




# Predicting the severity of COVID-19 anxiety based on sleep quality and mental health in healthcare workers

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## Abstract

**Background:** One of the social groups whose psychological assessment is important during the COVID-19 outbreak is healthcare workers.

**Objective:** This study aimed to predict the severity of COVID-19 anxiety in healthcare workers based on sleep quality and mental health.

**Methods:** This correlational study was conducted on 180 healthcare workers (129 females and 51 males). Participants completed the researcher-created demographic information questionnaire, the Pittsburgh Sleep Quality Index (PSQI), the General Health Questionnaire (GHQ-12), and the COVID-19 Anxiety Scale (CDAS).

**Results:** The results showed that 23.3% of healthcare workers reported COVID-19 anxiety. The severity of COVID-19 anxiety varied among different work shifts and educational degrees of healthcare workers, with those on morning shifts and those with master's degrees showing low levels of COVID-19 anxiety. Additionally, there was a significant relationship between COVID-19 anxiety and mental health. Furthermore, there was a significant relationship between all dimensions of sleep quality except sleep efficiency and COVID-19 anxiety ( $P < 0.05$ ). Finally, the results of logistic regression analysis showed that low sleep quality in individuals increased the chance of emerging intense anxiety due to COVID-19 by 3.11 times ( $OR = 3.11$ ).

**Conclusion:** These results showed that the most important contributing factor to COVID-19 anxiety in healthcare workers is the sleep quality of individuals. Therefore, providing screening and interventional programs is needed to improve the sleep quality of healthcare workers during the COVID-19 pandemic.

**Keywords:** COVID-19, Quality of Sleep, Health Care Workers, Mental Health.

## Introduction

In the last days of December 2019, a new infectious disease epidemic was discovered in Wuhan, China, caused by a novel coronavirus and formally called COVID-19 by the World Health Organization (WHO).<sup>1</sup> This disease has spread rapidly around the world and poses a significant threat to all humans.<sup>2</sup> Considering that anxiety's inherent function is to protect people from life-threatening factors, in the face of life-threatening illnesses such as COVID-19, worry about one's health can manifest as anxiety. Anxiety refers to vague, excessive, and uncontrollable worry associated with physical symptoms in the absence of

specific objects, stimuli, and situations. COVID-19 anxiety is anxiety produced by a coronavirus infection, which causes cognitive and mental ambiguity.<sup>3</sup> COVID-19 anxiety is more common than other common threats because new life-threatening factors more strongly stimulate areas of anxiety processing in the brain, such as the amygdala, and cause more severe anxiety responses and symptoms in people responding to these stressful and anxious conditions.<sup>4</sup> For many reasons, COVID-19 disease in the amygdala can be considered an unknown and strong stimulant. Some of the main reasons include a very high transmission rate, a high disease mortality rate, long

latency, and a lack of definitive and specific treatment.<sup>5</sup>

Interestingly, the symptoms experienced during anxiety attacks (such as increased heart rate, increased respiratory rate, chest pain, shortness of breath, feeling hot, digestive problems, and fatigue) are similar to symptoms of COVID-19 disease. Therefore, in the stressful and precarious circumstances of the COVID-19 outbreak, people may mistakenly consider themselves infected with the SARS-CoV-2 virus without actually being infected.<sup>6</sup>

This condition can exacerbate anxiety symptoms in a vicious cycle. According to the findings, disorders such as stress and anxiety elevate blood levels of cortisol.<sup>7</sup> Obviously, cortisol has a variety of effects on different parts of the body in the short and long term. But one of the most important effects of cortisol in the short term is debilitating the immune system.<sup>8</sup> Noticeably, the debilitation of the immune system due to COVID-19 will definitely increase the vulnerability and possibility of infection with the SARS-CoV-2 virus in people.<sup>9</sup> Also, cortisol can disrupt the immune system's antiviral responses and increase the release of inflammatory factors that are important in the development and progression of COVID-19.<sup>10</sup>

Following the widespread outbreak of COVID-19 across the world and the high rate of deaths due to this disease, healthcare workers, as the first line of treatment, are more likely to be exposed to psychological disorders and anxiety than other populations.<sup>10</sup> A cross-sectional study of healthcare workers in China during the spread of COVID-19 from February 10 to February 20, 2020, showed that out of 512 nurses, about 164 (32.03%) had direct contact with an infected patient. The prevalence of anxiety was about 12.5%, of which 10.35% showed mild anxiety, 1.36% moderate anxiety, and about 0.78% severe anxiety.<sup>11</sup> Examination of the results of the same study also showed that healthcare workers who are in direct contact with patients infected with COVID-19 have a higher anxiety index than those who are not in direct contact with patients. Additionally, the rate of anxiety among healthcare workers in infected cities (such as Wuhan) is higher than in other cities. Another study of physicians and hospital nurses in Wuhan, China, during the spread of COVID-19 found that 44.6% of healthcare workers

experienced anxiety. To summarize, it is crucial to identify the predictor variables of COVID-19 anxiety in healthcare workers, as it determines who is at risk. A literature review revealed that various variables have been identified as predictors of COVID-19 anxiety, including mental health and sleep quality.<sup>12</sup>

## Objectives

However, the key point is to determine the contribution of each variable in predicting COVID-19 anxiety in order to develop appropriate preventive interventional programs. So, the aim of this study was to predict the severity of COVID-19 anxiety in healthcare workers based on sleep quality and mental health.

## Methods

### Study design, sample size, and sampling method

The study design was descriptive-analytical and was conducted from May 2020 to June 2020, coinciding with the outbreak of COVID-19 in Iran. The participants included all healthcare workers in medical centers in Khorramabad city, Lorestan, Iran (affiliated with Lorestan University of Medical Sciences (LUMS)). Initially, based on the Green sample size formula<sup>13</sup> the sample size for regression was calculated ( $M + 104$ ). According to the 8 predictor variables ( $M$ ) in the present study, including COVID-19 anxiety and 7 dimensions of sleep quality, a sample size of at least 112 people was required. Considering the possible dropout of participants, 180 samples were selected. Also, in order to reduce social contact and prevent the spread of COVID-19, the convenience sampling method and internet implementation were used. Therefore, the questionnaire link was sent to participants on WhatsApp and Telegram, as well as other common social networks. Inclusion criteria were being employed in health centers and being a cyberspace user, while exclusion criteria were dissatisfaction with participation in research and incomplete completion of the questionnaire.

### Demographic information questionnaire

The authors created an 8-question questionnaire with two demographic parts (age, educational status) and a

history of coronavirus exposure (history of COVID-19, having suspicious symptoms, history of close contact with a patient, history of the disease in close relatives). Responses were registered as yes or no, and this questionnaire investigated the demographic characteristics and history of exposure to COVID-19 in the study sample.

### **Pittsburgh Sleep Quality Index**

The Pittsburgh Sleep Quality Index (PSQI) assesses the quality and sleep patterns of individuals over the last month. This questionnaire evaluates seven factors, including subjective sleep quality, delayed falling asleep, sleep duration, sleep efficiency, sleep disorders, use of sleeping pills, and daily performance dysfunctions, and includes 18 items. Participants respond to a range of items from none (score of 0) to less than once a week (score of 1), once or twice a week (score of 2), and three or more times a week (score of 3). A total score higher than 5 indicates poor sleep quality. The validity of the Pittsburgh questionnaire is 80%, its reliability is 93–98%, and Cronbach's alpha coefficient of this questionnaire is 78–82%.<sup>14</sup> In the present study, Cronbach's alpha was calculated at 0.76.

### **General Health Questionnaire**

Goldberg created the General Health Questionnaire (GHQ-12), which assesses a person's mental state during the previous four weeks.<sup>15</sup> The questionnaire includes 12 items, with 6 positive items (3, 3, 4, 6, 10, and 12) and 6 negative items (11, 9, 8, 7, 5, and 1). For each positive item, four options are rated on a scale of 0 to 3, indicating whether the person's experience is better than ever, as always, less than always, or much less than always. Similarly, for each negative item, four options are rated on a scale of 0 to 3, indicating whether the person has never, no more than ever, more than ever, or much more than ever experienced the corresponding symptom. The instrument score is calculated by totaling the scores of the items, resulting in a range of scores between 0 and 36, with higher scores indicating more inappropriate mental health. Montazeri et al. demonstrated the questionnaire's validity for studying mental health in the Iranian population, and the questionnaire's reliability coefficient was reported to be 0.87 using Cronbach's alpha method.<sup>16</sup>

In the present study, reliability was calculated using Cronbach's alpha reliability method, with a coefficient of 0.68.

### **COVID-19 Anxiety Scale**

Alipour et al.,<sup>3</sup> validated the COVID-19 Anxiety Scale (CDAS), which comprises 18 items on a Likert scale (0 for never and 3 for forever). The final score is derived by adding all of the items together, yielding a number between 0 and 54. A higher score indicates more COVID-19 anxiety, with scores of 0–16 indicating mild anxiety or no symptoms, 17–29 indicating moderate anxiety, and 30–54 indicating severe anxiety. The instrument's validity and structure were confirmed through factor analysis and Cronbach's alpha, with a value of 0.91 and 0.96, respectively, in this study.

### **Statistical analysis**

In the part about descriptive statistics, statistical indicators such as frequency, mean, and standard deviation were used. Various tests, including t-independent tests, one-way analysis of variance (ANOVA), Scheffe's post-hoc test, correlation, and logistic regression analysis, were employed in the inferential statistics section to compare and assess the relationship between variables. All statistical analyses were performed with SPSS (version 16.0, SPSS Inc., Chicago, IL, USA). A "P-value" less than 0.05 was considered significant.

### **Ethical considerations**

Participants in the study were instructed to avoid writing their names on the questionnaires and were assured that all questionnaires would be collected for statistical analysis and that their information would maintain confidentiality. Moreover, each patient received an explanation that they were free to withdraw from this study. The study was conducted in accordance with the Declaration of Helsinki. Institutional Review Board approval (code: IR.BMSU.BAQ.REC.1399.586) was obtained (Baqiyatallah Hospital). All participants signed an informed consent form.

## **Results**

In this study, 180 participants (129 females and 51 males) were recruited to contribute to the study. Of these, 42

participants (23.3%) had severe COVID-19 anxiety, while 138 participants (76.7%) had mild to moderate COVID-19 anxiety. Additionally, 98 participants (54.4%) had inappropriate sleep quality, while 82 participants (45.6%) had good sleep quality. The frequency distribution of participants in terms of age, gender, marital status, educational status, and work shift according to the severity of COVID-19 anxiety is presented in Table 1.

The results of the one-way ANOVA showed that the severity of COVID-19 anxiety differed significantly across different levels of education ( $F=11.45, p<0.000$ ) and work shifts ( $F=21.96, p<0.000$ ). The Scheffe post-hoc test revealed that there were significant differences between the levels of master's degree and diploma, as well as between the rotating shift and the morning shift. Specifically, the mean COVID-19 anxiety score was lower among participants with a master's degree compared to those with a bachelor's degree. Additionally, the mean COVID-19 anxiety severity was significantly lower among participants on the morning shift compared to the rotating shift.

It is worth noting that the severity of COVID-19 anxiety was not significantly related to age, gender, or marital status.

The results of Table 2 show that mental health has a significant positive relationship with COVID-19 anxiety. This means that if the mental health score increases, the severity of COVID-19 anxiety will be enhanced (a higher mental health score indicates poorer mental health). Additionally, there is a significant positive relationship

between all dimensions of sleep quality and sleep efficiency and COVID-19 anxiety. Specifically, as the score for sleep quality dimensions increases (a higher score indicates poorer sleep quality), the severity of COVID-19 anxiety also increases.

Finally, binary logistic regression was used to investigate the simultaneous effect of mental health and dimensions of sleep quality on the likelihood of severe anxiety due to COVID-19 (scores of 30 or higher). A total of 180 participants were included in the analysis. The results of the omnibus test show the evaluation of the overall logistic regression model and assess the extent to which the model is explanatory and efficient. According to the results of this test, the general model was statistically significant ( $p<0.000$  and  $df=4$ ) and correctly predicted 52.4% of the probability of severe anxiety in COVID-19 based on predictor variables. The overall prediction accuracy was 82.2%. Cox & Snell R-squared and Nagelkerke R-squared values also showed that the independent study variables could explain 29 to 44% of the variance of severe COVID-19 anxiety. Table 3 shows the regression coefficients, WALD statistics, significance level and degrees of freedom, and probability values for each of the predictor variables. These results indicate that only the subjective quality of sleep has the power to predict the likelihood of developing severe COVID-19 anxiety with a probability ratio of 3.1. This suggests that increasing the subjective quality score of sleep (a higher score on this scale represents a worse subjective quality of sleep) increases the chance of developing severe COVID-19 anxiety by 3.1.

**Table 1.** Comparison of severity of COVID-19 anxiety based on age, gender, marital status, education and work shift

Variables		Frequency (percent)	M	SD	t/f	P value
Age	≥35	91(50.6)	20.96	11.346	-1.22	0.22
	<35	89(49.4)	18.83	12.135		
Gender	Male	51(28.3)	19.15	12.50	-.54	0.59
	Female	129 (71.7)	20.20	11.48		
Marital status	Single	55 (30.6)	17.83	12.50	-1.57	0.11
	Married	125 (69.4)	20.82	11.48		
Education	Diploma	22 (12.2)	26.09	9.40	11.45	0.000
	Bachelor	104 (57.8)	22.03	10.39		
	Master	35 (19.4)	11.37	9.84		
	Phd	19 (10.6)	16.84	15.69		
Shift	Morning	41 (22.8)	10.43	8.72	21.96	0.000
	Afternoon	4 (2.2)	16.50	16.13		
	Rotation	135 (75)	22.88	10.92		

**Table 2.** Pearson correlation coefficient matrix between dimensions of quality of sleep, mental health with COVID-19 anxiety in health care workers

Variables	1	2	3	4	5	6	7	8	9
1.Covid-19 anxiety	1								
2.Mental health	0.53**	1							
3.Delay in falling asleep	0.15*	0.25**	1						
4.Daily performance dysfunctions	0.48**	0.37**	0.16*	1					
5.Sleep duration	0.34**	0.24**	0.15*	0.38**	1				
6.Sleep efficiency	0.25	0.81	0.31**	0.16*	0.50**	1			
7.Subjective quality of sleep	0.63**	0.45**	0.40**	0.56**	0.42**	0.15**	1		
8.Use of sleeping pills	0.48**	0.32**	0.17*	0.51**	0.24**	0.12	0.50**	1	
9.Sleep disorders	0.47**	0.33**	0.24**	0.53**	0.26**	0.03	0.48**	0.36**	1

\*\*p&lt;0.05, \*p&lt;0.01

**Table 3.** Regression Logistic regression predicting the likelihood of severe COVID-19 anxiety

variables	B	SE	Wald	df	Sig	Exp (B)= OR	Lower	Upper
GHQ	.086	.086	1.015	1	.314	1.090	.922	1.289
Sleep efficiency	-.898	.491	3.346	1	.067	.407	.156	1.066
Sleep duration	.192	.320	.359	1	.549	1.211	.647	2.268
Subjective quality of sleep	1.136	.444	6.533	1	.011	3.114	1.303	7.439
Sleep disorders	.755	.509	2.206	1	.137	2.128	.785	5.767
Delay in falling asleep	.471	.477	.973	1	.324	1.602	.628	4.082
Daily performance dysfunctions	.439	.375	1.372	1	.242	1.552	.744	3.237
Use of sleeping pills	.576	.323	3.184	1	.074	1.779	.945	3.348
Constant	-7.074	1.931	13.420	1	.000	.001		

95% C.I. for EXP (B)

## Discussion

The results of the present study showed that the severity of COVID-19 anxiety was significantly different at different levels of education. There was a significant difference between the level of master's degree and the levels of diploma and bachelor's degree, and the mean score of severity of COVID-19 anxiety was lower at the master's level. These results are consistent with a previous study.<sup>17</sup>

Analytically, it can be claimed that education indirectly affects the employment status and income level of individuals, which in turn provides access to more resources to reduce stress. Moreover, education as a source of human capital may empower people cognitively and enhance their problem-solving strategies, making them better equipped to handle stressful situations.

Another finding indicated that there was a significant difference between the rotating shift and the morning shift in terms of symptoms of the severity of COVID-19

anxiety, and the mean score of severity of COVID-19 anxiety in the morning shift was lower. This finding is consistent with previous research that highlighted the role of shift work on mental health.<sup>18-20</sup> Physiologically, when the sleep-wake cycle is disrupted, other physiological functions of the body may also be affected. For example, a person may experience sleep disturbances, loss of appetite, feelings of tiredness, and a lack of concentration, which can lead to physical and mental illness.<sup>21</sup> The results showed that 23.3% of healthcare workers had severe symptoms of COVID-19 anxiety. The meta-analysis results revealed that the rate of anxiety during the COVID-19 pandemic in different societies was between 11.3% and 50%, and the present study falls within this range.<sup>22</sup> Different prevalences of anxiety in different countries<sup>23</sup> can be due to various reasons, including workload, social and organizational support in different countries, consideration of different screening tools,<sup>24</sup> and severity of trauma.<sup>25</sup> It is worth noting that only a limited number of

studies have specifically measured COVID-19 anxiety, and most studies have examined the extent of general anxiety in healthcare workers during the COVID-19 outbreak.<sup>11,26,27</sup>

While the two are different, anxiety can generally be due to fear of developing COVID-19 or anxiety caused by lifestyle changes in the COVID-19 pandemic in healthcare workers, for example, being away from family, fear of transmitting the disease to family members, increasing workload, or a lack of medical facilities. It is suggested that in future research, a distinction be made between general anxiety and different types of anxiety, including COVID-19 anxiety, health anxiety, and generalized anxiety disorder (GAD), in order to provide a more appropriate solution by more accurately understanding the psychological needs of healthcare workers.

The results of the Pearson correlation analysis revealed that COVID-19 anxiety had a significant positive relationship with mental health. This finding suggests that as mental health scores increase (a higher score indicates a more inappropriate mental health status), COVID-19 anxiety scores also increase. This result is consistent with previous studies that have found a positive relationship between anxiety and mental health.<sup>28,29</sup> In essence, while low levels of anxiety can motivate individuals to follow health instructions to protect themselves against COVID-19, exposure to high levels of anxiety can have negative consequences such as sleep disturbances, emotional problems, and cognitive dysfunction.<sup>30,31</sup> Therefore, high anxiety in COVID-19 may compromise the mental health of healthcare workers.

The results showed that all dimensions of sleep quality except sleep efficiency had a significant positive relationship with COVID-19 anxiety. This finding is consistent with previous research that suggests that sleep can reduce anxiety by reorganizing communication in the brain.<sup>32</sup>

Researchers believe that when people sleep less than enough, they become stressed, anxious, and agitated due to the production of stress hormones in their bodies. The production and release of these hormones make it challenging for a person to fall asleep, leading to a vicious cycle of insufficient sleep and stress in their body.<sup>33</sup> Others

claimed that sleep disorders due to deficiency in emotion regulation and adaptive memory performance increase anxiety-related disorders.<sup>31</sup>

The results of the logistic regression analysis revealed that, among the predictor variables, only subjective quality of sleep can predict COVID-19 anxiety. This variable increases the likelihood of developing COVID-19-severe anxiety up to 3.11 times. Considering that 54.4% of the participants in the present study experienced poor sleep quality and the relationship between subjective sleep quality and COVID-19 anxiety,<sup>34</sup> it is suggested that more attention be paid to the quality of sleep of healthcare workers. It is evident that sleep quality, in addition to affecting mental health, also affects physical health and the fight against infections.<sup>35</sup>

The low number of participants with COVID-19 was one of the limitations of the present study. For those infected with COVID-19, anxiety may be much more severe. Therefore, the results of this study must be interpreted with accuracy. Epidemic conditions were required, and this study was conducted virtually through social networks. Therefore, people who did not have the ability or access to use social networks did not participate in this study. The present study was conducted in Khorramabad city. Clearly, the generalization of the results to other cities in Iran should be done with caution. Given the cross-sectional nature of the present study, it is difficult to draw conclusions about its long-term effects. Despite these limitations, the present study has provided valuable information about the mental health status of healthcare workers in the early stages of the development of COVID-19. A comprehensive assessment of the sleep status of healthcare workers in seven dimensions and the study of the most important factors involved in the development of severe anxiety in COVID-19 are the strengths of the present study.

## Conclusions

Overall, severe COVID-19 anxiety can lead to a decrease in the immune system and make the body more vulnerable to physical and mental illness. Considering that the subjective quality of sleep was significantly associated with the likelihood of developing severe anxiety in COVID-19,

sleep quality should be evaluated and monitored as an important parameter in the healthcare worker population. Therefore, it is recommended to hold online sleep health workshops and provide proper planning by managers to improve the quality of sleep of healthcare workers. On the other hand, considering the severity of the COVID-19 pandemic and the increasing workload of healthcare workers, attention to their psychological state is more crucial than ever. Therefore, improving the mental health of healthcare workers can enhance the quality of services they provide.

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### Competing interests

The authors declare that they have no competing interests.

### Abbreviations

Coronavirus disease 2019: COVID-19;  
Severe acute respiratory syndrome coronavirus 2: SARS-CoV-2;  
World Health Organization: WHO  
Pittsburgh Sleep Quality Index: PSQI;  
General Health Questionnaire: GHQ-12;  
COVID-19 Anxiety Scale: CDAS;  
Generalized Anxiety Disorder: GAD.

### Authors' contributions

All authors read and approved the final manuscript. All authors take responsibility for the integrity of the data and the accuracy of the data analysis.

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### Availability of data and materials

The data used in this study are available from the corresponding author on request.

### Ethics approval and consent to participate

The study was conducted in accordance with the Declaration of Helsinki. Institutional Review Board approval (code: IR.BMSU.BAQ.REC.1399.586) was obtained (Baqiyatallah Hospital). All participants signed an informed consent form.

### Consent for publication

By submitting this document, the authors declare their consent for the final accepted version of the manuscript to be considered for publication.

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