

SLEEP QUALITY AND ITS IMPACT ON THE OCCURRENCE OF MEDICAL ERRORS AMONG PHYSICIANS DURING THE COVID-19 PANDEMIC

By

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Abstract

Introduction: Sleep deprivation is a severe health issue for health-care personnel, especially during the COVID-19 pandemic. It affects their physical, emotional, psychological well-being, as well as their work performance. **Aim of Work:** To measure the percentage of poor sleep among physicians during COVID-19 pandemic, to identify its risk factors and to determine the association between it and the occurrence of medical errors. **Materials and Methods:** Cross sectional study was conducted among physicians working at different hospitals and medical centers in Cairo, Egypt. A total of 260 physicians were included in the study through sending online self-administered questionnaire. The questionnaire including items about sociodemographic, work related characteristics, COVID 19 associated risks, items assessed the sleep quality through using validated Pittsburgh Sleep Quality Index (PSQI) and assessment of medical errors related to COVID-19 pandemic. **Results:** Most of the participants (65.4%) were females, 79.2% were married, 76.9% had children and 93.5% don't live alone. The mean age was 36.23 ± 5.7 . As regard work-related characteristics, 45.6% of participants worked equal or more than 48 hours weekly, 38.8% had night shifts and 66.5% had equal or more than 10 years' experience. Only (26.2%) are working in COVID-19 isolation hospitals. The percentage of poor sleep quality among physicians was 79.6%. The global PSQI mean score was 7.54 ± 3.5 while the worst components' mean scores were the sleep latency, sleep duration and sleep disturbance scores (1.59 ± 1.02 , 1.41 ± 0.87 and 1.29 ± 0.6 respectively). Poor sleep quality was associated with having chronic diseases, being night shifters, working equal to or more than 48 hours weekly, satisfaction with the availability of personal protective equipments (PPEs), and with COVID-19 management protocols. Medical errors were performed by 30.4% of the studied physicians. There was a significant association between poor sleep quality and giving the patients incorrect doses or overdose. **Conclusion:** There was a high percentage of poor sleep among the studied physicians. Having chronic diseases, working equal to or more than 48 hours weekly, and having night shifts were identified as significant predictors of poor sleep quality among them.

Keywords: Sleep quality, Physicians, COVID-19 pandemic and Medical errors.

Introduction

Sleep is a very critical part of the physiology of the humans and sufficient adequate sleep is very important for the proper function of the immune system to fight against the viruses and diseases (Besedovsky et al., 2012). Sleep disorders may be classified into problems either in the quality, timing, or amount of sleep (Thorpy, 2012).

The prevalence of sleep disorders among health care workers was generally higher than that in non- health care workers or general population. Health care workers are more prone to sleep disturbance even before the beginning of the COVID-19 pandemic because they are exposed to many situations which may have a negative impact on sleep quality including work schedule, frequent night shifts and on-call hours (Lin et al., 2021).

However, the occurrence of the pandemic increases the probability and the risk of these disorders particularly among the health care workers, because they are at the front lines of dealing with COVID-19 suspected and infected patients. In addition to a persistent fear of contracting COVID-19 themselves or transmitting the infection to family members (Abbas et al., 2021),

fatigue from the work overload, stigma, inadequate and uncertain information regarding the disease epidemiology, insufficient supplies to implement the preventive and control measures, and the associated economic burden (Brooks et al., 2020).

Before the COVID-19 pandemic the prevalence of sleep disorders was 43.1% among the health care workers in a study conducted in Tehran by Ghalichi et al, 2013. After COVID-19 pandemic, it was found that the prevalence of sleep disorders was 68.3% among physicians in Iraq (Abdulah and Musa, 2020) and 44.9% in King Saudi Arabia (Almater et al., 2020).

The main critical responsibility of any physicians is to take care of the sick and critically ill patients, make critical decisions as regard the diagnosis and management, and calculate doses for different medications in which there is no space or time to make errors (Sweileh et al., 2011) .The link between sleep and patient safety is very important and require considerable attention (Abbas et al., 2021).

There is a scarcity of research works that study the epidemiology of sleep disorders during the epidemic. However, the clinical impacts of the poor sleep

quality on frequency of the occurrence of medical errors still unclear and especially during the pandemic (Trockel et al., 2020).

Aim of Work

To measure the percentage of poor sleep among physicians during COVID-19 pandemic, to identify its risk factors and to determine the association between it and the occurrence of medical errors.

Materials and Methods

Study design: A cross sectional study was conducted.

Study Setting, population and duration: The study was conducted among physicians aged between 24 and 60 years, from different specialties, different hospitals and medical centers in Cairo, Egypt from November 2021 to March 2022. **Exclusion criteria:** Physicians with past history of psychiatric disorders, medical problems and current use of medications which may affect sleep quality.

Study sample : Convenience sample was used. By using Open Epi, version 3, for sample size calculation and based on reported 78% proportion of poor sleep quality among physicians during the COVID-19 pandemic and the proportion of medical errors is pro-

posed to be 82.46% and 58.7% in the physicians with poor and good sleep quality (Abbas et al, 2021) with 95% confidence level, and 5% marginal error, the estimated sample size required was 260 physicians.

Study methods:

Data collection tools: An English anonymous online **self-administered questionnaire** (google form) was sent to the physicians through social networks such as WhatsApp and Facebook.

The questionnaire was divided into five sections as the following:

1) Socio-demographic characteristics: such as age, gender, marital status, presence of children and their number and educational level.

2) Work related characteristics: such as specialty, job position, night shifts, working hours and years of experience.

3) COVID 19 associated risks: such as exposure and doing swabs for COVID 19 cases, following the updates in the COVID 19 protocol, and satisfaction with PPE and management protocols of COVID 19 treatment.

4) Validated Pittsburgh Sleep Quality Index (PSQI): The PSQI was

developed by Daniel J. Buysse and collaborators (Buysse et al., 1989) to measure quality of sleep and to help discriminate between individuals who experience poor sleep versus individuals who sleep well. The Pittsburgh Sleep Quality Index (PSQI) contains 7 components which include subjective sleep quality, sleep latency, sleep duration, habitual sleep efficiency, sleep disturbances, use of sleep medication, and daytime dysfunction. The PSQI contains 24 questions (19 self-rated questions, and 5 questions rated by the roommate). Only self-rated questions were included in the scoring and the other 5 items are usually used for clinical information only. The questions are rated from (0 to 3) and a score of 0 indicates no difficulty; while a score of 3 indicates severe difficulty. Question number 6 examine the subjective sleep quality, question number 4 examine the sleep duration, while scores of questions 2 and 5a were added to examine the sleep latency. Habitual sleep efficiency was calculated by dividing number of hours slept (question 4) over number of hours spent on bed (question 1 and 3) then multiplied by 100. More than 85% rated 0, 75-84% rated 1, 65-74% rated 2 and less than 64% rated 3. Sleep disturbance component exam-

ined in questions 5b to 5j. Question 7 examined the use of sleep medication component, while daytime dysfunction examined in questions 8 and 9.

The seven component scores are then added to give one global score with a range of 0-21 points. A score ≥ 5 considered as a significant sleep disturbance. The validity of PSQI is good with a sensitivity of 89.6% and a specificity of 86.5% of patients versus control subjects (kappa = 0.75, p less than 0.001) in distinguishing good and poor sleepers (Buysse et al., 1989).

5) Assessment of medical errors related to COVID-19 pandemic: such as the frequency of medical errors in the last year, not checking for drug allergies, dispensing medication with incomplete instructions, accidental extubation, provision of incorrect doses or over dosage, incorrect explanation of the use of medication, and prescribing drugs to the wrong patient (Abbas et al., 2021).

Consent

An informed consent was taken from all participants in the study in the first question of the questionnaire and confidentiality was maintained.

Ethical Approval

The ethical committee approval

was obtained from Ethical Committee at Faculty of Medicine, Ain Shams University.

Data Management

Data were collected, coded and entered on personal computer and analyzed using SPSS (Statistical Package for Social Science) program version 25 then data were checked for data entry

errors. Quantitative data were presented as mean and standard deviation. Qualitative data were presented as number and percentage. Suitable statistical tests were done as independent t test, chi square test, and fisher's exact test. Binary logistic regression was done to indicate the independent predictors of poor sleep. A two-sided p-value ≤ 0.05 was considered statistically significant.

Results

Table (1): The percentage of poor sleep quality and its components among the studied participants (No=260).

Variables	Mean \pm SD
Sleep quality score	1.24 \pm 0.71
Sleep latency score	1.59 \pm 1.02
Sleep duration score	1.41 \pm 0.87
Habitual sleep efficiency score	0.77 \pm 1.02
Sleep disturbance score	1.29 \pm 0.6
Sleep initiating medication score	0.19 \pm 0.6
Daytime dysfunction score	1.04 \pm 0.84
Global PSQI score	7.54 \pm 3.5
Sleep quality	No (%)
	Good
Poor	53(20.4) 207(79.6)

PSQI: Pittsburgh Sleep Quality Index ≥ 5 poor

Table (1) showed that the percentage of poor sleep quality among physicians during COVID-19 pandemic was 79.6%. The global PSQI mean score was 7.54 \pm 3.5 while the worst components' mean scores were the sleep latency, sleep duration and sleep disturbance scores (1.59 \pm 1.02, 1.41 \pm 0.87 and 1.29 \pm 0.6 respectively).

Table (2): Sociodemographic and work-related characteristics and their associations with poor sleep quality among the studied participants (No=260).

	No (%)	Good sleep	Poor sleep	Tests	p value	OR (95% CI) ^a
Sociodemographic characteristics						
Age (years): Mean ± SD	36.23±5.7	36.3 ±5.2	36.22 ±5.9	0.026 ^b	0.98	(-1.7-1.7)
Gender						
Male	90(34.6)	24(26.7)	66(73.3)	3.35	0.06	1.77(0.96-3.27)
Female	170(65.4)	29(17.1)	141(82.9)			
Marital status						
Single	45(17.3)	8(17.8)	37(82.2)	0.79	0.68	
Married	206(79.2)	44(21.4)	162(78.6)			
Divorced	9(3.5)	1(11.1)	8(88.9)			
Educational level						
Bachelor	49(18.8)	12(24.5)	37(75.5)	0.19 ^c	0.66	
Master	153(58.8)	29(19)	124(81)			
Doctorate	58(22.3)	12(20.7)	46(79.3)			
Having children (yes)	200(76.9)	42(21)	158(79)	0.2	0.65	0.85(0.4-1.77)
Living status						
Alone	17(6.5)	3(17.6)	14(82.4)	0.08	0.77	0.83(0.23-2.99)
Not alone	243(93.5)	50(20.6)	193(79.4)			
Having chronic diseases	44(16.9)	4(9.1)	40(90.9)	4.16	0.04*	2.9(1-8.6)
Work-related characteristics						
Years of experience						
< 10 years	87(33.5)	15(17.2)	72(82.8)	0.79	0.37	0.74(0.38-1.44)
≥ 10 years	173(66.5)	38(22)	135(78)			
Working hours / week						
< 48	144(55.4)	38(26.4)	106(73.6)	7.17	0.007*	2.4(1.25-4.66)
≥ 48	116(44.6)	15(12.9)	101(87.1)			
Specialty						
Internal Medicine and its specialties	105(41.5)	21(20)	84(80)	2.9 ^d	0.83	
Pediatric	71(28.1)	11(15.5)	60(84.5)			
General surgery and its specialties	32(12.6)	7(21.9)	25(78.1)			
Gynecology & obstetrics	9(3.6)	1(11.1)	8(88.9)			
Family Medicine	7(2.8)	1(14.3)	6(85.7)			
General Practitioner	5(2)	1(20)	4(80)			
Dentist	24(9.5)	7(29.2)	17(70.8)			

Current job position						
General Practitioner	56(21.5)	8(14.3)	48(85.7)			
Specialist	126(48.5)	31(24.6)	95(75.4)	5.1	0.17	
Consultant	70(26.9)	11(15.7)	59(84.3)			
Registrar	8(3.1)	3(37.5)	5(62.5)			
Night shifts (Yes)	101(38.8)	14(13.9)	87(86.1)	4.33	0.037*	2.02(1.03-3.9)
Working in isolation hospitals (Yes)	68(26.2)	16(23.5)	52(76.5)	0.56	0.45	0.78(0.39-1.5)

a: OR: odds ratio; CI: confidence interval, b: Independent t test,
c: linear by linear association d: fisher's exact test *: Statistically significant

Table 2 showed that among the participants; 65.4% were females, 79.2% were married, 76.9% had children and 93.5% don't live alone. The mean age of the participants was 36.23±5.7. Physicians with master degree constituted 58.8% of responders; 22.3% had doctorate degree, and 18.8% had bachelor degree. Most of the participants (83.1%) don't have any chronic diseases.

As regard work-related characteristics, 55.4% of participants worked equal or more than 48 hours weekly, 38.8% had night shifts and 66.5% had equal or more than 10 years' experience with the following specialties: 41.5% Internal Medicine and its specialty, 28.1% Pediatrician, 12.6% General Surgery and its specialties and the remaining were General Practitioners, Family physicians and dentists. About half of the participants (48.5%) were specialists followed by 26.7% were consultants. Only (26.2%) are working in COVID-19 isolation hospitals .

Having chronic diseases, working equal to or more than 48 hours weekly and night shifters were significantly associated with poor sleep as shown in Table 2.

Table (3): Description of COVID-19 associated risks and its association with poor sleep quality among the studied participants (No=260).

Variables	No (%)	Good sleep	Poor sleep	Chi square test	p value	OR (95% CI)
Exposure to suspected or confirmed COVID-19 cases (Yes)	230(88.5)	45(19.6)	185(80.4)	0.83	0.36	1.49(0.63-3.58)
Undergo any swabs for suspected cases (Yes)	126(48.5)	27(21.4)	99(78.6)	0.16	0.69	0.88(0.48-1.61)
Getting previous COVID-19 infection (Yes)	153(58.8)	30(19.6)	123(80.4)	0.14	0.71	1.12(0.61-2.1)
Know a colleague/friend who was infected with or died of COVID-19 (Yes)	252(96.9)	50(19.8)	202(80.2)	#	0.21	2.42(0.56-10.5)
Following COVID-19 updates (Yes)	201(77.3)	38(18.9)	163(81.1)	1.19	0.28	1.46(0.74-2.9)
Satisfaction with the available (PPE)						
Satisfied	54(20.8)	15(27.8)	39(72.2)	2.29	0.13	1.7(0.85-3.39)
Dissatisfied	206(79.2)	38(18.4)	168(81.6)			
Satisfaction the management protocols						
Satisfied	57(21.9)	18(31.6)	39(68.4)	5.64	0.018*	2.22(1.14-4.32)
Dissatisfied	203(78.1)	35(17.2)	168(82.8)			

#: Fisher's exact test

*: Statistically significant

PPT: Personal protective equipment

Among the studied group, 88.5% were exposed to suspect or confirmed COVID-19 cases in their work, 45.5% undergo swabs for suspected cases and 77.3% of them following COVID-19 news and updates. Moreover, 58.8% of them were getting previous COVID-19 infection and 96.9% had a colleague, friend or family member infected with or died of COVID-19. Only 20.8% were satisfied with the availability of protective personal equipments (PPEs) at their work and only 21.9% were satisfied with COVID-19 management protocols. There was a significant association between poor sleep quality and dissatisfaction with COVID-19 management protocols (p value = 0.018) (Table 3).

Table (4): Frequency and types of medical errors and impact of poor sleep quality on it among the studied participants (No=260).

Variables	No (%)	Good sleep	Poor sleep	Chi square test	p value	OR (95% CI)
Medical errors (Yes)	79 (30.4)	14(26.4)	65 (31.4)	0.49	0.48	1.28(0.65-2.5)
Dispensing medication with incomplete instructions (Yes)	65(25)	8(15.1)	57 (27.5)	3.48	0.06	2.14(0.95-4.8)
No check for drug allergies (Yes)	72(27.7)	12 (22.6)	60(29)	0.85	0.36	1.39(0.69-2.84)
Accidental extubation(Yes)	9(3.5)	2 (3.8)	7(3.4)	#	1	0.89(0.18-4.43)
Incorrect dosing or overdose (Yes)	41(15.8)	3 (5.7)	38(18.4)	5.12	0.02*	3.75(1.11-12.7)
Incorrect explanation of the usage of medication (Yes)	36 (13.8)	4 (7.5)	32(15.5)	2.21	0.14	2.24(0.76-6.64)
Prescription of drugs to the wrong patient (Yes)	16 (6.2)	2(3.8)	14(6.8)	#	0.5	1.85(0.41-8.4)

#: Fisher's exact test

*: Statistically significant

Table 4 showed that medical errors were performed by 30.4% of the physicians in the previous year. The most common medical ones were: not checking the drug allergy (27.7%), dispensing medication with incomplete instructions (25%), giving incorrect doses or overdose (15.8%), incorrect explaining of the usage of medication (13.8%), prescribing drugs to the wrong patient (6.2%) and finally accidental extubation (3.5%).

There was a significant association between poor sleep quality and giving the patients incorrect doses or overdose (18.4% among poor sleep versus 5.7% among good sleep) (p value=0.02, OR (95%CI) = 3.75(1.11-12.7).

Table (5): Predictors of poor sleep quality among the studied participants (No=260).

Variables	B	p value	OR	95% CI	
				Lower	Upper
Gender					0.79
Male	-1	0.011*	0.37		
Having chronic diseases				0.17	10.97
Yes	1.21	0.045*	3.35		
Working hours per week				1.02	7.37
≥48 hours per week	1.18	0.005*	3.26		
Night shifts				1.4	6.49
Yes	0.99	0.025*	2.7		
Working in isolation hospital				1.1	1.19
Yes	-0.62	0.13	0.54		
Current job title				0.24	-
General Practitioners	-	0.06	-		1.56
Specialist	-0.49	0.3	0.61	-	4.24
Consultant	0.35	0.54	1.41	0.24	0.93
Registrar	-1.94	0.04*	0.14	0.47	
Satisfaction with the available PPE				0.02	1.89
Dissatisfied	0.38	0.9	1.04		
Satisfaction the management protocols	0.48	0.09	1.62	0.57	2.8
Dissatisfied				0.94	
Constant	0.23	0.78	1.25		

PPT: Personal protective equipment

*: Statistically significant

Multivariate binary logistic regression analysis of factors associated with poor sleep quality revealed that having chronic diseases; OR (95%CI) = 3.35 (1.02-10.97), $p=0.045$, working equal to or more than 48 hours weekly; OR = 3.26 (1.4-7.37), $p=0.005$, and having night shifts; OR (95%CI) = 2.7 (1.1-6.49), $p=0.025$, were three independent predictors of poor sleep quality. While being a male doctor; OR (95%CI) = 0.37 (0.17-0.79) and being a registrar OR (95%CI) = 0.14 (0.02-0.93) were a protective factors of poor sleep quality as shown in Table 5.

Discussion

Sleep deprivation is a common problem, especially among health-care workers, and it's associated with higher health risks, which can compromise patient safety and the quality of care offered. The emergence of the COVID-19 pandemic has exaggerated a number of health problems among the first line of defense against the pandemic, and the assessment of these disorders among health care professionals should be a priority for the health sector's responsible authorities.

This cross-sectional study aimed to measure the percentage of poor sleep quality among 260 physicians during COVID-19 pandemic. The results reported that more than half of the studied physicians (79.6%) had poor sleep quality (Table 1). This is nearly similar to other studies conducted in the same region which reported that working during the pandemic had a negative impact on the sleep quality among 57% of the physicians (Elweshahi et al., 2021) and among 71.2% of the studied doctors (Abdellah et al., 2021).

Another study conducted in Kuwait by Abbas et al., 2021; reported that (78.8%) of the studied medical team had poor sleep quality during the pandemic.

However, before the beginning of the Covid -19 pandemic it was found that the prevalence of poor sleep quality was less than the half of the studied medical team, as it was 43.1% in a study conducted in Tehran (Ghalichi et al., 2013) and 45.5% in another study conducted in Iraq (Azzez et al., 2019).

Physicians suffering from chronic diseases among the studied group had significantly poorer sleep quality compared to healthy ones (p value 0.04), OR (95%CI) = 2.9(1-8.6) (Table 2). Otherwise, none of the socio-demographic factors were associated with poor sleep quality. These results were consistent with prior study demonstrating that having chronic diseases is a risk factor for poor sleep (Tür et al., 2015). Physicians suffering from chronic diseases face a variety of stressors related to their illnesses, in addition to work-related stressor that may affect their sleep, and so, special attention should be directed to these vulnerable group.

Regardless of their medical specialty or place of work, many physicians in Egypt were dealing with suspected or confirmed cases with a much higher probability of becoming infected due to the expansion of the

list of hospitals that provide different services for COVID-19 cases all over the governorates (Elweshahi et al., 2021).

Excessive work hours and the presence of night shifts, on the other hand, were associated with poor sleep quality (p value <0.05) (Table 2). It is considered as a vicious circle because sleep deprivation from excessive work hours may lead to exhaustion, reduce attention capacity, and decrease efficiency, which contributes to increased work hours (Trockel et al., 2020).

There are a lot of studies that were conducted among health care workers who had night shifts, such as (Johnson et al., 2014 and Tür et al., 2015). They found that night shifts were associated with sleep problems.

There was a significant association between poor sleep quality and dissatisfaction with COVID-19 management protocols (p value = 0.018) (Table 3), as the treatment protocols are different and changing daily, and there is no clear universal consensus on which strategy or guideline to follow. All these issues create a 'panic' picture in the minds of all the health care workers (Grover et al., 2020). These uncertainties put the doctors

under great stress because they are facing the dilemma of doing the best for their patients and risking a significant increase in aerosols exposure, as well as the possibility of infection transmission to their family members, colleagues, and other patients. In addition, the constant worry that the surrounding community will be afraid of contracting the infection from them because they are the ones most at risk, thus exposing them to stigma and social exclusion.

It has been documented in a lot of studies that COVID-19 has negatively affected the mental and psychological wellbeing of health care workers (Preti et al., 2020 from Italy and Kalmbach et al., 2017 from Michigan, USA), which may have a negative impact on their sleep quality. Sufficient sleep is essential for immunity, which helps in the fight against infections and disorders (Besedovsky et al., 2012), improving doctor-patient relationships (Azzez et al., 2019), and preventing the occurrence of medical errors (Kalmbach et al., 2017).

The percentage of the studied physicians who made a clinically significant error was 30.4 % (Table 4). This was in accordance with other studies done by Kalmbach et al., 2017

and Arimura et al., 2010 who concluded that medical error rates were statistically significantly higher among health care workers with sleep difficulties. Also, there was a higher frequency of medical errors among the studied physicians with poor quality of sleep, but the only statistically significant self-reported medical error was incorrect dosing or overdose (p value=0.02) (Table 4).

Poor sleep quality, unsurprisingly, is associated with decreased cognitive performance, tiredness, a lower capacity for attention, and memory impairment, all of which can influence health care workers' decisions about their patients, leading to medical errors (Sweileh et al., 2011)

Among the studied group, having chronic diseases (p=0.045), working equal to or more than 48 hours weekly (p=0.005), and having night shifts (p=0.025) were the three independent predictors of poor sleep but being a male doctor and being a registrar were protective factors of poor sleep quality (Table 5). These results were different than that detected by Abbas et al., 2021 from Kuwait who found that being a health care worker on the front line of the COVID-19, taking swabs from suspected cases, and having a positive

co morbid profile were the three independent predictors of poor sleep among their studied participants.

Conclusion: This online survey showed high percentage of poor sleep quality among Egyptian physicians throughout the pandemic of Covid 19, with bad effect on the occurrence of one of the clinically significant medical errors which is incorrect dosing or overdose.

Recommendations:

The COVID-19 pandemic is considered as a severe challenge for health care workers. According to the findings of the current study, the responsible authority should recognize the magnitude of this problem and act to provide optimal working hours with sufficient breaks, a brief length of time during the night shifts, mandatory leaves. As well as employ more health care workers if needed. In addition to developing and conducting educational and training programs for screening and early detection of the physicians with sleep difficulties and for the physicians to overcome the stressors they will face during the pandemic to prevent the negative consequences, as they are the first line of defense.

Conflict of interest

The authors declared that there was no conflict of interest.

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