Since January 2020 Elsevier has created a COVID-19 resource centre with free information in English and Mandarin on the novel coronavirus COVID-19. The COVID-19 resource centre is hosted on Elsevier Connect, the company's public news and information website.

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Original Article

Sleep characteristics in health workers exposed to the COVID-19 pandemic

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ABSTRACT

Introduction: The development of sleep disorders, and specifically insomnia, has been linked to the exposure to different stressors. In this line, Coronavirus disease 2019 (COVID-19) outbreak caused by the new coronavirus SARS-CoV-2, has caused a huge impact on our environment, and has exposed healthcare workers to an unprecedented threat. In this study, we try to assess sleep quality and the development of sleep disorders in health personnel directly dedicated to the care of COVID-19 patients at the height of the pandemic, compared to the general population.

Materials and methods: A cross-sectional, anonymized, self-reported questionnaire survey was carried out at the "12 de Octubre" Hospital, in Madrid, Spain, during the outbreak of COVID-19, from March 1st to April 30th 2020. We compared two groups, healthcare workers who have treated directly COVID-19 patients versus non-healthcare workers. The questionnaire included demographic data, sleep related aspects, Epworth Sleepiness Scale (ESS), Pittsburgh Sleep Quality Index (PSQI), Insomnia Severity Index (ISI) and 17-items Hamilton Rating Scale (HRS).

Results: In total 170 participants completed the questionnaire successfully, 100 healthcare workers and 70 non-healthcare workers. Self-reported insomnia, nightmares, sleepwalking, sleep terrors and PSQI>6 were more frequent in the healthcare group ($p < 0,05$). Shift work was associated to greater risk when performing multiple logistic regression analysis.

Conclusions: We observed that, during the outbreak of COVID-19, healthcare workers on the front line developed more sleep disturbances than non-healthcare professionals, and they had worse quality of sleep. Special attention should be paid to shift workers. Concrete protection and prevention measures for particularly exposed population should be considered in pandemic situations.

1. Introduction

The Coronavirus disease 2019 (COVID-19) outbreak caused by the new coronavirus SARS-CoV-2, has caused a huge impact on our environment, with consequences to be determined yet. This pandemic has caused great social struggle, testing the performance of different global health systems. Health workers have been placed under enormous care pressure and potential traumatic exposure, that might have consequences on their health. The development of sleep disorders, and specifically insomnia, has been linked to the exposure to different stressors. Wars, economic crises, public health risk situations, natural disasters, terrorist attacks and migrations, among others, have been associated with these health issues [1,2].

In this context, insomnia has been described as a neurobiological and physiological mechanism in response to stress [3]. It may appear in isolation or association with other signs and symptoms of a state of hyperarousal, which could be developed in response to exposure to traumatic events [4]. This response may be more

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intense and maladaptive in predisposed individuals [5], and has been described as one of the main physiological substrates of chronic insomnia [6]. Therefore, exposure to the COVID-19 pandemic in the workplace could act as a precipitating factor or generator of a *hyperarousal* state, which could lead to a higher incidence of insomnia and other sleep disorders, when comparing with the general population. Adaptive failure of these stress response mechanisms can lead to the development of chronic insomnia, as well as other sleep disorders impacting on health of individuals. Chronic insomnia has an impact at several levels, negatively affecting the perception of subjective quality of life, mental health, occupational and cognitive performance, among others [7]. In addition, insomnia has been linked to an increased risk of myocardial infarction, coronary heart disease, heart failure, high blood pressure, diabetes, and death, especially when accompanied by a decreased total sleep time [8].

In addition to insomnia, exposure to traumatic events has been linked to the development of other sleep disorders, including nightmares, "lucid" or "vivid" dreams or periodic leg movements [9]. These symptoms can occur in the absence of the entire clinical spectrum that constitutes post-traumatic stress disorder (PTSD), although they are characteristic of this entity and can act as a marker of its severity [3]. Therefore, it is advisable to recognize and detect them in the population exposed to a possible traumatic event.

As a result of these facts, exposure to a stressor as important as the COVID-19 pandemic, especially in a "frontline" population such as health workers, can lead to the inception of sleep disorders. This can precipitate the development of insomnia disorder, with significant health consequences. It is known that the health population directly involved in the care and treatment of COVID-19 patients are subjected to a greater emotional burden, related to excessive concern about possible contagion, social isolation, separation of their loved ones in order to avoid possible transmission of the virus, social stigma for their employment situation, change in their usual workplace, and constant need for protective measures in the workplace, among other factors [10]. This "exposed" situation would act as a differentiating factor against a global stressor, as it is the case of the COVID-19 pandemic, not affecting all population groups in the same way.

Although the onset of insomnia and other psychological disorders in health workers has previously been analyzed, both during the current SARS-CoV-2 pandemic, and in prior SARS outbreaks [11,12], the quality of sleep and the occurrence of sleep disorders during the COVID-19 pandemic have not been specifically analyzed to date in exposed health worker compared to non-sanitary population. The only exception is *Zhang* et al. study [13], which includes insomnia as one of the mental health parameters assessed.

This study tries to assess sleep quality and the appearance of sleep disorders in health personnel directly dedicated to the care of COVID-19 patients in a first-level hospital in the Community of Madrid, Spain, during the COVID-19 pandemic outbreak, compared to the general population.

2. Materials and Methods

2.1. Study design and participants

This study is a cross-sectional, anonymized, self-reported questionnaire survey, that is included in a one-year prospective cohort study, carried out at the "12 de Octubre" Hospital, in Madrid, Spain, during the outbreak of COVID19, from March 1st to April 30th 2020. During that period, the "12 de Octubre" Hospital was mainly dedicated to the treatment of COVID-19 patients, reaching a peak of more than 1000 COVID-19 inpatients in the hardest days of the outbreak.

Study participants were distributed into two groups, the first of them formed by health workers who have treated directly COVID-19 patients, while the second group corresponded to the general non-health workers population (control group). A stratified sampling technique with subsequent simple randomization in each group was used to obtain the sample. The recruitment of both groups was carried out through the direct dissemination of the survey, both in the hospital itself, and among friends, acquaintances, and relatives of the hospital staff, according to the inclusion and exclusion criteria.

The inclusion criteria were, for the case of the health workers group: (1) age between 18 and 65 years; (2) be an active healthcare worker (doctor, nurse, nursing assistant, porter or cleaning staff); (3) have treated or worked directly with patients affected by COVID-19 at least for 15 days in the month prior to the completion of the questionnaire; (4) have sufficient electronic equipment to respond to the test; (5) be able to read and understand the questionnaires. The exclusion criteria used in this group were: (1) not being able to give informed consent; (2) present a medical or mental illness that, in the opinion of the examiner, interferes with or prevents the performance of the tests and/or the rest of the anamnesis; and (3) not having access or availability for telephone contact. For the population group of non-health workers, the same inclusion and exclusion criteria were used except those relating to the employment situation. To be an active health worker or to have had direct contact with COVID19 patients were exclusion criteria.

The study was previously explained to all participants, informed consent was obtained prior to their inclusion and personal data was anonymized by assigning a questionnaire response number. The questionnaire was conducted directly by each participant through *Google Forms*, anonymously.

This study was conducted in accordance with the Declaration of Helsinki. Clinical research ethics committee of "12 de Octubre" Hospital approval was received before the initiation of the study. Participants could withdraw from the survey at any moment without providing any justification. Attention and treatment in a sleep disorders clinic were offered to all participants, if necessary.

2.2. Data collection

All participants were asked to answer the whole questionnaire anonymously on the internet, which included: demographic data, personal and family past medical history, sleep related aspects (insomnia, type of insomnia, days of insomnia per week, parasomnia and type of parasomnia). Additionally participants completed four standardized questionnaires, in their validated Spanish versions, which assessed their insomnia and severity of insomnia (Insomnia Severity Index, ISI) [14], sleep quality (Pittsburgh Sleep Quality Index, PSQI) [15], daytime sleepiness (Epworth Sleepiness Scale, ESS) [16], and anxiety, insomnia and depressive symptoms (17-items Hamilton Rating Scale, HRS) [17]. Detailed instructions were offered to all participants in order to ensure the quality of the survey and to complete properly the HRS.

The online survey was divided into five blocks and each block had to be completed before proceeding the next one, so valid participants were those who managed to complete all questions of the online survey. Duplicated, mistaken or incomplete questionnaires at any item were excluded from the analysis. Finally, a total of 170 subjects were included, 100 in the health workers group and 70 in the non-health workers.

2.3. Measures

2.3.1. Demographic information

Demographic data were self-reported by the participants, including age, gender, occupation (medical staff, nurses, nursing

assistant, porter, cleaning staff or no health workers), and change of usual residence. Working information included shift worker, guards, moving from the usual working place and time of dealing with COVID-19 patients. Past medical history was also collected, encompassing insomnia, sleep disorders, neurological and psychiatric diseases, drug use, abuse of drugs and cardiovascular risk factors. Past familiar medical history of sleep disorders was also compiled.

2.3.2. Insomnia and parasomnia symptoms

Both insomnia and/or parasomnia symptoms during the COVID-19 outbreak were asked in the questionnaire, concerning the months of March and April 2020. Insomnia was defined as inception of difficulties falling or staying asleep as long as desired, for at least one day per week. Participants with past medical history of insomnia where asked if their insomnia had worsened. As this is a cross-sectional two-month study, only short term insomnia definition was considered at this point. In order to increase the reliability of the questionnaire, once the participant answered "yes" to the insomnia question, he or she was told to specify whether it was sleep-onset, sleep-maintenance or waking up too early insomnia.

Parasomnia was shown in the questionnaire as presenting one of the following symptoms: 1) nightmares; 2) vivid dreams; 3) limb movement while asleep; 4) sleepwalking; 5) confusional arousal; 6) sleep paralysis; 7) other symptoms while asleep and detail of them. Responses were delimited as "yes" or "no", except for the last one, in order to simplify the answers.

2.3.3. Sleep and psychological test

Sleepiness was evaluated with the Epworth Sleepiness Scale (ESS), which is a self-administered questionnaire of 8 questions, each of them scoring from 0 to 3 points, with 24 being the maximum score. Commonly, scores of 11–24 are considered above the "normal" daytime sleepiness, so we assume it as suggestive of excessive daytime sleepiness.

Insomnia was assessed via the Insomnia Severity Index (ISI), a brief 7-item self-reported index evaluating the severity of initial, middle, and late insomnia. ISI total score higher than 8 indicates that insomnia is present. This test has also shown to be suitable for Web delivery [18].

The Pittsburgh Sleep Quality Index (PSQI), is a self-reported questionnaire that assesses sleep quality over a 1-month interval. The scale contains seven components (subjective sleep quality, sleep duration, sleep latency, habitual sleep efficiency, use of sleep medications, sleep disturbance, and daytime dysfunction), and the score for each component ranges from 0 to 3 points. The global PSQI score ranges from 0 to 21, with higher scores indicating more severe sleep disorder. We assume a score of 7 or higher as indicative of poor sleep quality. Trying to improve the accuracy of the questionnaire, a participant instruction text was included at the beginning of the test, indicating to answer specifically about the month of exposure to the COVID-19 patients, in case that happened.

Finally, for anxiety, depressive and insomnia symptoms the 17 item Hamilton Rating Scale (HRS) was used. This is a multiple choice survey rated by a clinician. Although is not a self-administered test, we choose this questionnaire due to its strength in evaluating sleep symptoms and its habitual use in clinical research. Previous instructions and direct assessing by the investigator were provided to complete the test. A score of 8 or above is considered as indicative of mild depression, and we assume 8 as a cutoff point indicative of the presence of mild depression symptoms.

2.4. Statistical analysis

Data analysis was performed using STATA (Statistics Data Analysis) software version IC 14.2. All hypotheses were tested at a significance level of 0.05. Descriptive analyses were conducted to describe the demographic characteristics of both groups and the presence of insomnia and/or self-perceptive sleep disorders. Continuous variables were presented as mean and standard deviation (SD), and categorical variables as total number (n) and percentage (%). χ [2] tests or the fisher exact test were used to compare group differences of categorical variables according to sample distribution. Continuous variables were compared using independent group *t*-test. Bonferroni correction was used to attempt to mitigate the effect of multiple comparisons.

Multivariable logistic regression analysis was performed to calculate Odds ratios (OR) and 95% confidence intervals (95% CI) to examine the association of sleep disturbance with socio-demographic, work-related and COVID-19 pandemic-related factors. Initially, univariate analysis was performed to explore potential risk factors. Subgroup analyses were performed for medical and non-medical health workers.

3. Results

A total of 170 out of 200 contacted individuals completed the questionnaire, with an overall participation rate of 85% and similar response rates in both groups, 83% in the healthcare group and 87% in the non-healthcare group.

3.1. Demographic characteristics

Demographic data of participants are shown in Table 1, distinguishing between health workers and non-health workers groups. Overall, 200 questionnaires were received, being only 170 of them adequate for analysis, due to incomplete, mistaken, or duplicate data. 100 health workers were finally enrolled in the study, compared to 70 non-health workers group.

Among the 100 health care workers, 41 (41%) were males and 59 (59%) females. Mean age in this group was 35.3 ± 9.2 years. A total of 58 (58%) were doctors, 26 (26%) nurses, 10 (10%) nursing assistant, 4 (4%) porters and 2 (2%) cleaning staff. 53 (53%) of the participants in this group were shift worker, 62 (62%) had guards, and another 53 (53%) had changed from the usual workplace. Past medical history of insomnia was present in 10 cases (10%), other sleep disorders and neurological diseases in 8 (8%) and 4 (4%) of them, respectively. Only 9 (9%) take drugs regularly for their diseases, and 22 (22%) consume alcohol or tobacco. 8 of them (8%) had moved from their habitual residence and overall, 24 (24%) had past familiar medical history of sleep disorders. Mean time of exposition to COVID-19 patients was 33,1 ± 15.6 days.

Regarding the non-health workers group (n = 70), mean age was 37.9 ± 9.2 years, 29 (41,4%) were males and 41 (58,6%) females. Only 18 were shift workers (25,7%), 1 of them reported guard (1,4%), and 18 (25,7%) had changed their usual workplace. In this group, 4 participants (5,7%) reported past medical history of insomnia, 1 (1,4%) other sleep disorders, 3 (4,2%) neurological diseases and 1 (1,4%) psychiatric disease. 14 individuals (20%) take drugs for their medical diseases, and 13 (18,6%) consume tobacco or alcohol. 6 (8,6%) had moved from their residence during the COVID-19 outbreak, and 13 (18,6%) reported past medical family history of sleep disorders.

No differences between both groups were observed in the prevalence of cardiovascular risk factors.

Table 1
Demographic characteristics of participants. COVID-19, coronavirus disease 2019.

Characteristics	All participants (N = 170)		Healthcare workers (N = 100)		Non-healthcare workers (N = 70)		P-value
	n	%	n	%	n	%	
Age (years)	x̄ = 36,4 ± 9,3		x̄ = 35.3 ± 9.2		x̄ = 37.9 ± 9.2		0,0741
Gender							
Male	70	41,18%	41	41%	29	41,43%	
Female	100	58,82%	59	59%	41	58,57%	0,955
Workplace type							
Medical doctor	58	34,11%	58	58%	0	0%	
Nurse	26	15,29%	26	26%	0	0%	
Nursing assistant	10	5,88%	10	10%	0	0%	
Porter	4	2,35%	4	4%	0	0%	
Cleaning staff	2	1,17%	2	2%	0	0%	
Non-healthcare worker	70	41,17%	0	0%	70	100%	
Shiftworker	71	41,76%	53	53%	18	25,71%	p < 0,001
Guards	63	37,06%	62	62%	1	1,43%	p < 0,001
Moving from usual residence	14	8,24%	8	8%	6	8,57%	0,894
Past medical history							
Insomnia	14	8,24%	10	10%	4	5,71%	0,317
Other sleep disturbances	9	5,29%	8	8%	1	1,43%	0,06
Neurological diseases	7	4,11%	4	4%	3	4,29%	0,926
Psychiatric diseases	1	0,59%	0	0%	1	1,43%	0,231
HTA	2	1,18%	1	1%	1	1,43%	1
Diabetes	0		0		0		
Dyslipemia	3	1,76%	1	1%	2	2,86%	0,569
Past familiar medical history of sleep disorders	37	21,76%	24	24%	13	18,57%	0,399
Toxic consumption	35	20,59%	22	22%	13	18,57%	0,586
Medicines	23	13,53%	9	9%	14	20%	0,039
Time of exposition to COVID19 patients (days)			x̄ = 33.1 ± 15,69				

3.2. Insomnia and parasomnia self-reported symptoms

Data regarding insomnia and parasomnia characteristics are summarized in Table 2. In the health workers group (n = 100), a total number of 57 (57%) manifested new onset or worsening of insomnia during the attention to COVID-19 patients, as opposed to 24 (34,2%) in the non-health workers group (p = 0,004). Mean frequency of insomnia was 3,9 ± 1,7 days per week in the health workers group with insomnia, and 3,1 ± 1,7 days per week in the non-health workers cohort (p = 0,045). In terms of insomnia type, among the healthcare workers 29 (29%) had sleep-onset insomnia, 24 (24%) sleep-maintenance and 30 (30%) waking up too early insomnia, versus 16 (22,9%), 9 (12,9%) and 8 (11,4%) respectively in the non-health workers group. When comparing type of insomnia between both groups, only waking up too early subtype showed statistical significance (p = 0.004).

Parasomnias were reported in 58 (58%) of the participants in the health workers group, in opposition to 31 (44,3%) in the non-health workers group, not reaching statistical significance in this case (p = 0,078), but showing a clear trend in this direction. Nonetheless, analyzing each symptom individually, 19 participants in the health workers group showed symptoms of sleepwalking (19%) versus none in the non-health workers group (p < 0,001) and 38 (38%) versus 15 (21,4%) reported nightmares (p = 0,02). Moreover, 6 individuals in the health workers group (6%) reported symptoms of sleep terrors, meanwhile no reports were collected in the non-health workers group (p = 0,043).

Univariable analysis showed that two variables were associated with insomnia among medical workers: age above or equal to 35 (OR, 2,56, 95% CI, 1.13–5,81; p = 0.024), and shift worker (OR, 3,73, 95% CI, 1,62–8,60; p = 0,002). Multivariable logistic regression analysis using these parameters (Table 4), showed that only shift worker was independently associated with insomnia symptoms

Table 2
Sleep disturbances in healthcare workers versus non-healthcare workers.

	Total	Health workers	Non-health workers	p value
Insomnia % (n)	47,65 (81)	57 (57)	34,29 (24)	0,004*
Type of insomnia				
Sleep onset	26,47 (45)	29 (29)	22,86 (16)	0,372
Sleep maintenance	19,41 (33)	24 (24)	12,86 (9)	0,071
Waking up too early	22,35 (38)	30 (30)	11,43 (8)	0,004*
Frequency (x̄±SD)	x̄ = 3,70 ± 1,69	x̄ = 3,94 ± 1,65	x̄ = 3,12 ± 1,67	0,045*
Parasomnias % (n)	52,35 (89)	58 (58)	44,29 (31)	0.078
Type of symptoms				
Sleepwalking	21,35 (19)	19 (19)	0 (0)	<0,001*
Sleep terrors	3,53 (6)	6 (6)	0 (0)	0,043*
Sleep paralysis	1,76 (3)	3 (3)	0 (0)	0,269
Limb movement while asleep	6,47 (11)	5 (5)	8,57 (6)	0,363
Nightmares	31,18 (53)	38 (38)	21,43 (15)	0,022*
Vivid dreams	19,41 (33)	23 (23)	14,29 (10)	0,157
Confusional arousal	4,71 (8)	5 (5)	4,29 (3)	1
Other symptoms	1,18 (2)	2 (2)	0 (0)	0,513

(OR 3,48, 95% CI: 1,48–8,16, p = 0,004). Regarding parasomnias in this group, being a shift worker is also associated with higher frequency of reporting sleep related symptoms (OR, 2,40, 95% CI, 1,06–5,42; p = 0,034). In the non-health workers group (Table 5), being a woman was both associated with insomnia (OR 4,14, CI 95%, 1,32–12,99; p = 0,015) and parasomnia (OR 5,98, CI 95%, 2,00–17,92; p = 0,001).

3.3. Sleep and psychological tests

Results of tests are summarized in Table 3. Regarding PSQI, health workers scores were higher when compared with the control group, with a mean of 8,78 ± 4,5 (a score of 7 or above is considered indicative of poor sleep quality), versus a mean of 6,2 ± 3,6 in the non-health workers group (p < 0,001). Globally, 64 (64%) health workers participants scored 7 or higher in the PSQI test, against 31 (44,29%) in the non-health workers group (p = 0,001). Health workers also scored higher in the ISI when comparing with the non-health workers, with a mean of 7,8 ± 5,3 versus 6,3 ± 4,3 (p = 0,05), with a total of 44 (44%) participants having a score higher than 8 when compared with the 22 (31,4%) in the non-health workers group (p = 0,098).

No statistical significant differences were observed in the mean of the ESS and HRS tests between both groups, with a mean of 6,2 ± 3,1 in the non-health workers versus 5,7 ± 3,1 in the health-workers in the ESS (p = 0,36); and 7,6 ± 5,4 in the health workers versus 6 ± 5,1 in non-health workers in the HRS (p = 0,06). However, there is a tendency to obtain higher scores in the HRS observed in the health workers as a group. The number of participants that had a score of 8 or more in the HRS, 45 were found in the health workers group versus 24 in the non-health workers, without statistical significance (p = 0,161). Checking the results in the ESS test, only 6 participants scored 11 or higher in the health workers group and 4 in the non-health group (p = 0,93).

When performing univariable analysis in each test, being nurse, shift worker and having guards, in the healthcare workers group, were variables associated with higher scores (above 8) in the ISI questionnaire. When applying multivariable logistic regression analysis (Table 4), only shift worker appeared to be associated with poorer outcomes in the ISI test (OR: 3,81, 95% IC, 1,36–10,62; p = 0,011). Among non-healthcare group (Table 5), only female sex is associated with scores above 8 in the ISI questionnaire, in the line of what it is observed when reporting self-perceptive symptoms of insomnia. Regarding the PSQI test, only the healthcare group having guards and shift worker were associated to scores of 7 or above. When applying the multivariable logistic regression analysis only shift workers were associated with poorer sleep quality (OR: 3,01, 95% IC, 1,21–7,48, p = 0,018) (Table 4).

In both ESS and HRS test, only shift worker was independently associated with worse results in the HRS among the healthcare group (OR: 2,34, 95% IC: 1,04–5,26; p = 0,03) (Table 4). In the non-healthcare group, moving from the habitual residence and age below 35 years old were associated with worse scores in the HRS, but these results were not observed when applying multivariable logistic regression analysis (Table 5).

4. Discussion

In this study, healthcare workers directly involved in the treatment or attention to COVID-19 patients during the COVID-19 pandemic showed a higher incidence of insomnia self-reported symptoms, when compared to non-healthcare workers. A greater impact of insomnia, in terms of days affected per week, in this group of workers (3,9 days versus 3,1) was also found. Although a high incidence of insomnia has been seen in the control group (34,2%, with an ISI>8 of 31,4%and a mean value of 6,3), similar to other results found in the general population during de COVID-19 outbreak [19], higher scores were shown in the frontline healthcare workers (57% reporting difficulties initiating o maintaining sleep, with an ISI>8 of 44% and a mean value of 7,8). These results are not unexpected, as other studies have shown high prevalence of mental health symptoms among healthcare workers who attended patients with COVID-19, including insomnia [20]. However, in this study, a direct and isolated impact of the working environment in sleep could explain the differential impact found between the two groups, as no differences were observed in terms of anxiety and depressive symptoms or other demographic characteristics. This hypothesis is also sustained by the results obtained in the PSQI, which showed higher scores and poorer sleep quality among healthcare workers. In this group, being a shift worker is related to a greater impact of insomnia, which is also in the line of previous reports regarding the epidemiological characteristics of insomnia align with the general population [21,22].

Nurses and shift workers tend to score worse in the ISI among healthcare workers. This could represent a higher amount of stress and exposition to the patient in this subgroup (nurses), as they are closer, more frequent and longer in contact with infected patients, as outlined in previous reports [23]. Also, it is interesting that waking up too early was significantly more reported in the healthcare workers group, which could be related to an anticipatory reaction before going to the workplace.

Concerning parasomnias, both groups reported a high incidence of symptoms associated with nocturnal sleep, which is expected when a stressful event hits a large part of the population [1–3], as in the COVID-19 pandemic. However self-reported symptoms compatible with sleepwalking, sleep terrors and nightmares, were much more frequent in the frontline health workers group. Nightmares are one of the most common sleep disturbances sawn following trauma. When they become chronic it may reflect the maladaptation of a stress response mechanism, as it happens with chronic insomnia [24]. Moreover, nightmares early after trauma

Table 3
Sleep and psychological test in healthcare workers versus non-healthcare workers.

	Total	Health workers	Non-health workers	p value
Insomnia Severity Index (ISI) total score (mean ± SD)	$\bar{x}$ = 7,21 ± 4,94	$\bar{x}$ = 7,83 ± 5,29	$\bar{x}$ = 6,32 ± 4,28	0,05
Insomnia Severity Index (ISI) > 8%(n)	38,82 (66)	44 (44)	31,34 (22)	0,09
Pittsburgh Sleep Quality Index (PSQI) total score	$\bar{x}$ = 7,73 ± 4,32	$\bar{x}$ = 8,78 ± 4,51	$\bar{x}$ = 6,24 ± 3,58	<0,001*
Pittsburgh Sleep Quality Index (PSQI) > 6%(n)	55,88 (95)	64 (64)	44,29 (31)	0,01*
Epworth Sleepiness Scale (ESS) total score	$\bar{x}$ = 5,91 ± 3,13	$\bar{x}$ = 5,73 ± 3,16	$\bar{x}$ = 6,17 ± 3,11	0,36
Epworth Sleepiness Scale (ESS) > 10%(n)	5,88 (10)	6 (6)	5,71 (4)	1
17 item Hamilton Rating Scale (HRS) total score	$\bar{x}$ = 6,92 ± 5,37	$\bar{x}$ = 7,56 ± 5,45	$\bar{x}$ = 6,02 ± 5,17	0,06
17 item Hamilton Rating Scale (HRS) > 7%(n)	40,59 (69)	45 (45)	34,29 (24)	0,16

*p < 0,005.
Mean ± SD, mean and standard deviation.

Table 4
Risk Factors for insomnia, parasomnia and poorer sleep quality in healthcare population identified by Multivariable Logistic Regression Analysis[a].

Variable	Insomnia	p value	Parasomnia	p value	ISI>8	p value	PSQI>6	p value	HRS>7	p value
	OR (95% CI)		OR (95% CI)		OR (95% CI)		OR (95% CI)		OR (95% CI)	
Shift worker[b]	3,48 (1,48–8,16)	0,004	2,40 (1,06–5,42)	0,034	3,81 (1,36–10,62)	0,011	3,01 (1,21–7,48)	0,018	2,34 (1,04–5,26)	0,037
Guards					0,49 (0,155–1,58)	0,237	0,59 (0,22–1,56)	0,29		
Workplace type:										
Nurse					0,90 (0.23–3,45)	0,889				
Age:										
>35	2,32 (0,98–5,46)	0,054								

[a] Using statistically significant variables after univariate analysis.
[b] Possible risk factor.
95% CI, 95% confidence interval; OR, odds ratio.

Table 5
Statistically significant variables after univariate analysis in the non-health workers group.

Variable	Insomnia	p value	Parasomnia	p value	ISI>8	p value	HRS>7[a]	p value
	OR (95% CI)		OR (95% CI)		OR (95% CI)		OR (95% CI)	
Sex:								
Female	4,14 (1,32–12,99)	0,015	5,98 (2,00–17,92)	0,001	3,4 (1,08–10,69)	0,036		
Moving from habitual residence							11,84 (1,29 108,27)	0,009
Age								
<35							0,29 (0,10–0,84)	0,02

95% CI, 95% confidence interval; OR, odds ratio.
[a] No differences when applying multivariable logistic regression analysis.

exposure may be an attempt to assimilate the traumatic event into the individual's experiences., Therefore, chronic nightmares may indicate a failure of this process [25]. These results, all together with insomnia and the PSQI questionnaire scores, exhibit a deeper impact of COVID-19 pandemic in the sleep of healthcare workers. Despite affecting the entire population, pandemics would not affect equally all population groups, in terms of sleep quality, as shown by the high rates of insomnia, parasomnia and poor sleep quality observed in the control group.

In this study, sleep and psychological test applied showed a great burden of sleep difficulties in both groups. Notably, PSQI showed worse sleep quality among healthcare workers when compared with the control group. This was not companioned by statistical significative differences in anxiety or depressive symptoms while measuring them in the HRS. Up to 64% of health workers on the front line that answered the test had scores above 6, which is indicative of poor sleep quality. The average of all the scores in this group was 8,8, being statistically significant with respect to non-healthcare workers and despite the fact that high test scores were also observed in this group. Shift workers were also associated with higher scores on this questionnaire. These results are aligned with other studies that postulate that transient sleep disturbances following trauma exposure may be adaptive for survival [9]. In addition, some experimental studies in humans found that sleep deprivation led to a reduction in PTSD-like symptoms, so sleep loss immediately following trauma exposure may be beneficial, although this point is still hypothetical [9].

Potential reasons for these differences observed in both groups could be the special working conditions in which healthcare professionals had been working during COVID-19 pandemic, specifically including: the uncertainty surrounding this new virus, lack of adequate protection material and training, the long-term workload, risk of contagion and endangering family members or housing partners, confronting dramatic situations such as the death of many patients in isolation and lack of physical and psychological rest in an information overload society [13]. In consequence, health authorities and public health bodies should take account the results observed in this and other studies, in other to implement protection and prevention measures for health workers facing situations of extraordinary risk to public health. Moreover, another study has observed that harmful psychological effects of infectious disease outbreaks may last for a long time after the end of the exposure among healthcare workers [26].

The study has several limitations, first of all, it is a cross-sectional study, so it is difficult to make causal inferences, although it is expected to conduct a prospective study of both cohorts for one year, which may help to mitigate this effect. Secondly, assessment of clinical aspects was based on an online survey and self-reported tools, in order to avoid possible infections. Thirdly, psychological evaluation was made through HRS, which is not designed to be self-administered, so it had to be adapted through prior instructions and telephone interviews with participants, which may interfere with the final results of the test. In fact, it is always desirable to carry out face to face evaluations, although it has not been possible to do so due to the special circumstances of this pandemic.

In conclusion, we identified: poorer sleep quality, higher incidence of self-reported insomnia and sleep associated symptoms consistent with nightmares, sleepwalking and sleep terrors, in frontline health care workers that have been dealing directly with COVID-19 patients. These results suggest that this specific population have been subjected to a great amount of stress related to large exposure to a new pandemic disease with unknown consequences, directly impacting on their sleep. Health authorities should take this study into account in order to provide special protection measures for particularly exposed population groups in extraordinaire situations such viral pandemic, as healthcare workers who work in the front line.

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Conflict of interest

The authors declare that they have no conflicts of interests.

The ICMJE Uniform Disclosure Form for Potential Conflicts of Interest associated with this article can be viewed by clicking on the following link: https://doi.org/10.1016/j.sleep.2020.08.013.

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