



Original Article

Sleep Quality Among Healthcare Workers During the COVID-19 Pandemic and Its Impact on Medical Errors: Kuwait Experience

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Abstract

OBJECTIVE: Millions of people suffer from sleep disturbances. In addition, the coronavirus disease 2019 (COVID-19) pandemic created several new challenges—particularly for frontline healthcare workers (HCWs). This study assessed the sleep quality (SQ) among HCWs.

MATERIAL AND METHODS: A cross-sectional study was conducted using an English-language online survey. The participants were invited via a web link sent using social network platforms. It included sociodemographic- and profession-related characteristics. COVID-19-associated risks were assessed (e.g., being on the front line, doing swabs, satisfaction about protective equipment, and management protocols). Assessment of SQ was done using the Pittsburgh Sleep Quality Index (PSQI) and various medical errors were recorded.

RESULTS: A total of 217 HCWs completed the survey with mean (\pm standard deviation) age of 35.8 (\pm 7.3) years; 56.2% were male, 18.43% had comorbidities, and 61.75% experienced sleep difficulties before the COVID-19 crisis. This work reports a 78.8% prevalence of poor SQ, with the mean (standard deviation) global PSQI score of 9.36 (\pm 4.4). HCWs with poor sleep experienced more positive comorbid profile (23.64% versus 6.52%, $p=0.01$). Working on the front lines of COVID-19 was associated with poor sleep (69.59% versus 47.83%, $p=0.006$). Among the participants, 77.42% performed medical errors, particularly not checking for drug allergies (17.97%), dispensing medication with incomplete instructions (20.74%), providing incorrect doses or overdosing (14.75%), incorrectly explaining the use of medication (9.22%), and prescribing a drug to the wrong patient (10.14%).

CONCLUSION: This nationwide survey reported high prevalence of poor SQ among HCWs during the COVID-19 pandemic. Being an HCW on the front lines of COVID-19 and doing swabs with a positive comorbidity was associated with poor sleep.

KEYWORDS: COVID-19, medical errors, sleep quality

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INTRODUCTION

Sleep is a refreshing, healing, and crucial part of human physiology. Sleep disturbances and deprivation, particularly in a chronic form, are linked to immune system depression and affect memory. This could be alarming in physicians, whose main responsibility is to care for the sick and critically ill, make decisions, and calculate doses—responsibilities in which there is no space for errors [1–5].

Coronaviruses are known animal and human pathogens. By the end of 2019, a pneumonia cluster with an unidentified etiology was reported by Chinese officials; afterwards, a novel coronavirus was identified. In February 2020, the World Health Organization (WHO) designated the disease “coronavirus disease 2019 (COVID-19).” The virus that causes the disease was designated severe acute respiratory syndrome (SARS) coronavirus 2. Initially, cases outside China occurred mainly among travelers from China and those who had contact with them. However, the WHO now considers COVID-19 a pandemic [6].

Sleep disturbances were prevalent in millions of people even before the pandemic, a global event that created a fertile environment for new challenges in those who had not experienced sleep problems before. Infected persons and healthcare workers (HCWs) on the front line are at higher risk than others. Lockdowns, social distancing, distance learning, quarantines, fear about oneself and ones loved ones, and economic consequences added burdens to normal routine life [7–9].

It was a common finding that HCWs took frequent night shifts, on-call hours, and experienced stress that led to loss of sleep and manifested symptoms of sleep deprivation.

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Statistics provided in China show that HCWs in Wuhan, the initial epicenter of COVID-19, experienced high levels of anxiety, depression, fear, anger, and stress because of excessive work pressures, direct exposure to the disease, and the possibility of being infected.

Extensive research confirms that sleep deprivation affects the functioning and concentration of physicians. Allowing sleep deprivation to permeate all medical specialties will cause damage both to patients and healthcare professionals [10,11].

Given the importance of sleep and its known effect on cognitive performance, the link between sleep and patient safety has garnered considerable attention.

In one report, fatigue is characterized as a latent hazard and “an unsafe condition” that leads to increased rates of medical errors among HCWs. These cognitive activities place significant loads on prefrontal cortex functions, such as memory and tracking capacity, which are particularly sensitive to sleep deprivation and related fatigue.

Both acute and chronic sleep deprivation result in cumulative deficits in executive function and mood as well as heightened irritability; all of these can impair communication and coordination in teams of HCWs. Chronic sleep deprivation can also contribute to burnout, which is increasingly recognized as a threat to patient safety [12].

This study aimed to assess the sleep quality (SQ) among HCWs on the front line of COVID-19 management at Kuwait Ministry of Health (MOH) hospitals and its relationship to experiencing medical errors.

MATERIAL AND METHODS

Study design: Cross-sectional study.

Subjects: HCWs at Kuwait MOH hospitals, Kuwait, from May–July 2020.

Exclusion criteria

- Age above 60 years.
- Refusal to participate.
- Incomplete or duplicate answers.
- Not being on duty at the time of the study.

Sample size:

The prevalence of poor sleep in HCWs ranged from 21–66% [13]. At a 90% confidence level with a type I error rate of ap-

proximately 5%, the minimal sample size was calculated to be 209 participants (Epi Info 7, Centers for Disease Control and Prevention, Atlanta, GA, USA).

Data Collection

An English-language online survey was conducted via Google forms. Participants from different medical specialties were invited to complete this via an online web link sent using social network platforms. Google forms saves each filled questionnaire in the principal investigator’s Google Drive.

Before collecting data, a pilot test was conducted on 10% of the sample (not included in the study) to estimate the average time needed to finish the questionnaire, evaluate its adequacy, and predict suspected obstacles.

Respondents were assured of anonymity and confidentiality. Consent to participate was the first question and answering “yes” was mandatory. Ethical approval was obtained from the Research Ethics Committee of the MOH, Kuwait. The study was conducted following the Declaration of Helsinki on human research.

The survey focused on the following.

Sociodemographic characteristics: age, sex, smoking and marital states, number of siblings, partner’s job, history of previous sleep disorders or medications affecting sleep, and comorbidities.

Profession-related characteristics: specialty, current job title, years of experience, and number of hours worked per week.

COVID-19-associated risks: being on the front line of COVID-19 management, doing swabs for suspected or confirmed cases, following updates and news about COVID-19, satisfaction with and availability of personal protective equipment (PPE), satisfaction with management protocols and arrangements between triage and isolation, and becoming infected with or knowing a colleague/friend who was infected with or died of COVID-19.

Assessment of SQ using Pittsburgh Sleep Quality Index (PSQI): the PSQI is a simple tool that assesses SQ over a 1 month period. It includes 7 components, with a global PSQI score > 5 being indicative of poor SQ [14–16].

Documentation of various medical errors: not checking for drug allergies, dispensing medication with incomplete instructions, accidental extubation, provision of incorrect doses or overdosage, incorrect explanation of the use of medication, and prescribing drugs to the wrong patient.

Statistical Analysis

The statistical analysis was performed using Minitab 17.1.0.0 for Windows (Minitab Inc., 2013, State College, PA, USA). Continuous data were presented as mean and standard deviation (SD) and categorical data as number and percentage (%); the normality of data was examined using the Shapiro–Wilk test. The associations between poor SQ and participant characteristics or COVID-19-related risks were evaluated using the Chi-square test and an independent *t*-test. The poor SQ prediction was evaluated using multiple regression analysis

MAIN POINTS

- The prevalence of poor SQ during COVID-19 pandemic was 78.8%
- There was a higher frequency of medical errors in HCWs with poor SQ ; 82.46% versus 58.7% in those with good SQ.
- Being a front line HCW, taking swabs, and having a positive comorbid profile were the three independent predictors of poor sleep among study participants.

Table 1. Prevalence of poor sleep quality and its components among participants in this study

Factors	Total (n = 217)	
	Mean/SD (n)	%
Suffering from sleep difficulties before pandemic (Yes)	64	29.49
Receiving medication that affect sleep (Yes)	21	9.68
Sleep quality score	1.41	0.85
Sleep latency score	1.94	1.10
Duration of sleep score	1.54	1.18
Sleep efficiency score	1.54	1.18
Sleep troubles score	1.38	0.59
Sleep initiating medication score	0.37	0.15
Daytime sleepiness score	1.16	0.82
Global PSQI score	9.34	± 4.40
Sleep quality groups		
Good	46	21.2
Poor	171	78.8

Note: Continuous data were represented as mean & SD, and categorical data as number & percentage. SD: standard deviation; PSQI: Pittsburgh Sleep Quality Index.

models, with either the adjusted or nonadjusted technique and backward elimination methods. All tests were two sided; *P* was considered significant if < 0.05.

RESULTS

A total of 217 HCWs completed the survey. Of these, 64 experienced sleep difficulties before COVID-19 crisis and 21 (9.68%) had a history of consuming medication for sleep difficulties. In this work, the reported prevalence of poor SQ during the COVID-19 pandemic and its stresses increased to 171 (78.8%), with a global PSQI score mean (SD) of 9.36 ± 4.4; the worst components of SQ were sleep latency, duration, and efficacy; hence, the mean scores for these were near 2–1.94, 1.54, and 1.54, respectively, as illustrated in Table 1. Sociodemographic and profession-related characteristics and their relationship to poor SQ are shown in Table 2. All participants had mean (SD) age of 35.8 ± 7.3 years; of them, 56.2% were male, 8.76% were current smokers, and 18.43% had a positive comorbid profile. Moreover, 76.96% of the participants were married and 42.86% had a HCW partner. HCWs with poor sleep (compared with good sleep) experienced a more positive comorbid profile (23.64% versus 6.52%, *p*=0.01), while there was no significant association between other sociodemographics (age, sex, smoking status, and marital status) with poor sleep state.

Table 2. Association between sociodemographic and profession-related characteristics and poor sleep quality

Factors	Total (n = 217)		Good sleep quality (n = 46)		Poor sleep quality (n = 171)		p
	Mean/n	SD/%	Mean/n	SD/%	Mean/n	SD/%	
Sociodemographic characteristics							
Age (years)	35.8	±7.3	36.33	±7.66	35.7	±7.17	0.62 [§]
Sex (male)	122	(56.2%)	27	58.7	95	55.56	0.7 [#]
Smoking habits (Yes)	19	(8.76%)	2	4.35	17	9.94	0.23 [#]
Comorbidity (Yes)	40	(18.43%)	3	6.52	37	21.64	0.01 [#]
Marital status (married)	167	(76.96%)	37	80.43	130	76.02	0.52 [#]
Have children (Yes)	157	(72.35%)	31	67.39	126	73.68	0.39 [#]
Number of children	1.6	±1.3	1.43	±1.24	1.65	±1.29	0.30 [§]
Partner's job (HCW)	93	(42.86%)	19	41.3	74	43.27	0.81 [#]
Profession-related characteristics							
HCW on the front line of COVID-19 management (Yes)	141	64.98	22	47.83	119	69.59	0.006 [#]
Current job titles							
Consultant	34	15.67	9	19.57	25	14.62	0.67 [#]
Senior Registrar and Specialist	79	36.41	15	32.61	64	37.43	
Registrar	104	47.93	22	47.83	82	47.95	
Years of experience							
Less than 10	118	54.38	24	52.17	94	54.97	0.73 [#]
More than 10	99	45.62	22	47.83	77	45.03	
Weekly working hours							
More than 48	137	63.13	22	47.83	115	67.25	0.015 [#]
Less than 48	80	36.87	24	42.17	56	32.75	

Continuous data were represented as mean and SD, and categorical data as number and percentage.

[§]independent t-test, [#]Chi-square test, *p* is considered significant if < 0.05.

HCW: healthcare worker; SD: standard deviation

Table 3. Correlation between COVID-19-related risks and poor sleep quality

Factors	Total (n = 217)		Good sleep quality (n = 46)		Poor sleep quality (n = 171)		p
	N	%	n	%	n	%	
Following updates & news about COVID-19 (Yes)	176	81.11	36	78.26	140	81.87	0.57 ¹
Satisfied with supply of PPE (Yes)	98	45.16	21	45.65	77	45.03	0.54 [#]
Satisfied with management protocol	105	48.39	22	47.83	83	48.54	0.48 [#]
Satisfied with arrangement between triage and isolation	115	52.99	24	52.17	91	53.22	0.89 [#]
Doing swabs for suspected COVID-19 cases	32	14.75	2	4.35	30	17.54	0.01 [#]
Becoming infected with COVID-19	7	3.23	1	2.17	6	3.51	0.64 [#]
Family member becoming infected with COVID-19	173	79.72	31	67.39	142	83.04	0.01 [#]
Any colleague becoming infected with COVID-19	19	8.76	5	10.87	14	8.19	0.56 [#]
Family member or colleague died from COVID-19	35	16.13	5	10.87	30	17.54	0.27 [#]

Continuous data were represented as mean and SD, and categorical data as number and percentage.

¹: independent t-test, [#]: Chi-square test, p is considered significant if < 0.05.

PPE: personal protective equipment; SD: standard deviation

Table 4. Consequences of poor sleep quality and its impact on medical errors among HCWs

Medical errors	Total (n = 217)		Good SQ (n = 46)		Poor SQ (n = 171)		p
	N	%	n	%	n	%	
Frequency of medical errors	168	77.42	27	58.7	141	82.46	0.006 [#]
Nervousness <0.001 [#]	152	70.05	23	50	129	75.44	
No checks for drug allergies	39	17.97	8	17.39	31	18.13	0.9 [#]
Dispensing medication with incomplete instructions	45	20.74	4	8.7	41	39.98	0.02 [#]
Accidental extubation	28	12.9	6	13.04	22	12.87	0.97 [#]
Incorrect dosing or overdose	32		2	4.35	30	17.54	0.025 [#]
Incorrect explanation of the usage of medication	20	9.22	5	10.87	15	8.77	0.66 [#]
Prescribing drugs to the wrong patient	22	10.14	1	2.17	21	12.28	0.043 [#]

Continuous data were represented as mean and SD, and categorical data as number and percentage.

[#]: Chi-square test, p is considered significant if < 0.05.

HCWs; healthcare workers; SD: standard deviation

In terms of profession-related characteristics, 64.98% of participants worked on the front line of COVID-19 front, 63.13% worked more than 48 h weekly, and nearly 50% had less than 10 years of work experience with the following ranks: registrar (47.93%), senior registrar and specialist (36.41%), and consultant (15.67%). Working on the front line of COVID-19 was associated with poor sleep (69.59% versus 47.83%, $p = 0.006$). Moreover, HCWs with poor sleep had higher weekly working hours compared with those with good sleep (67.25% versus 47.83, $p = 0.015$).

Table 3 highlights the impact of COVID-19-related risks on SQ. Among the participants, 81.11% were regularly followed updates and news about COVID-19, 45.16% were satisfied with their PPE, 48.39% were satisfied with the management protocol, and 52.99% were satisfied with the arrangement between triage and isolation. Moreover, 3.23% of participants had been infected with COVID-19, 79.72% had a family member infected with COVID-19, 8.76% had a colleague infected with COVID-19, and, finally, 16.13% of them experienced a colleague or a family member passed away because

of COVID-19. Furthermore, 83.04% of participants with poor sleep (compared with 67.39% of those with good sleep) had a family member infected with COVID-19 ($p = 0.01$). Among the 32 participants who did swabs for suspected COVID-19 patients during their duties, 30 (93.75%) of them ($p = 0.01$) experienced poor sleep.

The consequences of poor SQ on both HCWs and the rate of medical errors occurring are shown in Table 4. Of the participants, 77.42% experienced medical errors in the form of not checking for drug allergies (17.97%), dispensing medication with incomplete instructions (20.74%), unplanned extubation episodes (12.9%), giving incorrect doses or overdosage (14.75%), incorrectly explaining the usage of medications (9.22%), and prescribing a drug to the incorrect patient (10.14%). In participants with poor SQ, there was a higher frequency of experiencing medical errors compared with those with good sleep (82.46% versus 58.7%, $p = 0.006$); this was particularly significant in the form of medications being dispensed with incomplete instructions (39.98% versus 8.7%, $p = 0.02$), incorrect or overdosage (17.54% versus

Table 5. Predictors of poor sleep quality among HCWs studied

Factors	OR	95% CI	p
Doing swabs for COVID-19 cases	4.95	(0.94, 25.98)	0.032
Comorbidity (Yes)	4.57	(1.11, 18.72)	0.017
COVID-19 frontline (Yes)	2.80	(1.26, 6.20)	0.01

Pearson, $\chi^2 = 204.3$, $p=0.57$.
OR: odds ratio; CI: confidence interval

Table 6. Impact of working on the front lines of COVID-19 on poor sleep quality using both adjusted and nonadjusted models

Factors	OR	95% CI	p
Nonadjusted model*	2.50	(1.29, 4.85)	0.007
Adjusted model**	2.80	(1.26, 6.20)	0.01

*Pearson, $\chi^2 = 217$, $p=0.45$
**Pearson, $\chi^2 = 204.3$, $p=0.57$
OR: odds ratio; CI: confidence interval

4.35%, $p=0.025$), and prescribing drugs to the wrong patient (12.28% versus 2.17%, $p=0.043$). Moreover, 70.05% of participants showed nervousness with a greater association among those with a poor SQ, $p<0.001$.

Multivariate regression analysis of factors associated with poor SQ revealed three independent predictors of poor SQ; being a front line HCW (odds ratio (OR) = 2.80, $p = 0.01$), doing swabs for suspected or confirmed cases (OR = 4.95, $p=0.032$), with a positive comorbid profile (OR = 4.57, $p=0.017$, (Table 5). The impact of working on the front lines of the COVID-19 pandemic as an independent predictor of poor SQ is illustrated in Table 6 using multivariate regression analysis models with adjusted and nonadjusted simulation. The likelihood of poor SQ increased up to 3 times in both adjusted and nonadjusted models (OR = 2.8; $p=0.01$ and 2.5; $p=0.007$, respectively).

DISCUSSION

Sleep disorders are not uncommon among HCWs, including nurses; physicians; and administrative and technical staff. Growing reports disagree about the prevalence of sleep difficulties among HCWs, which range from 21–65.5%. During the current COVID-19 pandemic and the resultant high stress levels, high chances of getting infected, inadequate availability of protective equipment, high workloads, and exhaustion, HCWs are at an increased risk for mental health issues and sleep difficulties compared to the time before the pandemic [17–22].

During any outbreak or pandemic with high transmissibility and mortality, screening for deleterious mental health effects such as anxiety, insomnia, and other sleep disturbances is desirable, particularly among HCWs. This not only assures their long-term wellbeing, but also keeps them away from negative outcomes as they are the first line of defense against the pandemic [23–25].

In this work, the reported prevalence of poor SQ among HCWs during the COVID-19 pandemic and its stressful work

was 171 (78.8%), similar to a study confirmed that working with COVID-19 patients had a negative effect on the sleep of physicians [26]; another study conducted in the same region in 2019 reported that 45.5% of physicians experienced sleepless; however, this percentage reached 68.3% during COVID-19 outbreak [27].

A large report from China agreed with other studies including HCWs involved in the management of patients with COVID-19 showed a higher frequency of mental health issues—particularly insomnia (34%), distress (71.5%), depressive disorders (50.4%), and anxiety disorders (44.6%). Frontline HCWs had an increased risk of developing anxiety and depression (OR: 1.52 and 1.57, respectively) [28,29].

A cross-sectional study by Huang and Zhao [30] conducted through a web-based survey screened for the prevalence of mental health issues among HCWs during the current pandemic; 35% of the participants presented with poor sleep.

Sleep disorders and circadian rhythm abnormalities have also been linked to negative influences on the patient-doctor relationship.

Efficient sleep during the COVID-19 is important; a night of good sleep is generally considered one of the best ways to improve immunity and defend against viruses and diseases [17].

Good sleep had been associated with adequate immune response and production of undifferentiated naïve T cells and proinflammatory cytokines, which improve the adaptive response toward different antigens, and a reduction in the subsequent liability to infection [16,31,32].

In a study by Abdulah and Musa [26], a longer duration of contact with suspected or confirmed COVID-19 patients was associated with sleep difficulties, no matter the medical specialty of a HCW, but SQ was worse among female physicians compared with males. Spending too much time (up to 3 h daily) focusing on the outbreak and following updates and news was associated with anxiety and subsequent sleep difficulties in HCWs [30].

Unsurprisingly, HCWs have poor SQ compared with those in other occupations, a condition that could be mediated by stress during COVID-19 pandemic; the former was reported to have reached a critical frequency (up to 70%) and was correlated with an increased duration of close contact with suspected or confirmed cases. This finding was also notable in the previous coronavirus outbreaks [33–35].

In Toronto, during the first month of SARS outbreak, 11 of 19 infected persons in a large hospital were HCWs; this was reflected by fear, anger, anxiety, insomnia, and worry about the effect of isolation and contact with patients on their family members and friends. This motivated the hospital to allow mental health support teams to alleviate these negative impacts, which could have affected later performance post-recovery [36].

Nochaiwong et al. [37] found that negative emotion and psychosocial distress may occur among frontline HCWs who are

directly in contact with the COVID-19 patients; this could be characterized by unintentional mistakes and delays in treatment owing to communication failures.

This study had some limitations. First, it was cross-sectional; therefore, SQ and medical errors were not assessed for different time intervals. Second, it could have been influenced by the wave of COVID-19 cases in Kuwait. Finally, other variables that could have affected SQ and medical errors, e.g., depression, anxiety, burnout, and the influence of nursing experience and workload, were not measured.

In conclusion, this nationwide online survey reported high prevalence of poor SQ among HCWs in Kuwait during the COVID-19 pandemic, with negative impact on medical errors committed. Being a HCW on the front line of the COVID-19, taking swabs from suspected or confirmed cases, and having a positive comorbid profile were the three independent predictors of poor sleep among study participants.

Ethics Committee Approval: This study was approved by Ethics committee of Kuwait Ministry of Health, (Approval No: 1464/2020).

Informed Consent: Written informed consent was obtained from the patients who agreed to take part in the study.

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REFERENCES

- Sweileh WM, Ali IA, Sawalha AF, Abu-Taha AS, Zyoud SH, Al-Jabi SW. Sleep habits and sleep problems among Palestinian students. *Child Adolesc Psychiatry Ment Health* 2011;5:25. [\[CrossRef\]](#)
- Nazatul SM, Saimy I, Moy FM, Nabila AS. Prevalence of sleep disturbance among nurses in a Malaysian government hospital and its association with work characteristics. *Transl Behav Med* 2008;11:66-71. [\[CrossRef\]](#)
- Chien PL, Su HF, Hsieh PC, Siao RY, Ling PY, Jou HJ. Sleep quality among female hospital staff nurses. *Sleep Disord* 2013;2013:283490. [\[CrossRef\]](#)
- Surani AA, Surani A, Zahid S, Ali S, Farhan R, Surani S. To assess sleep quality among Pakistani junior physicians (house officers): a cross-sectional study. *Ann Med Health Sci Res* 2015;5:329-33. [\[CrossRef\]](#)
- Vela-Bueno A, Moreno-Jiménez B, Rodríguez-Muñoz A, et al. Insomnia and sleep quality among primary care physicians with low and high burnout levels. *J Psychosom Res* 2008;64:435-42. [\[CrossRef\]](#)
- World Health Organization. 2020. Director-General's remarks at the media briefing on 2019-nCoV on 11 February 2020. Available at: <https://www.who.int/dg/speeches/detail/who-director-general-s-remarks-at-the-media-briefing-on-2019-ncov-on-11-february-2020>.
- Ursin R, Baste V, Moen BE. Sleep duration and sleep-related problems in different occupations in the Hordaland Health Study. *Scand J Work Environ Health* 2009;35:193-202. [\[CrossRef\]](#)
- Ertel KA, Berkman LF, Buxton OM. Socioeconomic status, occupational characteristics, and sleep duration in African/Caribbean immigrants and US white health care workers. *Sleep* 2011;34:509-18. [\[CrossRef\]](#)
- Patterson PD, Weaver MD, Frank RC, et al. Association between poor sleep, fatigue, and safety outcomes in emergency medical services providers. *Prehosp Emerg Care* 2012;16:86-97. [\[CrossRef\]](#)
- Wu K, Wei X. Analysis of psychological and sleep status and exercise rehabilitation of front-line clinical staff in the fight against COVID-19 in China. *Med Sci Monit Basic Res* 2020;26:e924085. [\[CrossRef\]](#)
- Geoffroy PA, Le Goanvic V, Sabbagh O, et al. Psychological support system for hospital workers during the Covid-19 outbreak: rapid design and implementation of the Covid-psy hotline. *Front Psychiatry* 2020;11:511. [\[CrossRef\]](#)
- Goel N, Rao H, Durmer JS, Dinges DF. Neurocognitive consequences of sleep deprivation. *Semin Neurol* 2009;29:320-39. [\[CrossRef\]](#)
- Liu H, Liu J, Chen M, et al. Sleep problems of healthcare workers in tertiary hospitals and influencing factors identified through a multilevel analysis: a cross-sectional study in china. *BMJ Open* 2019;9:e032239. [\[CrossRef\]](#)
- Buysse DJ, Reynolds CF 3rd, Monk TH, Berman SR, Kupfer DJ. The Pittsburgh sleep quality index: a new instrument for psychiatric practice and research. *Psychiatry Res* 1989;28:193-213. [\[CrossRef\]](#)
- Oshinaike O, Akinbami A, Ojelabi O, Dada A, Dosunmu A, John Olabode S. Quality of sleep in an HIV population on anti-retroviral therapy at an urban tertiary centre in Lagos, Nigeria. *Neurol Res Int* 2014;2014:298703. [\[CrossRef\]](#)
- Johns MW. A new method for measuring daytime sleepiness: the epworth sleepiness scale. *Sleep* 1991;14:540-5. [\[CrossRef\]](#)
- Koyanagi A, Stickley A. The association between sleep problems and psychotic symptoms in the general population: a global perspective. *Sleep* 2015;38:1875-85. [\[CrossRef\]](#)
- Schmidt LE, Johnson KP. A clinical guide to pediatric sleep. *Journal of the American Academy of Child & Adolescent Psychiatry* 2005;44:720-1. [\[CrossRef\]](#)
- Sun W, Fu J, Chang Y, Wang L. Epidemiological study on risk factors for anxiety disorder among Chinese doctors. *J Occup Health* 2012;54:1-8. [\[CrossRef\]](#)
- Yang X, Wang R, Liu Z, et al. Relationship between sleep quality and mental health of physicians. *China Journal of Health Psychology* 2007;15:654-6.
- Wang C, Horby PW, Hayden FG, Gao GF. A novel coronavirus outbreak of global health concern. *Lancet* 2020;395:470-3. [\[CrossRef\]](#)
- Fiorillo A, Gorwood P. The consequences of the COVID-19 pandemic on mental health and implications for clinical practice. *Eur Psychiatry* 2020;63:e32.
- Kang L, Li Y, Hu S, et al. The mental health of medical workers in Wuhan, China dealing with the 2019 novel coronavirus. *Lancet Psychiatry* 2020;7:e14. [\[CrossRef\]](#)

24. Brooks SK, Webster RK, Smith LE, et al. The psychological impact of quarantine and how to reduce it: rapid review of the evidence. *Lancet* 2020;395: 912-20. [\[CrossRef\]](#)
25. Shigemura J, Ursano RJ, Morganstein JC, Kurosawa M, Benedek DM. Public responses to the novel 2019 coronavirus (2019-nCoV) in Japan: mental health consequences and target populations. *Psychiatr Clin Neurosci* 2020;74:281-2. [\[CrossRef\]](#)
26. Abdulah DM, Musa DH. Insomnia and stress of physicians during COVID-19 outbreak *Sleep Med* 2020;2:100017. [\[CrossRef\]](#)
27. Azzez SS, Abdulah DM, Piro RS, Alhakem SSM. Sleep severity and fatigue manifestations in relation to the doctor-patient relationship. *Sleep Med* 2019;58:13-17. [\[CrossRef\]](#)
28. Lai J, Ma S, Wang Y, et al. Factors associated with mental health outcomes among health care workers exposed to Coronavirus Disease 2019. *JAMA Netw Open* 2020;3:e203976. [\[CrossRef\]](#)
29. Serrano-Ripoll MJ, Meneses-Echavez JF, Ricci-Cabello I, et al. Impact of viral epidemic outbreaks on mental health of health-care workers: a rapid systematic review. medRxiv 2020. Unpublished manuscript.
30. Huang Y, Zhao N. Generalized anxiety disorder, depressive symptoms and sleep quality during COVID-19 outbreak in China: a web-based cross-sectional survey. *Psychiatry Res* 2020;288:112954. [\[CrossRef\]](#)
31. Besedovsky L, Lange T, Born J. Sleep and immune function. *Pflugers Arch* 2012;463:121-37. [\[CrossRef\]](#)
32. Lange T, Perras B, Fehm HL, Born J. Sleep enhances the human antibody response to hepatitis A vaccination. *Psychosom Med* 2003;65:831-5. [\[CrossRef\]](#)
33. Abdulah DM, Mohammed AA. The consequences of the COVID-19 pandemic on perceived stress in clinical practice: experience of doctors in Iraqi Kurdistan 2020 Aug 3. *Rom J Intern Med.*2020. [Ahead of Print]. [\[CrossRef\]](#)
34. Lee AM, Wong JG, McAlonan GM, et al. Stress and psychological distress among SARS survivors 1 year after the outbreak. *Can J Psychiatry* 2007;52:233-40. [\[CrossRef\]](#)
35. Lu Y-C, Shu B-C, Chang Y-Y, Lung F-W. The mental health of hospital workers dealing with severe acute respiratory syndrome. *Psychother Psychosom* 2006;75: 370-5. [\[CrossRef\]](#)
36. Maunder R, Hunter J, Vincent L, et al. The immediate psychological and occupational impact of the 2003 SARS outbreak in a teaching hospital. *CMAJ* 2003;168:1245-51.
37. Nochaiwong S, Ruengorn C, Awiphan R, et al. Mental health circumstances among health care workers and general public under the pandemic situation of COVID-19 (HOME-COVID-19). *Medicine (Baltimore)* 2020;99:e20751. [\[CrossRef\]](#)