Article

Discovery Medicine 2024; 36(183): 690–698
https://doi.org/10.24976/Discov.Med.202436183.65

Sleep Disorders in Patients with Severe COVID-19 Treated in the Intensive Care Unit: A Real-Life Descriptive Study in Vietnam

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Published: 20 April 2024

Background: Coronavirus disease 2019 (COVID-19) patients with sleep disorders may be at greater risk for respiratory exacerbation or death compared to those without. After being infected with COVID-19, patients have many symptoms related to sleep disorders, especially those with severe acute respiratory syndrome-coronavirus-2 (SARS-CoV-2) infection. This study aimed to evaluate sleep disturbances in patients with severe SARS-CoV-2 infection who were treated in the Intensive Care Unit (ICU).
Methods: This cross-sectional study used the questionnaire provided by the Vietnam Sleep Disorder Study (ViSDiS) research, elaborated by the Vietnam Society of Sleep Medicine (VSSM). Seventy-seven COVID-19 patients were included.
Results: There was a significant difference in sleep status before and after SARS-CoV-2 infection among participants. Up to 83% of them reported experiencing insomnia after illness, 60% reported having frequent nightmares, and more than half of participants reported nocturia ($p < 0.0001$). More than 81.8% of patients with severe SARS-CoV-2 infection were unsatisfied with their sleep quality during hospitalization After SARS-CoV-2 infection, only 2.6% of participants felt they had good quality sleep ($p < 0.0001$). The majority of patients suffered from fatigue after SARS-CoV-2 infection, including a lack of energy, feeling heaviness in their limbs, aggravation of pre-existing sleep disorders, idleness, constant fatigue throughout the day, and difficulty concentrating.
Conclusion: Sleep problems are highly prevalence among hospitalized patients with severe COVID-19 in the ICU. Healthcare providers should pay attention to sleep problems and their associated symptoms to initiate appropriate treatment to improve severe COVID-19 patients' health status and minimize the risk of death.

Keywords: COVID-19; hospitalized patients; sleep disorders; insomnia; ICU

Introduction

In December 2019, a series of cases of viral pneumonia were reported in China. Analyzing patient samples using deep sequencing revealed that a novel coronavirus, severe acute respiratory syndrome-coronavirus-2 (SARS-CoV-2), was the cause of the disease that was later named coronavirus disease 2019 (COVID-19) [1,2]. Clinical symptoms of COVID-19 include fever, cough, dyspnea, chills, tremors, headache, muscle pain, and loss of smell or taste [3]. As of the end of April 2020, it was reported that about 80% of people infected with the novel virus had mild flu-like symptoms and recovered without medical care [4]. However, severe illness and hospitalization were reported in patients aged 65 years or older with comorbidities such as

chronic lung disease, diabetes, heart disease, stress, chronic kidney disease, obesity, immunodeficiency, and liver disease [2,5,6].

The epidemic and strict social isolation measures brought people immense anxiety and insecurity. Most production and business activities were suspended, economic sectors fell into crisis, and tens of thousands of people lost their jobs. This situation negatively impacted people's mental health and sleep quality. SARS-CoV-2 (COVID-19) infection itself also increased rates of anxiety, depression, and stress as well as affected sleep amongst patients with COVID-19 [7,8]. During the pandemic, achieving good quality sleep was essential for COVID-19 patients as it improved patients' quality of life, their mental health, and played an important role in preserving immune function, thus reducing the transmission of viral infections [9,10]. Especially for patients with severe COVID-19, decreasing sleep quality may increase dyspnea by aggravating pre-existing hypoxemia and hypercapnia as well as increase patients' anxiety and depression levels [11].

Therefore, in patients with COVID-19, psychological health and sleep status might influence immunity and thus good quality sleep may serve to enhance immunity to viral infections [12,13]. In addition, sleep quality plays a vital role in helping to restore brain activities and balance physiological, immunological, and metabolic factors in the body. Therefore, poor sleep quality may negatively affect physical, emotional, and psychological well-being in COVID-19 patients, particularly those with severe COVID-19. Hence, this study was conducted to evaluate sleep problems in patients with severe COVID-19 who were hospitalized in the Intensive Care Unit (ICU) of COVID-19 hospitals to analyze its impact on sleep quality and the physical and mental health status of these patients.

Methods

Participants and Study Design

This cross-sectional survey included COVID-19 patients admitted to the Intensive Care Unit (ICU) of Phu Chanh COVID-19 Treatment Unit of Binh Duong General Hospital (the largest COVID-19 treatment center in the South of Vietnam), Binh Duong Province from September to December 2021.

Inclusion Criteria

Patients aged ≥18 years diagnosed with COVID-19 by real-time polymerase chain reaction (RT-PCR); and having severe symptoms of COVID-19 needed to be treated with oxygen therapy (mask oxygen, high flow nasal cannula (HFNC), continuous positive airway pressure (CPAP), bilevel positive airway pressure (BiPAP)); accepting to sign the written consent form; being able to answer the questionnaires.

Table 1. General characteristics of the subjects participating in the study (N = 77).

Parameters (N = 77)	N	%	Mean ± SD
Sex			
Male	32	41.6	-
Female	45	58.4	-
Occupation			
Worker	41	53.2	-
Unemployed	21	27.3	-
Other	15	19.5	-
Marital status			
Single	23	29.9	-
Married	54	70.1	-
Community type			
Suburban	5	6.5	-
Rural	19	24.7	-
Urban	53	68.8	-
Age (years)			
18 to 45 years	46	59.8	33 ± 7
46 to 65 years	27	35.1	55 ± 6
>65 years	4	5.2	76 ± 10
Mean (all)			43 ± 15
Daily physical activity			
Regularly	9	11.7	-
Sometimes	12	15.6	-
Never	56	72.7	-
Comorbidities			
Diabetes	13	16.9*	-
Hypertension	16	20.8	-
Respiratory diseases	4	5.2	-
Cardiovascular diseases	5	6.5	-
Others	9	11.6	-
Vaccination status			
One shot	5	6.5	-
Two shots	0	0.0	-
Unvaccinated	72	93.5	-
COVID-19 symptoms			
Fever	65	84.4	-
Cough	77	100.0	-
Sore throat	35	45.5	-
Anosmia and/or ageusia	19	24.7	-
Dyspnea	77	100.0	-
Other	68	88.3	-
Treatment of COVID-19 in the ICU			
Conventional oxygen (cannula or mask)	4	5.2	-
HFNC	65	84.4	-
CPAP/BiPAP	8	10.4	-
Anticoagulation	77	100.0	-
Remdesivir	77	100.0	-
Corticosteroids	77	100.0	-
Antibiotics	43	55.8	-
Duration of hospitalization (days)			23 ± 6
Time of study interview (days)			17 ± 3

ICU, Intensive Care Unit; HFNC, high flow nasal cannula; CPAP, continuous positive airway pressure; BiPAP, bilevel positive airway pressure; COVID-19, coronavirus disease 2019.
(*): 9.1% type 1 diabetes and 7.8% type 2 diabetes.

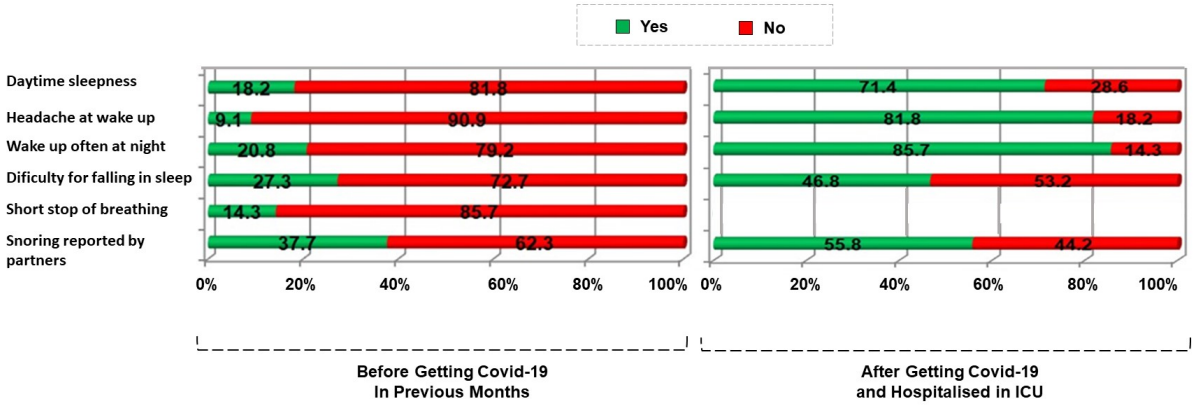

Fig. 1. Comparison of sleep disorder characteristics before and after getting COVID-19 (drawn with Excel software (version 2019, Microsoft, Redmond, WA, USA)).

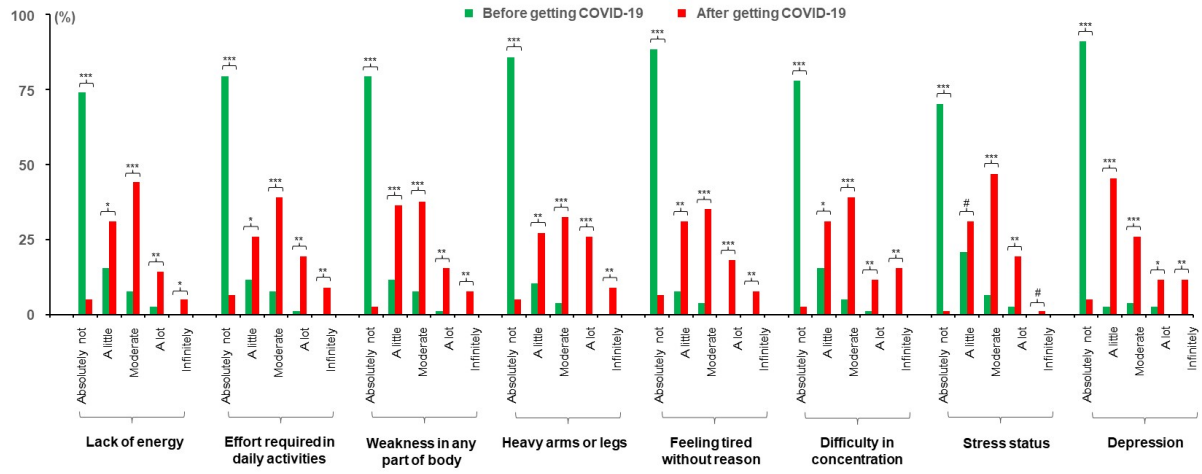

Fig. 2. Fatigue status and related psychological conditions before and after SARS-CoV-2 infection (drawn with Excel software (version 2019, Microsoft, Redmond, WA, USA)). *: significant difference with $p<0.05$; **: significant difference with $p<0.01$; ***: significant difference with $p<0.001$; #: non-significant difference.

Exclusion Criteria

Patients were excluded if they were intubated during their hospitalization in the ICU; and continued to receive their treatment for sleep disorders or any other psychiatric disorder/cognitive impairments or psychiatric disorder (based on clinical records or clinician opinion) as these conditions would prohibit completion of the questionnaire.

Sample

77 patients with severe COVID-19 were recruited to the study by convenient sampling.

Procedures

Data were collected by the research team. Potential participants were approached and invited to the study. Participants who agreed to participate were informed of the procedures in detail and were provided with the study information sheet. Each participant signed the consent form. Afterwards, the investigator used the questionnaire to interview them.

Measurements

The Vietnam Sleep Disorder Study (ViSDiS) questionnaire which was developed by the Scientific Committee of Vietnam Society of Sleep Medicine (VSSM) were used to collect information related to sleep problems in study patients. The study questionnaires were used to assess sleep

habits, sleep quality, and sleep disturbance status. This questionnaire included 2 parts investigating sleep patterns and other mental health problems of participants before infected with COVID-19 (29 items) and during COVID-19 treatment (27 items). The questionnaire is available at (https://forms.gle/naZAf7N6CwCgNNbq9). Information related to patients' age, sex, marital status, education, medical history, and sleep status before and after they contracted COVID-19 were also recorded.

Data Analysis

Data were analyzed using IBM SPSS statistics version 22.0 software (Chicago, IL, USA). The normal distribution of data was assessed with histograms and the Kolmogorov-Smirnov test. Descriptive analyses are presented as median and 25th–75th percentile values. Continuous variables are presented as the means ± standard deviations and categorical variables as numbers with percentages. Between-group comparisons (before-and-after) were performed using χ^2 test for categorical variables. The statistical significance was set at $p < 0.05$.

Results

General Characteristics of Study Patients

There were 77 patients with severe COVID-19 treated at the ICU of Phu Chanh COVID-19 Treatment Unit - Binh Duong General Hospital that participated in the study.

There was a significant difference between the percentage of participants with regard to sex (58.4% for men and 41.6% for women; $p = 0.018$). Workers accounted for the highest proportion of study participants at 53.2% compared to other jobs. The 18–45 years age group accounted for the highest percentage (59.8%) of participants and most of the study patients were married, accounting for 70.1%. The results showed that many subjects infected with COVID-19 did not participate in daily physical activity, accounting for 72.7% of the 77 patients, 15.6% of the subjects only occasionally participated in physical activities, and only 11.7% of the subjects participating in this study periodically participated in physical activities (Table 1). Most of the study patients lived in urban areas (68.8%) while 24.7% lived in rural areas and 6.5% in suburban areas.

The results showed that 61.0% of patients had comorbidities, including diabetes (16.9%: 9.1% type 1 diabetes and 7.8% type 2 diabetes), hypertension (20.8%), respiratory diseases (5.2%: asthma and COPD), cardiovascular diseases (6.5%), and other comorbidities (11.6%). 93.5% of patients were not vaccinated at the time of hospitalization and 84.4% of them were treated with high flow nasal cannula (HFNC). All patients were treated with anticoagulation, remdesivir, and corticosteroids. The mean time of hospitalization was 23 ± 6 days and the mean study interviewing time was 17 ± 3 days. Information regarding participants' characteristics is presented in Table 1.

Sleep Problems and Associated Factors before and after SARS-CoV-2 Infection

Prior to contracting COVID-19, 70.1% of patients felt that they got enough sleep, 18.2% reported daytime sleepiness, 9.1% reported headache upon waking, 20.8% reported waking up after sleep onset, and 14.3% were noted to have apneic episodes and 37.7% were noted to experience snoring as reported by their partners. These symptoms related to sleep disorders were more severe after contracting COVID-19. Most patients were unaffected by external influences on sleep before contracting COVID-19, aside from regular use of phones and tablets in bed, which accounted for 51.9% (Table 2 and Fig. 1).

The study results show a statistically significant difference in sleep status before and after SARS-CoV-2 infection. Up to 83.1% of study participants had insomnia after infection compared to 27.3% before infection. Regarding sleep quality, after being infected with COVID-19 only 2.6% achieved good sleep compared to 66.2% before infection. 77.9% of patients had difficulty falling asleep and maintaining sleep, 60.0% had nightmares, and 57.4% had nocturia after being infected with COVID-19 and treated in the ICU (Table 2).

Level of Fatigue and Related Psychological Conditions before and after SARS-CoV-2 Infection

The results showed that after being infected with COVID-19, the majority of participants reported symptoms of fatigue including lack of energy, effort to carry on daily activities, weakenss in any part of the body, heavy arms or legs, and feeling tired for no reason (Table 3). The prevalence of these symptoms were significantly higher compared to the post SARS-CoV-2 infection period. In addition, the level of difficulty concentrating, stress, and depression after being hospitalized for treatment of COVID-19 in the ICU were significantly increased in study patients in comparison to before getting COVID-19 from moderate (all $p < 0.001$; Table 3 and Fig. 2) to severe (11.7%, 19.5% and 11.7% vs 1.3%, 2.6% and 2.6%; all $p < 0.01$; respectively; Table 3 and Fig. 2).

Sleep and Related-Psychological Problems after Getting COVID-19

The results of this study showed that participants had different levels of sleep-related problems, including difficulty falling asleep (moderate: 48.1%, severe: 20.8%, and very severe: 5.2%), difficulty maintaining sleep (moderate: 46.8%, severe: 31.2%, and very severe: 3.9%), difficulty waking up in the morning (moderate: 53.2% and severe: 14.3%), and disturbances during daytime activities (moderate: 68.8% and severe: 14.3%). More than 81.8% of patients were unsatisfied with their current sleep status after being infected with COVID-19 and 66.2% had moderate anxiety regarding their sleep status. Other psychological symptoms also had high prevalence, including negative

Table 2. Sleep problems before and after getting SARS-CoV-2 infection.

Parameters	Before	After	χ^2	*p*-value
	N (%)	N (%)		
Having an adequate amount of sleep	54 (70.1)	10 (13.0)	51.77	<0.0001
Daytime sleepiness	14 (18.2)	52 (71.4)	38.29	<0.0001
Headache upon waking	7 (9.1)	63 (81.8)	38.82	<0.0001
Waking up after sleep onset	16 (20.8)	66 (85.7)	27.98	<0.0001
Apneic episodes as reported by partners	11 (14.3)	-		N/A
Loud snoring	29 (37.7)	43 (55.8)	2.87	0.09
Factors affecting sleep				
Fear of SARS-CoV-2 infection	11 (14.3)	58 (75.3)	30.32	<0.0001
Frequent use of smartphones in bed	40 (51.9)	21 (27.5)	9.27	<0.0001
Patient care activities in ICU (e.g., examinations, checking vitals, etc.)	-	42 (54.6)		N/A
ICU environment	-	48 (62.4)		N/A
Subjective insomnia assessment			14.59	<0.0001
Frequently	21 (27.3)	64 (83.1)		
Sometimes	19 (24.6)	11 (14.3)		
Subjective insomnia severity			40.31	<0.0001
Severe	8 (10.4)	37 (48.1)		
Moderate	17 (21.9)	24 (31.2)		
Mild	52 (67.5)	16 (20.8)		
Quality of sleep			76.23	<0.0001
Good	51 (66.2)	2 (2.6)		
Acceptable	16 (20.8)	21 (27.3)		
Poor	10 (13.0)	54 (70.1)		
Sleeping difficulty			82.16	<0.0001
Difficulty falling asleep	29 (37.6)	2 (2.6)		
Difficulty maintaining sleep	10 (13.0)	13 (16.9)		
Both	10 (13.0)	60 (77.9)		
None	28 (36.4)	2 (2.6)		
Having nightmares			43.84	<0.0001
Regularly	7 (9.1)	46 (60.0)		
Sometimes	43 (55.8)	18 (23.1)		
Never	27 (35.1)	13 (16.9)		
Nocturia			36.37	<0.0001
Regularly	13 (16.9)	44 (57.4)		
Sometimes	17 (22.3)	20 (25.7)		
Never	47 (60.9)	13 (16.9)		

N/A, not applicable.

thought patterns (very severe: 35.1%), poor mental clarity (very severe: 42.9%), and feelings of emptiness or low mood. Table 4 presented details of sleep and other psychological problems among participants.

Discussion

The finding of the study indicated a high prevalence of insomnia after SARS-CoV-2 infection among patients who were hospitalized in the ICU (83.1%) and the majority of them were dissatisfied with their sleep (81.8%). This proportion is remarkably higher than the prevalence of insomnia among hospitalized COVID-19 presented in previous systematic reviews (12% to 47%) [14–16]. This high proportion of insomnia is explained by the worsening of sleep parameters before and after SARS-CoV-2 infection. Only 13% of patients who were severely infected with COVID-19 felt that they received adequate sleep after illness compared to 70.1% before infection and the percentage of patients who reported experiencing insomnia after contracting COVID-19 was 3 times higher than before infection. Moreover, after being infected with COVID-19, less than 3% of study patients treated in the ICU felt that they had good sleep compared to more than 60% before infection. This result suggests that the quality of sleep of patients with severe COVID-19 could be severely damaged during hospitalization. Additionally, the percentage of study patients

Table 3. Characteristics of fatigue status and related psychological conditions.

Parameters	Before	After	χ^2	*p*-value
	N (%)	N (%)		
Lack of energy			63.31	<0.0001
None	57 (74.0)	4 (5.2)		
Mild	12 (15.6)	24 (31.2)		
Moderate	6 (7.8)	34 (44.2)		
Severe	2 (2.6)	11 (14.3)		
Very severe	0 (0.0)	4 (5.2)		
Effort to carry on daily activities			61.86	<0.0001
None	61 (79.2)	5 (6.5)		
Mild	9 (11.7)	20 (26.0)		
Moderate	6 (7.8)	30 (39.0)		
Much	1 (1.3)	15 (19.5)		
Very much	0 (0.0)	7 (9.1)		
Weakness in any part of the body			66.39	<0.0001
None	61 (79.2)	2 (2.6)		
Mild	9 (11.7)	28 (36.4)		
Moderate	6 (7.8)	29 (37.7)		
Severe	1 (1.3)	12 (15.6)		
Very severe	0 (0.0)	6 (7.8)		
Heavy arms or legs			77.5	<0.0001
None	66 (85.7)	4 (5.2)		
Mild	8 (10.4)	21 (27.3)		
Moderate	3 (3.9)	25 (32.5)		
Severe	0 (0.0)	20 (26.0)		
Very severe	0 (0.0)	7 (9.1)		
Feeling tired for no reason			93.996	<0.0001
None	68 (88.3)	5 (6.5)		
Mild	6 (7.8)	24 (31.2)		
Moderate	3 (3.9)	27 (35.1)		
Severe	0 (0.0)	14 (18.2)		
Very severe	0 (0.0)	6 (7.8)		
Difficulty concentrating			65.18	<0.0001
None	60 (77.9)	2 (2.6)		
Mild	12 (15.6)	24 (31.2)		
Moderate	4 (5.2)	30 (39.0)		
Severe	1 (1.3)	9 (11.7)		
Very severe	0 (0.0)	12 (15.6)		
Stress			68.39	<0.0001
None	54 (70.1)	1 (1.3)		
Mild	16 (20.8)	24 (31.2)		
Moderate	5 (6.5)	36 (46.8)		
Severe	2 (2.6)	15 (19.5)		
Very severe	0 (0.0)	1 (1.3)		
Depression			102.78	<0.0001
None	70 (90.9)	4 (5.2)		
Mild	2 (2.6)	35 (45.4)		
Moderate	3 (3.9)	20 (26.0)		
Severe	2 (2.6)	9 (11.7)		
Very severe	0 (0.0)	9 (11.7)		

who reported experiencing nightmares and nocturia also increased during hospitalization. These symptoms may be independent factors that affected study patients' sleep quality.

After SARS-CoV-2 infection, most participants experienced difficulty maintaining sleep from moderate to severe (81.9%). About 70% of them reported waking up too early in the morning. As such, interventions to improve sleep quality among this population should focus on improving and maintaining sleep. This finding suggests the needs and direction for developing the intervention to increase the quality of sleep among COVID-19 in the ICU.

People with SARS-CoV-2 infection have a higher risk of developing mental health problems [17]. Furthermore, the present study demonstrated that the symptoms and psychological status related to sleep disorders such as depression, anxiety, memory impairment, daytime drowsiness, and morning headache increased significantly after getting COVID-19. Previous studies have also shown that COVID-19 patients were often presented with reduced sleep quality, possibly due to being isolated from family, physical discomfort, lack of sleep, and psychological factors (fear, anxiety, helplessness and/or depression) [18,19]. The relationship between sleep quality and the psychological status of patients hospitalized with COVID-19 has been previously demonstrated [20]. Nevertheless, the bidirectional relationship between insomnia, depression, and anxiety has been well documented in the literature [21]. Hence, measuring anxiety, depression, and insomnia in patients hospitalized for severe COVID-19 must be included in usual care in the ICU. These results also indicate that to ensure success in insomnia treatment among severe COVID-19 cases, clinicians should consider treating depression and anxiety if they are presented.

The current study also revealed the prevalence of frequent waking and loud snoring significantly increased. Previous studies have shown that COVID-19 increased mortality in the elderly, especially those with obesity, hypertension, and diabetes, however, the prevalence of Obstructive Sleep Apnea (OSA) in patients with COVID-19 has not been well documented [13,22,23]. Nevertheless, the medical records of patients with a higher likelihood of death related to COVID-19 in these studies were similar to our patients (Tables 1,2). In this study, the majority of comorbidities included cardiovascular disease, hypertension, obesity, and diabetes. Thus, the presence of snoring before getting COVID-19 may pose a risk of serious consequences of SARS-CoV-2 infection such as ICU admission, assisted ventilation, or death in some patients with COVID-19 and play a role as a facilitator of SARS-CoV-2 infection [24].

Moreover, the results of our study showed that after being infected with COVID-19, some fatigue symptoms related to sleep disorders also became more prevalent, including severe lack of energy, feeling heaviness in the limbs, frequent fatigue, difficulty concentrating, involuntary and irritability. This is an important concern because patients with severe COVID-19 experience various "symptom clusters". A symptom cluster has been defined as at least two symptoms occurring together, relating to each other and be-

Table 4. Characteristics of sleep and psychological disorders after getting-19 infection.

Sleep and psychological disorders	%	Sleep and psychological disorders	%
Difficulty sleeping		Satisfied with the current sleep	
None	5.2	Very dissatisfied	10.4
Mild	20.8	dissatisfied	81.8
Moderate	48.1	Neutral	3.9
Severe	20.8	Satisfied	1.3
Very severe	5.2	Very satisfied	2.6
Difficulty maintaining sleep		Anxiety with sleep status	
None	2.6	None	3.9
Mild	15.6	A little	15.6
Moderate	46.8	Somewhat	66.2
Severe	31.2	Much	11.7
Very severe	3.9	Very much	2.6
Waking up too early in the morning		Negative thought patterns	
None	2.6	None	5.2
Mild	26.0	Mild	41.6
Moderate	53.2	Moderate	16.9
Severe	14.3	Severe	1.3
Very severe	3.9	Very severe	35.1
Disturbances during daytime activities		Poor mental clarity	
None	5.2	None	6.5
Mild	10.4	Mild	35.1
Moderate	68.8	Moderate	14.3
Severe	14.3	Severe	1.3
Very severe	1.3	Very severe	42.9
Feelings of Emptiness		Low mood	
None	6.5	None	5.2
A little	50.6	A little	39.0
Somewhat	29.9	Somewhat	39.0
Much	13.0	Much	16.9

ing clinically meaningful together [25,26]. That finding suggests comprehensive health checkups for this population must be implemented to improve the COVID-19 recovery process and patient's quality of life.

The authors acknowledge that the current study has several limitations related to sample size, the lack of objective measurement of sleep parameters and disorders such as the use of polysomnography, and the long-term follow-up of study subjects. The fact that patients with severe COVID-19 are in the ICU, while also having to manage comorbidities, is a limitation due to its impact on sleep quality. However, despite facing many difficulties during 4th wave of the COVID-19 pandemic in Vietnam, this study attempted to analyze the sleep quality, psychological health status, and clinical manifestations of sleep in patients with severe COVID-19 who were hospitalized in the ICU. Findings from this study have demonstrated possible interventions to improve the sleep of severe COVID-19 patients and raise the awareness of comprehensive examination of both physical and psychological symptoms in such patients. We hope that our results will facilitate further studies to treat psychological and sleep disorders in critically ill inpatients with COVID-19 and encourage physicians and other healthcare staff to identify factors affecting sleep quality in order to implement effective interventions.

Conclusion

This study raises the critical issue of improving the sleep quality of patients hospitalized with severe SARS-CoV-2 infection. Good quality sleep will help to strengthen immune function and reduce the burden of ICU care. We hope that our results will facilitate further studies to treat psychological and sleep disorders in critically ill inpatients hospitalized with COVID-19 and minimize the risk of death in this patient population. Thus, it is essential to monitor patients' psychological outcomes to initiate effective mental health interventions. However, there is a need for further studies that can use other sleep assessment methods such as polysomnography to re-evaluate sleep quality and sleep disturbances in patients with severe COVID-19 appropriately.

Availability of Data and Materials

Patient data and the clinical course were retrieved from the hospital's medical records. They are available from the corresponding author upon reasonable request.

Author Contributions

SDQ, TND, TNV, ANT, TTTC, KBD, QVTT, STD, TNNP, and VNN contributed to the conception and design. SDQ, TTTT, and DHTA contributed to the acquisition of data. SDQ, TND, HHTX contributed to analysis and interpretation of data. TND, SDQ, and DHTA drafted the initial manuscript and revised the final manuscript. HHTX, TNV, TTTT, ANT, TTTC, STD, TNNP, and TND improved the manuscript after the review process. TND, KBD, QVTT, VNN, and SDQ revised the manuscript. All authors approved the final manuscript as submitted and agreed to be accountable for all aspects of the work.

Ethics Approval and Consent to Participate

This study was approved by the Institutional Review Board of Vietnam Society of Sleep Medicine (VSSM-NCKH-02.09.2021). 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. Informed consent was obtained from all individual participants included in the study.

Acknowledgment

The authors would like to thank all members of Intensive Care Unit of Phu Chanh COVID-19 Hospital of Binh Duong General Hospital and Ms. Vanna Giang from Penn State College of Medicine for English edition.

Funding

This research received no external funding.

Conflict of Interest

The authors declare no conflict of interest.

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