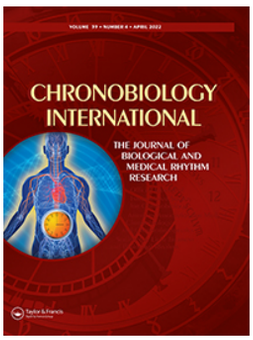

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ORIGINAL ARTICLE

COVID-19 epidemic effects on sleep quality among health sector workers: A follow up study

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ABSTRACT

Health care workers (HCWs) were vulnerable to sleep disturbances in normal circumstances. Poor sleep quality (PSQ) is common during the coronavirus disease 2019 (COVID-19) epidemic. The aim of this study is evaluation of sleep quality among healthcare workers during COVID-19 epidemic in a cohort study. In a follow-up study, we assessed sleep quality in 453 Iranian HCW participants in late-April 2021, after approximately 8 weeks of the epidemic of COVID-19. In order to compare the sleep quality in the two time intervals, during and before COVID-19, we used the recorded data of the same group of participants who were enrolled in a study named SHAHWAR (SHAhroud Health care Workers Associated Research) cohort that is focused on the health of HCWs who work at the Shahroud university of medical sciences. Data collection process in the SHAHWAR study started on October 2, 2019 and continued until February 19, 2020. Our results showed sleep quality worsened among shift-workers during COVID-19 outbreak; however, it was improved among non-shift staff. Sleep quality was more likely to be worsening if HCWs had shift-working roles [OR: 1.84(1.11–3.06), and if they experienced death in their families [OR: 5.06(1.60–12.80)]; however, having a paramedical role was a protective effect [OR: 0.52(0.27–092)], for poor quality sleep. Sleep quality worsened during the epidemic among HCWs. A greater impact, in terms of higher PSQI index, in this group of workers was seen in shift working staff.

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Epidemic; HCWs; sleep quality; Iran; COVID-19; cohort

Introduction

COVID-19 as a new infectious disease has rapidly spread around the world and was declared by WHO as a "Global Pandemic" on March 11, 2020 (Blaisdell et al. 2020). This pandemic led to increased medical demands, lack of medical resources, and created stress for health care workers (HCWs) as the front line soldiers. HCWs work under stress conditions because of direct contact with patients and their suffering, pains, and deaths. It is assumable that being in such a vigilant environment increases the risk of major psychological distress and significant symptoms of mental health illness among HCWs (5). Although a one-year study on intensive care physicians working at COVID-19 Hospitals found that more than 40% of participants experienced insomnia at the onset of the epidemic, they gradually recovered in later stages of the epidemic (Magnavita et al. 2021).

Accordingly, studies have reported an increased level of chronic stress and anxiety among HCWs during COVID-19 pandemic (Chen et al. 2020; Lai et al. 2020; Magnavita et al. 2021). Evidences from studies show that there is significant relation between occupational stress and adverse mental health outcomes including but not limited to anxiety, depression, burnout, and sleep dysfunction (Alimoradi et al. 2021; Garbarino and Magnavita 2019; Luo et al. 2021).

Studies have indicated that HCWs are prone to sleep dysfunction (Kaneita and Ohida 2011; Sayehmiri and Mohammadi 2018; Khastar et al. 2020, Chang and Li 2021) and stress has been nominated as the one of the major causes of sleep disturbances in this group (Zhang, Yang et al. 2020). The HCWs also have an irregular work program and night shifts, which can unpleasantly further affect their sleep quality (Zhao, Lan et al. 2021). Moreover, because of COVID-19 pandemic, medical staff have experienced higher levels of occupational distress due to excessive work pressure, direct exposure to disease, and the possibility of being infected or transmitting the infection to family members. The sum of these factors can negatively affect the sleep

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quality of HCWs (Pappa et al. 2020, Amalean, Pavuluri et al. 2021). A study performed by Jahrami and colleagues in Bahrain showed that as high as 60% of HCWs suffer from poor sleep quality (PSQ) during the COVID-19 pandemic (Jahrami, BaHammam et al. 2021). A recent published systematic review estimated the global and HCWs prevalence of sleep disturbances at 40.49% and 42.47%, during COVID-19 pandemic, respectively (Jahrami et al. 2022) . A meta-analysis study comprising 345,270 participants reported the corrected pooled estimated prevalence of sleep problems among healthcare professionals significantly higher than normal population and ranked it second highest after patients with COVID-19 (31 VS 57%) (Alimoradi et al. 2021).

Scientific evidences have indicated sleep disturbances can cause a range of physical, mental, and emotional problems including irritability, anxiety, depression, and even suicide attempt and death (Sher 2020, Jahrami, BaHammam et al. 2021). A systematic review comprising 177 studies showed a strong association between sleep problems and both depression and anxiety among HCWs (Alimoradi et al. 2021). Sleep dysfunction and occupational stress could also increase the risk of metabolic disorders (Garbarino and Magnavita 2019). A 5-year prospective cohort study included 242 police officers showed both occupational stress and sleep problems are significantly related to incident cases of metabolic syndrome (Garbarino and Magnavita 2019). There are also evidences that sleep dysfunction could increase the risk of cardiovascular events (Magnavita et al. 2018).

Our country, Iran, is one of the first sites of COVID-19 outbreak with involvement and infection in a great number of people. Similar to other countries, the HCWs of our country are a group with increased risk of health related issues such as sleep dysfunction. As preserving the health status of HCWs is crucial, especially in crisis situations such as this pandemic, identifying the prevalence of sleep problems in our HCWs is an important step toward implementation of suitable prevention and management strategies. Therefore, in this study, we aimed to evaluate the impact of COVID-19 pandemic on sleep quality of HCWs. As explained above, our hypothesis was the HCWs might be more susceptible to sleep dysfunction. Therefore, we assessed the sleep quality among this group after COVID-19 outbreak and compared it to their scores before epidemic. For this purpose, we used the data from SHAHWAR (SHAhroud Health sector Workers Associated Research) cohort study as a branch of the PERSIAN/Employees' Health Cohort Study, which is a prospective cohort study for evaluating the risk factors of non-communicable diseases among the employees of medical universities across country.

Method

Study setting

This cohort study used data from SHAHWAR (SHAhroud Health sector Workers Associated Research) cohort study as a branch of the PERSIAN/Employees' Health Cohort Study, a prospective cohort study for evaluating the risk factors of non-communicable diseases among the employees of medical universities across country launched by Research Deputy of Ministry of Health, Treatment, and Medical Education. SHAHWAR Cohort study, conducted by Shahroud University of Medical Sciences, was designed to serve as one of the centers of PERSIAN /Employees' Health Cohort Study in northeast Iran.

In brief, SHAHWAR Cohort study began in October, 2019 and intended to enroll all permanent employees of Shahroud University of Medical Sciences (health sector in Shahroud county) including physicians, nurses, service staff/cleaning workers or cleaners, administrative, primary healthcare providers, para-medical, and kitchen workers who aged 20 to 65 years old and follow them for at least 15 years with three follow-ups at 5 years intervals. The collected data in SHAHWAR Cohort study includes complete physical examination, anthropometric evaluation, and the completion of questionnaires related to socioeconomic status and social capital, history of diseases, lifestyle (including, nutrition, physical activity, cigarette, and hookah smoking), occupational exposures (including psychosocial factors at work and work-family conflicts), and different aspects of physical, mental, and occupational health. The SHAHWAR Cohort study will have three follow-ups at 5-year intervals.

Data collecting

All the employees of Shahroud University of Medical Sciences who enrolled in the enrollment phase of SHAHWAR Cohort study (October 2019–February 2020, n = 1054) and had completed the Pittsburgh Sleep Quality Index questionnaires at

baseline were invited to complete the follow-up questionnaire (epidemic phase) to assess the sleep quality again at end of April 2020, after approximately 8 weeks of initiation of COVID-19 epidemic in Iran. According to the official report of the Ministry of Health of Iran, the COVID-19 epidemic started on February 19, 2020 (Pourghasemi et al. 2020). Among 1054 invited individuals, 453 persons (43%) accepted the invitation and completed the survey and therefore these persons were included in our study. All data obtained through an interview by means questionnaires whose validity and reliability were approved by a group of experts in the field (Poustchi et al. 2018). The Pittsburgh Sleep Quality Index was used to assess the sleep quality of participants before COVID-19 epidemic and 8 weeks after the Epidemic initiated in Iran. The questionnaire is a 19-item self-rated index that evaluates sleep quality and disturbances over 4 weeks. This questionnaire has 7 subscales, including subjective sleep quality, sleep latency, sleep duration, habitual sleep efficiency, sleep disturbances, use of sleeping medication, and daytime dysfunction (Backhaus et al. 2002). We used the Persian version of the Pittsburgh Sleep Quality Index (PSQI-P) (Moghaddam et al. 2012). The score of each scale is calculated separately and gives an overall score of sleep quality. Each scale of the questionnaire is given a score from zero to 3, the scores of 0, 1, 2, and 3 in each scale indicate the normal condition, the presence of mild, moderate, and severe problems, respectively. The sum of the scores of the seven scales forms the total score, which is from zero to 21. An overall score of 6 or higher indicates PSQ. The reliability of the Pittsburgh Quality Questionnaire was estimated to be 0.83 using the Cronbach's alpha method (Moghaddam et al. 2012). The sensitivity and specificity of Iranian version of PSQI were 94% and 72% (Moghaddam et al. 2012).

Statistical analysis

Categorical variables were described as frequency and percentages, and continuous variables were described as mean ± SDs. Since the data distribution was normal, we used parametric tests. Independent-samples *t*-tests were used to compare the sleep scores across subjects who participated in study from October 2019 to February 2020 (baseline) and participants who completed the study in April 2020 (epidemic phase). For longitudinal analyses, we used paired sample *t*-tests to assess changes in sleep scores in participants who completed the survey both in baseline and epidemic phase. A logistic regression model with higher PSQI or poor sleep as the outcome of interest was used to investigate the odds ratio of each variable. The study covariates were age, gender, marital status, profession, length of work experiences, time spent on social media/watching TV per day, shift working job, history of infection with COVID-19 in participant's and his/her family, family members dead due to COVID-19, and educational attainment. The variables with a p-value of less than 0.1 in univariate analysis were included in multivariable analysis. Multiple regression included significant variables to predict the influence of explanatory variable and PSQI. Multiple analyses of prognostic factors were performed using logistic regression.

All the analyses were carried out with SPSS version 25 and the statistical significance was declared if the p-value was less than 0.05.

Ethical consideration

The study was approved by the ethic committee of Shahroud University of Medical Sciences ((IR.SHMU.REC.1399.21). All participants signed the informed consent prior to participation.

Results

A total of 453 subjects accepted to participate in follow up study and completed questionnaires. Among them 262 (57.8%) subjects were female and 191 (42.2%) were male. Demographic characteristics of the study population are presented in Table 1. The mean age of subjects was (36.9 ± 7.5) years. The majority of subjects had university level education (77%). Only 13.7% had less than 5 years of work experience. About 30 (6.6%) of included subjects had a positive history of COVID-19 infection.

Table 2 shows the scores of the sleep quality components. Our results showed that the sleep quality in our subjects significantly diminished in a way that the mean score of sleep quality before COVID-19 epidemic was significantly higher than during the epidemic (6.3 ± 3.7 vs. 6.8 ± 3.8, p = .008). It was also found that sleep quality scores in shift-workers increased significantly after the epidemic (6.6 ± 3.5 vs. 7.5 ± 3.9, p = .005), although sleep quality score among non-shift staff did not significantly differ compared to before the epidemic (6.1 ± 3.8 vs. 6.4 ± 3.6, p = .27), (Table 2). We also found individual-level variability in changes to PSQI global sleep quality score between shift workers and non- shift workers during the COVID-19 Epidemic. While only 4.4% of non-shift work subjects showed change in their sleep quality before and after the epidemic (McNemar test, P = .746),

Table 1. Demographic characteristics of study sample (N = 453).

Characteristics		N (%)
Age categories	18-29	35(7.73)
	30-49	363(80.13)
	50≤	55(12.14)
Gender	Male	191 (42.16)
	Female	262 (57.84)
Marital Status	Never married/Cohabiting	40(8.83)
	Married	397(87.64)
	Divorced/Separated/Widowed	16(3.53)
Educational attainment	104(22.96)	Diploma or less
	260(57.40)	University
	87(19.24)	Postgraduate
Time spent focusing on the COVID-19 news	Non user	36(7.95)
	2 hrs. or less	340(75.06)
	More than 2 hrs.	77(16.99)
Profession	Medical	120(26.49)
	Service/support staff	66(14.57)
	Para-medical	78(17.22)
	Primary health care	72(15.89)
	Administrative	117(25.83)
Work experiences	5 years ≥	62(13.69)
	6-15 years	210(46.36)
	16-24	121(26.71)
	25≤	60(13.24)
Shift-working	Yes	176(38.85)
	No	277(61.15)
Positive history of COVID-19	Yes	30(6.62)
	No	423(93.38)
Family history of COVID-19	Yes	121(26.71)
	No	332(73.29)
Family members dead because COVID-19	Yes	36(7.95)
	No	417(92.05)

18.4% of shift workers revealed the worsening of sleep quality after the epidemic (McNemar test, P = .001). Figure 1 shows the changes.

The results showed that while before the epidemic, 49.2% of our subjects had good sleep quality (PSQI ≤ 5), this number declined to 43.3%, p < .001. Interestingly, as shown in Table 2, some components of sleep quality such as rise time, sleep duration, sleep efficiency and daytime dysfunction showed improvement among non-shift staff during the epidemic compared with shift working-staff.

Results of the univariate and multivariate logistic regression models before the epidemic are shown in Table 3. Gender showed a significant association with PSQ before the COVID-19 epidemic in both crude and adjusted regression model. When we applied the adjusted model, before Covid-19 epidemic educational levels of diploma and lower (OR = 2.04, 95% CI: 1.39–2.98) were significantly associated with PSQ. While in bivariate model variables age, shift-working, marital status, educational attainment, profession, and work experiences did not show a significant relationship with PSQ.

The result of univariate and multivariate analysis of the relationship between PSQ and demographic variables during the COVID-19 epidemic are shown in Table 4. In univariate model shift workers had lower sleep quality (OR = 1.99, 95% CI: 1.35–2.95) than non-shift worker and those with university levels and below the diploma were more likely to have PSQ with an odds ratio of 1.87(1.15–3.06) and 1.26 (0.71–2.24), respectively compared with those who had postgraduate education. In crude model employees who had history of COVID-19 in their families or a history of family member's death because of COVID-19 had the worse sleep quality (OR = 2.13, 95% CI: 1.37–3.32), (OR = 4.26, 95% CI: 1.73–10.46), respectively.

Our adjusted model (Table 4) showed that loss of a family member because of COVID-19 (OR = 5.06, 95% CI: 1.60–12.80) followed by shift work job (OR = 1.84, 95% CI: 1.11–3.06) had the highest associations with PSQ in our subjects

Among medical profession and service/support people, sleep quality deteriorated during the COVID-19 epidemic compared with prior the pandemic (McNemar test, P = .009 and P = .001, respectively), while such changes did not occur among paramedical, primary health care and office staff, (McNemar test, P = .90, P = .850, and P = .256, respectively). Figure 2 shows these changes.

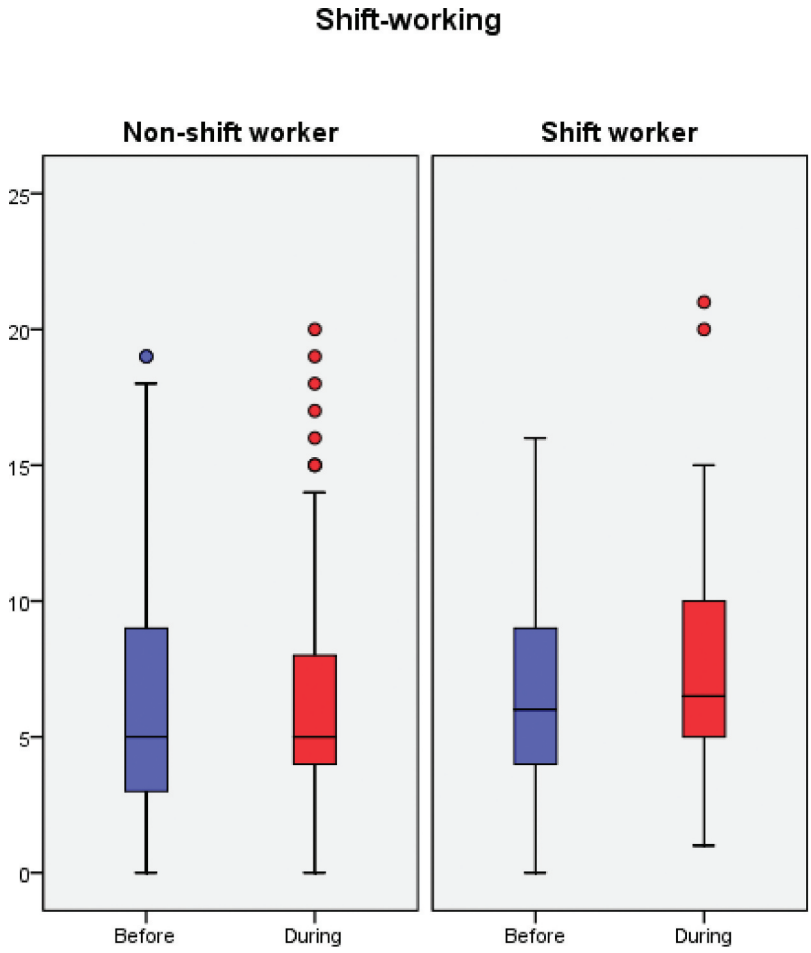

Figure 1. Box plots illustrating PSQI global sleep quality score according to shift working position before and during COVID-19 pandemic.

Discussion

Severe acute respiratory syndrome coronavirus-2 is a highly pathogenic novel virus that has caused a massive pandemic around the globe. Scientific experts are consistently working to find the most suitable ways to contain the virus. Currently, substantial efforts have been made to develop successful and safe treatments and SARS-CoV-2 vaccines. Some vaccines, such as inactivated vaccines, nucleic acid-based, and vector-based vaccines, have entered phase 3 clinical trials. Additionally, diverse small molecule drugs, peptides and antibodies are being developed to treat COVID-19. Besides to treatment issues, COVID-19 pandemic caused emotional and health related issues for both general populations and HCWs. In this study we aimed to assess the changes caused by COVID-19 pandemic on sleep quality of health care professionals. We found that sleep quality of HCWs significantly deteriorated during pandemic period. These changes were more prominent for shift workers. Moreover the percent of our subjects who had good quality sleep (PSQI ≤ 5) before pandemic significantly declined from 49.2% to 43.3%. While before COVID-19 pandemic, being female and lower educational levels had significant association with PSQ, after pandemic, other factors including history of COVID-19 in family member, death of family members by COVID-19, having paramedical profession and being shift workers had the greatest association with PSQ. Surprisingly, the history of COVID-19 infection in subjects itself did not increase the susceptibility of deterioration of sleep quality. This may be due to the small number of HCWs surveyed who had COVID-19.

Some studies have been performed on the effects of COVID-19 on sleep quality in HCWs and similar to what we have found in this study, they reported the deterioration of sleep quality after COVID-out break. For example, Qi J. et al. indicated the frontline medical workers (FMW) have higher prevalence of PSQ than non-FMW (Qi et al. 2020). Also Martin A. et al. reported that PSQI> 6 in their study was more common in HCWs

Table 2. PSQI component scores (N = 453).

PSQI components		Before COVID-19 Mean±(SD)	During COVID-19 Mean±(SD)	P-value (Paired-Test)
Bed time (hr.)	Shift workers	23:43 ± 1:12	00:44 ± 9:52	P < .001
	Non-shift workers	23:38 ± 1:16	23:47 ± 8:26	0.06
Rise time(hr.)	Shift workers	7:06 ± 1:46	6:25 ± 1:76	P < .001
	Non-shift workers	6:40 ± 0.73	6:53 ± 1:19	0.27
Subjective sleep quality	Shift workers	0.98 ± 0.59	1.1 ± 0.63	P < .001
	Non-shift workers	0.80 ± 0.65	0.91 ± 0.67	0.04
Sleep latency	Shift workers	1.04 ± 0.93	1.32 ± 0.78	0.0001
	Non-shift workers	0.94 ± 0.95	1.19 ± 1.1	0.01
Sleep duration	Shift workers	1.30 ± 1.12	1.52 ± 1.3	0.03
	Non-shift workers	1.45 ± 1.08	1.41 ± 0.92	0.57
Sleep efficiency	Shift workers	1.04 ± 1.22	0.96 ± 1.16	0.49
	Non-shift workers	0.92 ± 1.17	0.77 ± 1.09	0.07
Sleep disturbances	Shift workers	1.1 ± 0.53	1.23 ± 0.59	0.01
	Non-shift workers	1.08 ± 0.46	1.11 ± 0.51	0.36
Use of medication	Shift workers	0.15 ± 0.61	0.19 ± 0.57	0.35
	Non-shift workers	0.17 ± 0.61	0.21 ± 0.61	0.26
Daytime dysfunction	Shift workers	0.96 ± 0.78	0.88 ± 0.88	0.31
	Non-shift workers	0.75 ± 0.78	0.62 ± 0.72	0.03
PSQI global score	Shift workers	6.6 ± 3.53	7.47 ± 3.92	0.005
	Non-shift workers	6.13 ± 3.82	6.39 ± 3.64	0.27
PSQI global score among 453 HCWs		6.32 ± 3.72	6.81 ± 3.80	0.008

(San Martin et al. 2020). According to a study conducted by Badahdah AM et al., sleep quality among health care workers during the COVID-19 pandemic showed deterioration (Badahdah et al. 2020).

Although studies have shown higher rates of insomnia, anxiety, and depressive symptoms among HCWs relative to the general population (Du et al. 2020; Morin and Carrier 2020; Nena et al. 2018) the aim of the present study was to investigate changes in circadian rhythms in HCWs. Recent studies showed that one of the main effects of the COVID-19 crisis was its effect on circadian rhythms due to lifestyle changes in people at risk of epidemics at work and living conditions (Giuntella et al. 2021; Salehinejad et al. 2020). LSQ is well known among shift workers due to the conflict between work and their circadian system (Booker et al. 2018). A study by P Majumdar et al. showed that PSQ as a result of deteriorating physical and mental health was more prevalent among nurses on a rotational shift program in COVID-19 pandemic (Majumdar, Barman et al.). It has been shown that psychological distress increases during COVID-19 outbreaks as a response to adaptation to one's work environment (Pappa et al. 2020; Park and Park 2020). While shift workers fell asleep later and woke up earlier in our study, both bedtimes and wake-up times were delayed in the non-shift workers. Workplace stress may cause alteration in shift workers, however a shift towards the evening-type lifestyle reported in the general population at the time of COVID-19 pandemic is a good reason for delayed bedtimes and wake-up times in non-shift workers (Robillard et al. 2021).

We observed the female gender and lower educational attainment is associated with deteriorated sleep quality. High prevalence of sleep problems in women have been reported in many studies, both in the general population (Nojoumi et al. 2009) and in the HCWs (Ghalichi et al. 2013; Pappa et al. 2020). Other studies have shown that people with low levels of education more likely experienced a poor psychological health outcome such as PSQ (Asante et al. 2019) and suggested that SES inequalities including education play a major part in gender differences in sleep problems (Arber et al. 2009).

Our results showed that death resulting from COVID-19 in HCW`s family seemed to be strongly associated with PSQ which is in line with results of other studies. The results of the Franceschini`s study showed that the death of family members or close friends can be very traumatic, especially when it occurs unexpectedly during this period (Franceschini et al. 2020). They clearly stated that the death of a close person due to COVID-19 is a risk factor for sleep disorders.

Table 3. Association between poor sleep quality and its related risk factors using univariate and multivariate logistic regression before COVID-19 epidemic among HCWs.

Univariate logistic regression					
Sleep quality Characteristic variable		PSQI≤5 N (%)	PSQI>5 N (%)	p-value	OR (CI 95%)
Gender	Female	113(43.13)	149(56.87)	P < .001	2.03(1.31–2.93)
	Male	116(60.73)	75(39.27)		1
Age categories	18–29	16(45.71)	19(54.29)	0.80	1.14(0.49–2.57)
	30–49	186(51.24)	177(48.76)		0.91(0.52–1.64)
	50≤	27(49.09)	28(50.91)		1
Shift-working	Yes	86(48.86)	90(51.14)	0.56	1.17(0.76–1.58)
	No	139(50.18)	138(49.82)		1
Marital status	Never married	26(65)	14(35)	0.14	1
	Married	196(49.37)	201(50.63)		1.90(0.96 − 3.67)
	Divorced/ Widowed	7(43.75)	9(56.25)		2.38(0.73 − 7.66)
Educational attainment	Diploma or less	47(45.19)	57(54.81)	0.07	1.86(1.06–3.34)
	University	128(49.23)	132(50.77)		1.60 (0.98 − 2.63)
	Postgraduate	53(60.92)	34(39.08)		1
Profession	Medical	51(42.5)	69(57.5)	0.30	1.57 (0.94–2.57)
	Service/support staff	36(54.54)	30(45.46)		0.97 (0.53–1.66)
	Para-medical	36(50)	36(50)		0.95 (0.53–1.61)
	Primary health care	63(53.85)	54(46.15)		1.16 (0.64–2.13)
	Administrative	43(55.13)	35(44.87)		1
Work experiences	5 years ≥	37(59.68)	25(40.32)	0.43	1
	6–15 years	106(50.48)	104(49.12)		1.45(0.81–2.53)
	16–24	57(47.11)	64(52.89)		1.66(0.89–3.09)
	25≤	29(48.33)	31(51.67)		1.58(0.77–3.21)
Multivariate logistic regression **Variables**		**B**	**S.E**	**P-value**	**OR (CI95%)**
Gender	Female	0.71	0.19	0.001	2. 04 (1.39–2.98)
	Male				1
Educational attainment	Diploma or less	0.75	0.30	0.01	2.12(1.17–3.83)
	University	0.42	0.25	0.10	1.52(0.92–2.52)
	Postgraduate				1
Marital status	Never married				1
	Married	0.63	0.35	0.07	1.88(0.93–3.78
	Divorced/ Widowed	0.60	0.63	0.34	1.83(0.52–6.37)

Table 4. Univariate and multivariate analysis of the relationship between poor sleep quality and demographic variables during the COVID-19 epidemic among HCWs.

Univariate logistic regression					
Sleep quality Characteristic variables		PSQI≤5 N (%)	PSQI>5 N (%)	p-value	OR (CI95%)
Gender	Female	110(41.98)	152(58.01)	0.38	1.18(0.81–1.71)
	Male	88(46.07)	103(53.93)		1
Age categories	18–29	13(37.14)	22(62.86)	0.11	2.18(0.91–5.20)
	30–49	154(42.42)	209(57.58)		1.75(0.98–3.1)
	50≤	31(56.36)	24(43.64)		1
Shift-working	Yes	59(33.52)	117(66.48)	0.001	1.99(1.35–2.95)
	No	143(51.62)	134(48.38)		1
Marital status	Never married	19(7.98)	219(92.02)	0.54	1
	Married	174 (43.83)	223(56.17)		1.16(0.60–2.22)
	Divorced/Widowed	5(31.25)	11(68.75)		1.99(0.58–6.78)
Educational attainment	Diploma or less	50(48.08)	54 (51.92)	0.02	1.26(0.71–2.24)
	University	100(38.46)	160(61.54)		1.87(1.15–3.06)
	Postgraduate	47(54.02)	40(45.98)		1
Profession	Medical	33(27.50)	87(72.50)	0.001	2.33(1.36–4.01)
	Service/support staff	29(43.94)	37(56.06)		1.13 (0.61–2.07)
	Para-medical	43(55.13)	35(44.07)		0.72(0.40–1.28)
	Primary health care	38 (52.78)	34(47.22)		0.79(0.44–1.42)
	Administrative	55(47.01)	62(52.99)		1
Work experiences	5 years ≥	28(45.16)	34(54.84)	0.07	1
	6–15 years	80(38.10)	130(61.90)		1.33(0.75–2.37)
	16–24	56(46.28)	65(53.72)		0.95(0.51–1.76)
	25≤	34(56.67)	26(43.33)		0.63(0.30–1.28)
Time spent focusing on the COVID-19 news	Non user	15(41.67)	21(58.33)	0.6	1
	2 hrs. or less	153(45.00)	187(55.00)		0.87(0.43–1.75)
	More than 2 hrs.	30(38.96)	47(61.04)		1.11(0.50–2.50)
Positive history of COVID-19	Yes	11(36.67)	19(63.33)	0.42	1.36(0.63–2.94)
	No	187(44.21)	236(58.79)		1
Family history of COVID-19	YES	37(30.58)	84(69.42)	0.001	2.13(1.37–3.32)
	No	161(48.49)	171 (51.51)		1
Family members dead	Yes	6 (16.67)	30 (83.33)	0.002	4.26 (1.73–10.46)
	No	192 (46.04)	225 (53.96)		1
Multivariate logistic regression					
Variables		**B**	**S.E**	**P-value**	**OR (CI95%)**
Family members dead	Yes	1.08	0.50	0.03	5.06(1.60–12.80)
	No				1
Shift-working	Yes	0.61	0.25	0.01	1.84(1.11–3.06)
	No				1
Profession	Medical	0.46	0.32	0.15	1.6(0.86–3.02)
	Service/support staff	−0.21	0.34	0.53	0.78(0.40–1.59)
	Para-medical	−0.64	0.33	0.04	0.52(0.27–092)
	Primary health care	−0.14	0.30	0.63	0.83(0.47–1.57)
	Administrative				1
Age categories	18–29	0.75	0.47	0.11	2.12(0.83–5.44)
	30–49	0.48	0.31	0.13	1.60(0.86–2.97)
	50≤				1
Educational attainment	Diploma or less	0.22	0.36	0.53	1.25(0.61–2.57)
	University	0.42	0.28	0.14	1.52(0.86–2.58)
	Postgraduate				1

Recently studies have been performed on the effects of COVID-19 on sleep quality in HCWs. In the majority of these studies, the effect has been reported either without comparison with sleep quality scores prior to the COVID-19 pandemic (Qiu et al. 2020; San Martin et al. 2020; Zhao et al. 2020) or the data collected retrospectively (Gao and Scullin 2020; Morin and Carrier 2020). In the current study, we were able to compare the sleep quality index in the same population over time using the same measures and tools. To our knowledge, no study has evaluated the sleep quality in this format.

In our study, the prevalence of PSQ among HCWs was high (more than 50%) even before COVID-outbreak which points to vulnerability of this group to sleep disturbance. Such a high prevalence of sleep disturbance in medical staff has been reported by previous studies (Kaneita and Ohida 2011; Qiu et al. 2020). For example, in a study conducted on HCWs in Iran, PSQ was observed in 65% of them (Khastar et al. 2020). Also Ghalichi L. et al. reported PSQ in 45% of the HCWs they surveyed (Ghalichi et al. 2013). According to a systematic review

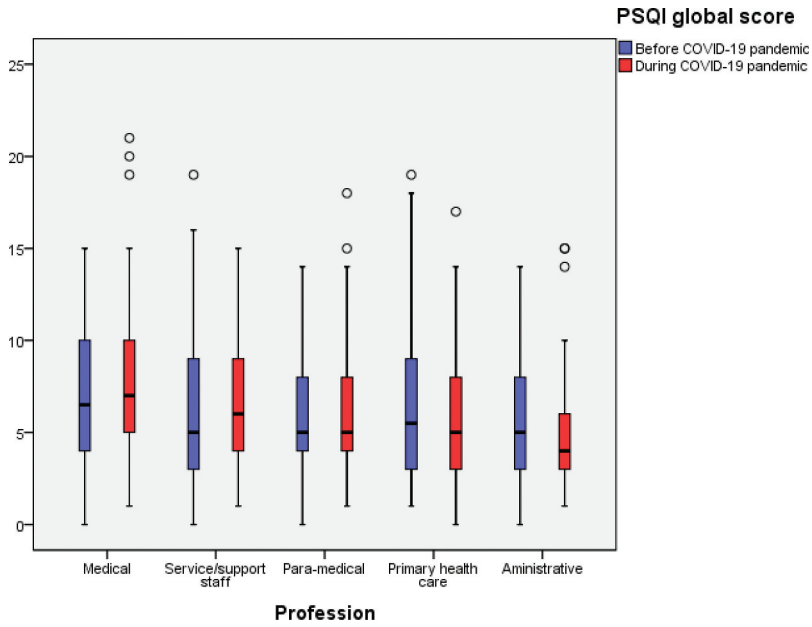

Figure 2. Box plots illustrating that measured PSQI global sleep quality score according to proffession before and during COVID-19 pandemic.

conducted in Iran with a sample size of 6,894 subjects, PSQ was reported in 64% of nurses (Sayehmiri and Mohammadi 2018).

In the present study, the worsening of sleep quality was found to be more predominant in shift workers as compared to non-shift workers. Consistence with our results in a study by Morin CM et al. assessment of acute effects of the COVID-19 epidemic on sleep quality showed more prominent worsening of sleep quality among HCWs and front-line medical workers (Morin and Carrier 2020). Also, the effect of COVID-19 epidemic on the sleep quality among hospital frontline medical workers was reported in Qi J. et al. study (Qi et al. 2020). Moreover, the attenuation of overall sleep quality index was found to be present in some of its components including sleep times and later bedtimes. The high prevalence of PSQ in HCWs, and considering that changes in normal circadian cycles among shift working staff could be regarded as one of the most important factor leading to PSQ (Ahmadian et al. 2018; San Martin et al. 2020). Exposure to high level of professional stress could be among other factors affecting the sleep quality in this group (d'Ettorre et al. 2018; Gao and Scullin 2020).

Our results showed having experience of COVID-19 infection/death in family member has strong association with deterioration of sleep quality. This is similar to the result of Santo FD' et al.'s study, although their population comprise of general population (Dal Santo et al. 2021). Interestingly an association between grief and shorter sleep duration and lower sleep quality was reported by Milic et al (Milic et al. 2019).

To the best of our knowledge, this is the first study to assess sleep quality in HCWs during COVID-19 outbreak based on a cohort study. In the current study, because of the available infrastructure (SHAHWAR cohort study) in which the complete medical and psychological information of Shahroud University of Medical Sciences' staff are collected, we were able to compare the sleep quality index in the same population over time using the same measures and tools. All these factors could contribute to lower bias in our study and strengthen its power. However, there are some limitations that need to be noted. First, the reported sleep qualities were subjective and we could not measure the objective components of sleep quality. Second, our study subjects were vulnerable to poor sleep quality because of their professions and thus these results cannot be extrapolated to the general population. Third, since the data of the present study are derived from a single-center survey, its generalizability will be cautious.

Also, due to variables such as socioeconomic status and development index in different places that affect the response to the pandemic, the ability to generalize the results in the group of health workers in each place, requires special attention. Understanding the relationship between health system preparedness and the pattern of COVID-19 epidemic spread in countries responding to pandemics, despite widespread inequalities in socioeconomic characteristics (such as housing and employment status) and other risk factors (age) and public health structure affected by the burden of chronic disease is very important (Rocha et al. 2021). Studies have shown that

reducing socioeconomic inequalities and strengthening the resilience of health systems are essential to better respond to global public health emergencies such as the COVID-19 epidemic (Zhu et al. 2021). In addition, it seems that a response rate about of 50% to the call to complete the PSQI is a potential source for respondent or selection bias. However, the results of sensitivity analysis on cohort data showed that participants who completed the questionnaire did not have statistically significant differences based on the prevalence of poor sleep quality and age, sex, and role characteristics of the nonrespondent group.

Conclusion

In conclusion, recognizing and treating PSQ during stressful times such as COVID-19 epidemic is especially important for HCWs. Our findings suggest that more attention should be paid to HCWs with a medical profession, who have caregiving responsibilities, those who have shift-working roles, and if they experienced COVID-19 infection/death in their families. Accessibility to medical resources for psychological aid to improve sleep hygiene during major disasters should be further strengthened. This comprehensive approach could reduce psychological distress and prevent further workplace dysfunctions.

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