Minimum**	**Maximum**	**Mean ± SD**
300	0	15	5.96 ± 3.159

sociodemographic and health disparities among individuals who had recovered from COVID-19. According to the findings, more than two-thirds (66%) of individuals who had recovered from COVID-19 experienced sleep disorders. However, the frequency and severity of these reported disorders varied widely due to various factors. The average severity of these disorders among participants was mild, with a mean score of 5.96.

In a similar vein, a systematic review by Malik et al. in 2021 also found that 47% of participants experienced mild to moderate sleep disorders post-COVID-19 (26).

Table 3. Sleep Disturbance Distribution Between the Subjects by Sociodemographic and Health Characters [a]

Variables	PSQI Level		Statistics		
	Normal Sleep Quality (Below 5)	Poor Sleep Quality (5 and Above)	t (df)	$\chi 2$ (df)	P-Value
Age	42.06 ± 8.88	41.50 ± 9.16	- 0.50 (298)		0.61
Minimum level of SaO_2	79.89 ± 10.72	78.52 ± 9.59	1.12 (298)		0.26
Number of hospitalization days	4.98 ± 3.61	5.51 ± 3.60	- 1.19 (298)		0.23
Sex				0.14 (1)	0.70
Male	50 (37.31)	84 (62.68)			
Female	52 (31.32)	114 (68.67)			
Birthplace				7.36 (7)	0.39
Tehran	96 (33.33)	192 (66.66)			
Other cities	5 (45.45)	6 (54.54)			
Hospital				8.28 (2)	0.01 [b]
A	30 (30)	70 (70)			
B	45 (45)	55 (55)			
C	27 (27)	73 (73)			
ICU admission				0.04 (1)	0.83
No	91 (34.21)	175 (65.78)			
Yes	11 (32.35)	23 (67.64)			
Marital status				0.81 (1)	0.77
Married	89 (33.71)	175 (66.28)			
Single	13 (36.11)	23 (63.88)			
Intubation				0.94 (1)	0.33
No	96 (34.78)	180 (65.21)			
Yes	6 (25)	18 (75)			
Time elapsed from the onset (mo)				1.07 (2)	0.58
3 - 6	36 (36)	64 (64)			
6 - 12	30 (30)	70 (70)			
12 - 18	36 (36)	64 (64)			
Hospitalization				0.77 (1)	0.37
No	78 (32.77)	160 (67.22)			
Yes	24 (38.70)	38 (61.29)			
Occupational status				6.95 (1)	0.073
Employed	45 (44.11)	112 (56.56)			
Unemployed	48 (47.05)	79 (39.89)			
Retired	9 (8.82)	7 (3.53)			
Education level				8.91 (1)	0.064
Primary	1 (0.98)	11 (5.55)			
Secondary	30 (29.41)	79 (39.89)			
Higher	71 (69.60)	108 (54.54)			

Abbreviations: PSQI, Pittsburgh Sleep Quality Index; ICU, Intensive care unit.

[a] Values are presented as mean ± SD or No. (%) unless otherwise indicated.

[b] $P < 0.05$.

This result is in line with the findings of the current study.

Additionally, participants with sleep disorders in the current investigation were younger, had lower minimum SaO2 levels, and eventually, further hospitalization days. Even though, the differences were not significant for each of the variables of “age” (P-value = 0.61), “minimum level of SaO_2” (P-value = 0.26) and finally “the number of hospitalization days” (P-value = 0.23). In this regard, according to a research implemented by Sreevalsan-Nair et al. in 2020 aming to maintain the effect of the duration of hospitalization on

Table 4. Mental Health Disparities Between the Subjects with and Without Sleep Disorders

Variables	PSQI level, Mean ± SD		Statistics	
	Normal Sleep Quality (Below 5)	Poor Sleep Quality (5 and Above)	T_{298}	P-Value [a]
PTSD	28.82 ± 17.10)	42.19 ± 15.76	- 6.75	0.0001
OCD	26.58 ± 15.56	32.64 ± 14.65	- 3.32	0.001
Depression	7.01 ± 5.52	9.55 ± 5.03	- 3.99	0.0001
Anxiety	6.66 ± 5.09	9.07 ± 4.63	- 4.11	0.0001
Stress	7.18 ± 5.24	9.77 ± 4.72	-4.33	0.0001

Abbreviations: PSQI, pittsburgh Sleep Quality Index; PTSD, post-traumatic stress disorder; OCD, Obsessive-compulsive disorder.

[a] $P < 0.05$.

Table 5. Results of the Bayesian Linear Regression Test Between sleep disturbance and Sociodemographic Inequalities, Health Inequalities, and Other Confounding Variables

Response Variable	Bayesian Factor	P-Value [a]
Sleep disturbance		
Depression	0.01	0.0001
Anxiety	0.02	0.0001
OCD	0.02	0.001
PTSD	0.0001	0.0001

Abbreviations: OCD, Obsessive-compulsive disorder; PTSD, Post-traumatic stress disorder.

[a] $P < 0.05$

the level of susceptibility among the Singaporean individuals who recovered from COVID_19, the results demonstrated the correlation between further length of hospitalization and the higher level of susceptibility among aforementioned individuals (27), which was congruent to the results of the current search. Further, another study was conducted by El Sayed et al. in 2021 in order to evaluate the sleep quality in post-COVID-19 recovery period, which results have indicated the prevalence of insomnia among older individuals with the background of moderate to severe severity of respiratory dysfunction during hospitalization (28). As mentioned, the results related to respiratory dysfunction were consistent with the results of the present study in this field. However, this issue has not been true in relation to age. The results could be due to the stressful tensions related to the socio-occupational situations that were more prevalent among younger individuals, which have fortified their sleep disorders' frequency and severity.

Furthermore, the prevalence of sleep disorders varied significantly among participants from different hospitals. The hospitals in this study were located in regions of Tehran with substantial socioeconomic disparities. For instance, the hospital located in the southern region of Tehran (hospital C) had a significantly higher prevalence of sleep disorders (36.86%) compared to the others (P-value = 0.01). These disparities in prevalence could be linked to differences in socioeconomic status and access to healthcare services among residents of these regions. Garnier et al. conducted a study in 2021 and found that poor socioeconomic status was associated with greater vulnerability among individuals who had recovered from COVID-19 (29). Interestingly, sleep disorders were more prevalent among individuals from the hospital in the northern region of Tehran (hospital A) (35.35%) compared to the hospital in the central region (hospital B) (27.77%). This contradicts the assumption that the northern region has a better socioeconomic status. However, a study by Kahneman and Deaton in 2021 emphasized that higher income does not necessarily improve emotional well-being (30). Given that the studied hospitals were all government-run (public) hospitals, most of the patients had a moderate socioeconomic status, regardless of the socioeconomic disparities in different regions of Tehran. Therefore, these conflicting results may be attributed to various factors.

In terms of “gender”, in general, the prevalence of sleep disorders was higher in females (114 individuals) than males (84 individuals). Nevertheless, according to the current investigation's segregated frequency of each gender, sleep disorders were more prevalent among

females (68.67% of the total frequency of females) compared to males (62.68% of the total frequency of males). However, this sex difference was not statistically significant (P-value = 0.70). This finding aligns with a study by El Sayed, which also found that females were more vulnerable to sleep disorders than males (28).

Additionally, the prevalence of sleep disorders was slightly higher among participants who were 6 to 12 months post-COVID-19 onset (70%) compared to other time-based groups (64%), but this difference was not statistically significant (P-value = 0.58). It appears that the peak frequency of sleep disorders is associated with the middle time period within the spectrum of 3 to 18 months, a pattern supported by a study conducted by Dvořáková in 2023 (31).

Regarding the "marital status", in general, sleep disorders were more prevalent among married individuals (175 individuals) compared to single individuals (36 individuals). However, considering the total higher frequency of married participants of the present study is indispensable. Nevertheless, the prevalence of sleep disorders was still slightly higher among married individuals (66.28% of the total 264 married individuals) than single individuals (63.88% of the total 36 individuals (P = 0.77) when the frequency by marital status was considered separately. In contrast, as claimed by El Sayed conversely, single individuals had higher prevalence of insomnia (28). The results which were inconsistent with the present research. As a justification, the reason for more frequent sleep disorders among married individuals can be explained by their more responsibilities, concerns and stressful social tensions compared to single individuals, which makes them more vulnerable.

Regarding education level, although the majority of participants in this study had a higher education level (university) (179 individuals), based on the segregated frequency of each educational group, individuals with secondary education (high school) and primary education had the highest prevalence of sleep disorders (91.66% of 12 individuals and 72.47% of 109 individuals, respectively). Participants with a higher education level had a lower prevalence of sleep disorders (60.33% of 179 individuals), although this difference was not statistically significant (P-value = 0.06). El Sayed's study also found that individuals with secondary education had a higher prevalence of insomnia compared to those with primary and higher education levels (28), which aligns with the present study's findings. This difference may be explained by the better self-management strategies and coping mechanisms of individuals with higher education levels. Similar results were reported in a study by Freire et al. in 2020 (32).

Additionally, the results showed that employed individuals (71.33% of 157 individuals) had a higher prevalence of sleep disorders compared to unemployed individuals (62.20% of 127 individuals) and retired individuals (43.75% of 16 individuals), although this difference was not statistically significant (P-value = 0.073). This variation in prevalence may be attributed to occupational stress, which has been noted in a study by El Sayed, where employed individuals were found to be more prone to developing insomnia (28).

In this investigation, participants from Tehran had the highest prevalence of sleep disorders. However, this difference was not statistically significant (P-value = 0.39). This result is expected as the majority of the participants were born in Tehran (288 individuals).

Lastly, sleep disorders were more prevalent among individuals with a history of hospitalization (67.22% of 238 individuals), ICU admission (66.64% of 34 individuals), and invasive intubation (75% of 24 individuals) during the COVID-19 pandemic, even long after recovery, compared to those without these records. However, none of these differences related to the history of hospitalization, ICU admission, and intubation were statistically significant (P-value = 0.37, 0.83, and 0.33, respectively). It is undeniable that conditions such as a history of hospitalization, ICU admission, and invasive procedures like intubation can be associated with significant psychological stress. Therefore, the higher prevalence of psychological disorders such as sleep disorders among these individuals was expected. A review study conducted by Pinto et al. highlighted the significant impact of surgical complications, as invasive procedures, on individuals' psychosocial well-being (33). Moreover, Rose et al. reported significant psychiatric disorders, including delusions, anxiety, depression, and PTSD, following ICU admission (34). Bellan et al. also noted that more noticeable psychological consequences were common among individuals admitted to the hospital for COVID-19 (35). Thus, the findings of the current research align with these similar studies.

Furthermore, a significant correlation was observed between sleep disorders and other psychological disorders such as PTSD, OCD, depression, anxiety, and stress (P-value < 0.05). This means that individuals who had these psychological disorders concurrently were more likely to experience sleep disorders compared to those without these disorders. These results are consistent with separate investigations conducted by Koffel et al. (2016) (36), Carpi and Vestri (37), and Segalàs et al. (38). However, based on Bayesian analysis, a

significant correlation was specifically found between sleep disorders and depression (BF = 0.01 and P-value = 0.0001), sleep disorders and anxiety (BF = 0.02 and P-value = 0.0001), sleep disorders and OCD (BF= 0.02 and P-value = 0.001), and finally sleep disorders and PTSD (BF = 0.0001 and P-value = 0.001). This indicates a predictive relationship between these factors. In line with this, a cross-sectional study by Poyraz et al. in 2021 reported a correlation between "sleep disorders and PTSD" ($P < 0.001$ and BF = 42.07) (39). Moreover, according to a cross-sectional investigation implemented by Simonetti et al. (40) in 2021, An association between "sleep disorders and anxiety" (BF = 0.40 and $P < 0.0001$) and "sleep disorders and depression" (BF = 0.41 and $P < 0.0001$) has been reported. Furthermore, in line with the findings of Segalàs et al., a significant correlation between sleep disorders and OCD was identified ($P < 0.001$ and BF = 0.04) (38). Despite the minor statistical differences, these results corroborate the findings of the present study and provide additional support for the observed relationships.

5.1. Limitations

The current investigation, like any other study, had certain limitations. One of these limitations was the relatively small sample size. Only 339 individuals out of a total of 1 103 potential respondents completed the entire questionnaire. Therefore, it is reasonable to assume that more individuals might be suffering from sleep disorders. Additionally, the generalizability of our participants' data was constrained by ethical norms that required voluntary participation.

In conclusion, this study found that mild sleep disorders were observed in more than half of the individuals who recovered from COVID-19. The prevalence of these disorders was higher, though not statistically significant, among participants who were younger, male, married, employed, had a secondary education status, were born in Tehran, had a lower level of SaO_2, were admitted to the hospital, covered by hospital C, had more ICU hospitalization days, and had a history of intubation. Furthermore, a meaningful correlation and strong predictive power were observed between PTSD, OCD, anxiety, depression, and sleep disorders.

Supplementary Material

Supplementary material(s) is available here [To read supplementary materials, please refer to the journal website and open PDF/HTML].

Footnotes

Authors' Contribution: AHS, the corresponding author, conceived and designed the evaluation, drafted the manuscript, and collected the clinical data. FG re-evaluated the clinical data, performed the statistical analysis, revised the manuscript, and contributed to the study. All authors read and approved the final manuscript.

Conflict of Interests: The authors declare no conflicts of interest regarding this research.

Data Availability: The dataset presented in the study is available upon request from the corresponding author during submission or after publication.

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