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Sleep, anxiety and depression and physical activity in healthcare professionals during COVID-19 pandemic

Sono, ansiedade e depressão e atividade física em profissionais de saúde durante a pandemia de COVID-19

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ABSTRACT
To verify associations between sleep parameters, anxiety and depression symptoms and physical activity level in healthcare professionals during COVID-19 pandemic. We evaluated sleep quality (SQ), excessive daytime sleepiness (EDS), anxiety and depression symptoms and physical activity level (PAL**)** in healthcare professionals who worked during COVID-19 pandemic in Recife-Brazil. Correlations were observed between SQ and anxiety ($p < 0.001$) and depression ($p < 0.001$), as well between EDS and anxiety: $p < 0.05$) and depression ($p < 0$ .05). No correlations were found between PAL and sleep parameters (QS: $p > 0.05$) (EDS: $p > 0.05$). No association was observed between SQ and anxiety ($p = 0.005$) and depression ($p = 0.014$). No association was found between EDS and anxiety and depression symptoms. In healthcare professionals during COVID-19 pandemic, anxiety and depression symptoms are predictors of sleep quality. No association was found between anxiety and depression symptoms and EDS.

Keywords: Sleep. Anxiety. Depression. Activity, Physical. COVID-19.

RESUMO
Verificar associações entre parâmetros do sono, sintomas de ansiedade e depressão e nível de atividade física (NAF) em profissionais de saúde da linha de frente COVID-19. Foram avaliados qualidade do sono (QS), sonolência diurna excessiva (SDE), sintomas de ansiedade e depressão e NAF. Houve correlações entre QS e ansiedade ($p < 0,001$) e depressão ($p < 0,001$) e entre SDE e ansiedade ($p < 0,05$) e depressão ($p < 0,05$). Não houve correlações entre o NAF e QS ($p > 0,05$) e SDE ($p > 0,05$). Houve associação entre QS e sintomas de ansiedade ($p= 0,005$) e depressão (0,014). Não houve associação entre a SDE e sintomas de ansiedade e depressão. Em profissionais de saúde na linha de frente durante a pandemia de COVID-19, os sintomas de ansiedade e depressão foram preditores da QS. Não foi observada associação entre SDE e sintomas de ansiedade e depressão.

Palavras-chave: Sono. Ansiedade. Depressão. Atividade Física. COVID-19.

INTRODUCTION

The World Health Organization (WHO) recently confirmed the COVID-19 pandemic caused by a new human coronavirus (SARS-COV-2)[1]. Outbreaks of infectious diseases, whether endemic or pandemic, are often associated with an increase in psychological stress and mental health degradation. Health professionals are more exposed to this reality, presenting symptoms such as anxiety, depression and sleep disorders[2]. Working on-call or on shifts, especially for night workers, causes insomnia, drowsiness and excessive daytime fatigue, shorter duration and poorer sleep quality caused by dysregulation of the circadian rhythm and the sleep/wake cycle[3].

The reduction in sleep duration is related to the emergence of anxiety and depression symptoms[4,5]. Several potential mechanisms resulting from sleep fragmentation can increase the risk or perpetuation of these mood disorders, including modifications in monoaminergic, glutamatergic and orexinergic neurotransmission, abnormalities in the hypothalamic-pituitary-adrenal axis involved in stress and chronic inflammation, alteration in the release of factors brain-derived neurotrophics, cerebral neuroplasticity dysfunctions and circadian system dysregulation[6–8].

Thus, isolation and social distancing measures were taken to delay the spread of contagion and prevent the collapse of health systems. However, these criteria have impacts on the general health of the population due to restrictions on physical activities in parks, squares, tracks, gyms and closed sports centers, walking distance restrictions, and the lack of space and infrastructure of housing to carry out physical exercise [9]. While some people may have sufficient autonomous regulation of physical activity level when engaging in alternative activities, others may become less active due to a lack of available social support or concerns such as contracting the virus outdoors, aggravating mood disorders and sleep disorders[10]. On the other hand, it is known that physical activity level is significantly associated with regulating these physiological indicators, which can reduce the prevalence of symptoms of mood disorders, and improve mental health[11].

In this context, these mechanisms compose a mutually dependent relationship between sleep, mood and anxiety disorders and physical activity level, requiring more data to characterize how the COVID-19 pandemic is affecting behaviors related to healthy lifestyle habits. Thus, the objective of this study was to verify associations between sleep quality, excessive daytime sleepiness, anxiety and depression symptoms and the physical activity level in health professionals who are working at the frontline of COVID-19.

METHOD

This is a cross-sectional study conducted from October 2020 to July 2021, carried out in a virtual environment using an online form (Google Forms Platform). Health professionals (doctors, physiotherapists, nurses and nursing technicians/assistants), without sex/gender or age restrictions, who worked in the healthcare of patients with COVID-19 in hospitals (whether from the public and/or private health network) in the metropolitan region of Recife, PE, Brazil were included in the study. Individuals who were not directly involved in providing care for these patients were excluded, such as professionals from sectors that did not receive patients with COVID-19, as well as professionals who were away from their activities for more than 30 days at the time of the study.

The study was conducted following ethical standards in research involving human subjects and in accordance with the Helsinki Declaration. Ethical authorization was obtained from the Human Research Ethics Committee of the Federal University of Pernambuco (UFPE) (Nº. 4,289,462). All study participants read, understood and signed the informed consent form virtually. The researchers respected the privacy and confidentiality of study participants. The data was kept and used for scientific purposes only. Participants were informed that they had the right to withdraw from the study at any time.

Study participants were recruited through disseminating the study in digital media, as well as by indication by the research participants themselves. They were instructed to access a link that directed them to the Google Forms platform, which had information about the study and its objectives, followed by providing a digital signature for the Free and Informed Consent form (FICF) in case of acceptance. The participants initially answered questions consisting of personal, sociodemographic and professional information related to their professional activity, then they were clarified and guided through validated questionnaires related to excessive daytime sleepiness, sleep quality, anxiety and depression symptoms and physical activity level. The sample calculation was performed based on the formula developed by Tabachnick & Fidell (2001)[12] for performing regression analysis. The formula is: $n > 50 + 8m$, where "n" is equal to the number of independent variables which were three in this study (anxiety, depression and physical activity level). Thus, the calculation resulted in a minimum sample size of 74 individuals.

The Pittsburgh Sleep Quality Index (PSQI), a translated, adapted and validated questionnaire for the Brazilian population was used[13], which assesses the sleep quality for the

month prior to the assessment time. It is composed of four subjective questions and 15 self-administered objective questions divided into seven domains: subjective sleep quality, sleep duration, sleep latency, sleep disorders, sleep efficiency, daytime dysfunction and the use of sleep medications. The total score ranges from 0 to 21, stratified by sleep quality into good (<5) and poor (≥5).

The Epworth Sleepiness Scale (ESS) was used to evaluate excessive day time sleepiness, translated, adapted and validated for the Brazilian population[14], which is a self-administered questionnaire which assesses the probability of falling asleep in eight situations involving activities of daily living, with the test score ranging from 0 to 24. The score for each item ranges from 0 to 3, in which: 0 = no chance of napping, 1 = small chance, 2 = moderate chance, and 3 = high chance. Scores above 10 suggest an excessive daytime sleepiness diagnosis.

The Beck Anxiety Inventory (BAI) was used to evaluate anxiety symptoms, which consists of a questionnaire that assesses the presence of characteristic anxiety symptoms, translated and validated for Portuguese[15,16], categorized as: no anxiety (score 0-10), mild anxiety (11-19), moderate anxiety (20-30), and severe anxiety (31-63).

The Beck Depression Inventory (BDI), a questionnaire translated and validated for Portuguese[17] was used to assess the presence of symptoms characteristic of depression, categorized as: not depressed (score 0-3), mild (4-7), moderate (8-15), and severe (≥16).

PHYSICAL ACTIVITY LEVEL

The International Physical Activity Questionnaire (IPAQ) was used to assesses physical activity level, translated, adapted and validated for the Brazilian population[18], which evaluates the physical activity level performed weekly. It is composed of four subjective questions, each with two questions, which investigate the frequency, duration and intensity of physical activities performed. The results are expressed categorically (physically inactive, moderately active, and highly active) or continuously (MET-minute/week). The spreadsheet to automatically calculate the IPAQ was also used to interpret the results, available on the official website of the initiative (https://sites.google.com/site/theipaq/).

Data were analyzed using the Statistical Package for Social Sciences (SPSS) version 20.0 software program using descriptive and inferential statistical techniques. A significance level of 95% ($p<0.05$) was assigned for statistical analysis of the results. Data normality was

verified using the Kolmogorov-Smirnov test. Continuous data were expressed as mean and standard deviation. Categorical variables were expressed as number of cases and frequency. Bivariate correlation analyzes between sleep symptoms, mood disorders and physical activity level were performed using the Pearson or Spearman correlation tests, according to the normality distribution of the data. Sleep quality and daytime sleepiness according to different physical activity, anxiety and depression levels were compared using the One-way ANOVA and Posthoc Bonferroni tests. Multiple linear regression analyzes were performed between sleep quality, excessive daytime sleepiness and the independent variables that showed significant correlations.

RESULTS

Figure 1 shows the flowchart A total of 96 health professionals completed the study.

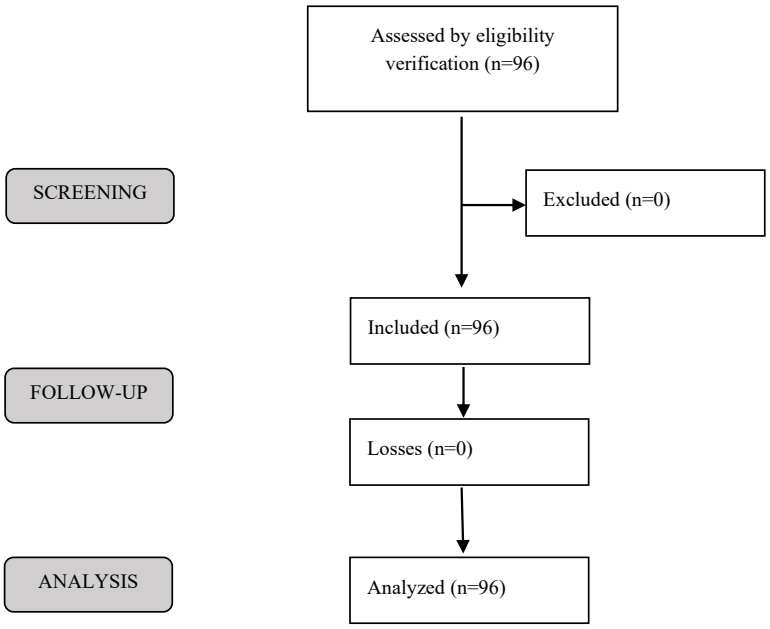

Figure 1. Patient recruitment and allocation flow chart.

Table 1 shows the sociodemographic distribution, anthropometric data and data related to professional activity, as well as the COVID-19 infection rate and its respective diagnosis forms, and the participants' physical activity level. Most of the sample consisted of physiotherapists and nursing technicians/assistants, totaling 68.8%. Professionals who worked exclusively in hospitals in the public health system comprised the majority of the sample

(56.3%). The shift work regime (12-hour on-call) was frequent in 85.4% of the professionals, with 68.3% working at night. The average weekly workload observed among the participants was 55.03 hours, with 68 (70%) of the individuals exceeding 44 hours per week. A high COVID-19 infection rate was observed among the participants (38.5%), with 2.1% of them requiring hospitalization due to the disease.

Table 1. Sample characteristics

Variables	n = 96
Age (years)	31.86 ± 7.65
Gender	
Masculino (n/%)	18 (18.8)
Female (n/%)	78 (81.3)
Weight (kg)	69.72 ± 15.36
Height (m)	1.64 ± 0.09
BMI (kg/m²)	25.66 ± 4.83
Physical activity level (IPAQ)	
Physically inactive (n/%)	26 (27.1)
Moderately active (n/%)	26 (27.1)
Highly active (n/%)	44 (45.8)
Profession	
Doctor (n/%)	12 (12.5)
Physiotherapist (n/%)	43 (44.8)
Nurse (n/%)	18 (18.8)
Nursing technician/assistant (n/%)	23 (24)
Health service	
Private (n/%)	8 (8.3)
Public (n/%)	54 (56.3)
Mixed (Public and private in the same service) (n/%)	13 (13.5)
Both (Public and private and different services) (n/%)	21 (21.9)
Work regime	
Daily (4, 6 or 8 hours a day) (n/%)	14 (14.6)
Shift work (12 hours) (n/%)	61 (63.5)
Both (n/%)	21 (21.9)
Work shift	
Day (n/%)	3 (31.3)
Night (n/%)	8 (8.3)
Both (n/%)	58 (60.4)
Weekly workload (hours)	55.03 ± 19.58
Comorbidities (yes) (n/%)	13 (13.5)
Asthma (n/%)	5 (5.2)
Diabetes Mellitus (n/%)	2 (2.1)
SAH (n/%)	6 (6.3)
COVID-19 positive (n/%)	37 (38.5)
Need for hospitalization (n/%)	2 (2.1)

Formo f diagnosis	
RT-PCR (n/%)	25 (26)
Serology	
Laboratory (n/%)	8 (8.3)
Pharmacy/Rapid testing (n/%)	4 (4.2)

Data presented in absolute numbers (percentage) and mean ± standard deviation

Table 2 shows the prevalence of poor sleep quality and the presence of excessive daytime sleepiness observed in 86.5% and 42.7% of the volunteers, respectively.

Table 2. Sleep parameters in healthcare professionals on the COVID-19 frontline

Variable	**(*n* = 96)**
PSQI subjective sleep quality (C1)	1.60 ± 0.78
PSQI sleep latency (C2)	1.54 ± 1.07
PSQI sleep duration (C3)	1.69 ± 0.91
PSQI habitual sleep efficiency (C4)	0.70 ± 0.98
PSQI sleep disorders (C5)	1.33 ± 0.66
PSQI use of sleep-promoting medications (C6)	0.54 ± 0.98
PSQI daytime dysfunction (C7)	1.47 ± 0.79
PSQI Total score	8.88 ± 3.94
Poor sleep quality: PSQI (≥5 points)	83 (86.5%)
Good sleep quality: PSQI (<5 points)	13 (13.5%)
Excessive daytime sleepiness (ESS score)	9.11 ± 3.65
Excessive daytime sleepiness: (ESS > 10)	41 (42.7%)
Absence of excessive daytime sleepiness: (ESS < 10)	55 (57.3%)

PSQI = Pittsburgh Sleep Quailty Index; ESS = Epworth Sleepiness Scale. Values presented as mean ± standard deviation and absolute numbers (percentage).

Table 3 presents the score for anxiety and depression symptoms among the participants. Approximately half (51%) of the subjects had some depression symptom, while 42.8% had some anxiety symptom.

Table 3. Characteristic depression and anxiety symptoms in healthcare professionals on the frontlines of COVID-19

Variable	**(*n* = 96)**
Total BDI score	10.76 ± 7.39
Not depressed	47 (49%)
Mild depression	35 (36.5%)
Moderate depression	13 (13.5%)
Severe depression	1 (1%)

Variable	(*n* = 96)
Total BAI score	11.55 ± 9.48
No anxiety	55 (57.3%)
Mild anxiety	23 (24%)
Moderate anxiety	14 (14.6%)
Severe anxiety	4 (4.2%)

BDI = Beck Depression Inventory; BAI = Beck Anxiety Inventory. Values presented as mean ± standard deviation and absolute numbers (percentage).

The comparison of sleep quality and excessive daytime sleepiness between groups with different physical activity levels, and anxiety and depression symptoms is shown in table 4. The group with no anxiety symptoms had better sleep quality when compared to the groups with mild (p = 0.006), moderate (p = 0.000) and severe (p = 0.001) symptoms. For depression symptoms, the group with no symptoms had better sleep quality when compared to the groups with mild (p = 0.044) and moderate (p = 0.000) symptoms. Individuals with moderate depression symptoms also had a worse sleep quality when compared to individuals with mild symptoms (p = 0.006). The presence of severe depression symptoms was only evident in one case, and it was not possible to include it in the post-hoc analysis. No differences were observed regarding excessive daytime sleepiness when comparing groups with different anxiety and depression symptom levels.

No differences were found in sleep quality and excessive daytime sleepiness between groups with different physical activity levels.

Table 4. Sleep quality and daytime sleepiness according to different physical activity, anxiety and depression levels

	PSQI	*p-value	Post-Hoc	ESS	*p-value
IPAQ					
Insufficiently active (n=26)	8.27 ± 3.45			9.46 ± 3.95	
Moderately active (n=26)	8.77 ± 3.39	0.572		9.12 ± 3.51	0.832
Highly active (n=44)	9.30 ± 4.50			8.91 ± 3.61	
BAI					
Absent (n=55)	7.13 ± 3.43			8.55 ± 3.67	
Mild (n=23)	9.87 ± 3.15	< 0.001*	0.006#	9.70 ± 3.75	0.201
Moderate (n=14)	12.64 ± 2.73		0.000#	9.57 ± 3.0	
Severe (n=4)	14.0 ± 3.16		0.001#	12.0 ± 3.91	
BDI					
Absent (n=47)	7.36 ± 3.61	< 0.001*	0.044#	8.28 ± 3.72	0.069
Mild (n=35)	9.31 ± 3.66		0.006$	10.11 ± 2.97	

Moderate (n=13)	12.92 ± 2.59	0.000#	9.62 ± 4.55

Note: BDI = Beck Depression Inventory; BAI = Beck Anxiety Inventory; IPAQ = International Physical Activity Questionnaire; PSQI = Pittsburgh Sleep Quality Index; ESS = Epworth Sleepiness Scale. values expressed as mean ± standard deviation. * One-Way Anova. #Posthoc Bonferroni: Absent vs. Mild, Absent vs. Moderate, Absent vs. Severe". $Posthoc Bonferroni: "Moderate vs. Light".

Table 5 shows the correlations between sleep parameters, anxiety and depression symptoms and physical activity level. Moderate correlations were observed between sleep quality and anxiety symptoms ($r = 0.587$ $p < 0.001$) and sleep quality and depression symptoms ($r = 0.588$ $p < 0.001$). Anxiety ($r = 0.220$; $p < 0.031$) and depression ($r = 0.217$; $p < 0.033$) were correlated with excessive daytime sleepiness. No correlation was observed between the physical activity level, sleep quality and excessive daytime sleepiness.

Table 5. Correlation between sleep symptoms, mood disorders and physical activity level

	PSQI		**ESS**	
	r	***p-value***	**r**	***p-value***
BAI	0.587	<0.001*	0.220	0.031*
BDI	0.588	<0.001*	0.217	0.033*
IPAQ (MET-minute/week)	0.180	0.079	0.030	0.768

BDI = Beck Depression Inventory; BAI = Beck Anxiety Inventory; IPAQ = International Physical Activity Questionnaire; PSQI = Pittsburgh Sleep Quality Index; ESS = Epworth Sleepiness Scale. r = Spearman's coefficient *significant values

A multiple linear regression analysis to check whether anxiety and depression symptoms can predict sleep quality and daytime sleepiness is shown in Table 6. The analysis resulted in a model in which anxiety symptoms ($\beta = 0.355$; $t = 2.883$; $p = 0.005$) and depression ($\beta = 0.307$; $t = 2.494$; $p = 0.014$) are sleep quality predictors. The analysis did not result in a significant model for daytime sleepiness [$F(2.93) = 2.121$; $p = 0.126$; $R^2 = 0.044$]. It was not possible to establish associations between the physical activity level and sleep parameters, as they did not correlate.

Table 6. Multiple linear regression analysis of predictors of sleep quality (PSQI) and excessive daytime sleepiness (ESS)

	PSQI						ESS					
	β (standardized)	t	p-value	F	p-value	R^2	β (standardized)	t	p-value	F	p-value	R^2
Anxiety (score)	0.355	2.883	0.005	28.985	< 0.001	0.384	0.178	1.160	0.249	2.121	0.126	0.044
Depresssion (score)	0.307	2.494	0.014				0.039	0.254	0.800			

Sleep quality = 5.41 + (0.164 x BDI score) + (0.147 x BAI score)
PSQI = Pittsburgh Sleep Quality Index; ESS = Epworth Sleepiness Scale.

DISCUSSION

As far as we know, this is the first study to assess sleep parameters and their associations with mood disorders and the physical activity level in health professionals from different professional categories working on the COVID-19 frontlines in Brazil. 1) In the present study, we observed a high prevalence of poor sleep quality. 2) Excessive daytime sleepiness, as well as the presence of some anxiety and depression symptoms were also elevated. 3) Most of the participants in our study had a moderate or high physical activity level (72.9%). 4) Sleep quality was correlated with anxiety and depression symptoms, but not with physical activity level. 5) No association was found between excessive daytime sleepiness and anxiety and depression or physical activity level.

The prevalence of poor sleep quality in health professionals observed in our study is higher than that observed in other studies during the pandemic. In a recent systematic review, Alimoradi et al. (2021) found a combined prevalence of poor sleep quality and insomnia of 43%. A large part of the articles included in the review (76 out of 177) were carried out in China, which has significant control over the outbreak from the initial and critical moments in relation to the rest of the world[19]. Professionals working in the public health system in Brazil were already facing the repercussions of social inequality in the work environment present in the country, such as overcrowding of reference hospitals and lack of supplies and basic hospital equipment[20]. With the worsening of the health crisis caused by the pandemic, Brazilian health professionals would be more subject to the fear of self-contamination, along with the permanent use of personal protective equipment which impairs communication and executing procedures, as well as the increase in professional demand and working hours, exponentially increasing its negative, physical and psychological repercussions[21].

Shift work (12-hour shift) was frequent in 85.4% of professionals in our study, with 68.3% working at night. Professionals who work in shifts have shorter and poorer quality sleep. In addition, nocturnal professional activity alters the phase of the sleep-wake cycle, interrupting internal regulation in the hypothalamus, more specifically in the suprachiasmatic nucleus, which, associated with peripheral oscillators, regulate the circadian rhythm and the sleep/wake cycle, also causing excessive daytime sleepiness and interfering with daytime performance[3,22,23].

Consistent with previous studies on frontline healthcare professionals COVID-19[24,25], we also observed a high prevalence of some depression and anxiety symptoms, as well as

positive correlations of these symptoms with poorer sleep quality and greater excessive daytime sleepiness. In theory, possible impact on the work environment with a greater risk of infection increased workload and an isolated environment are factors that can contribute to the emergence of or increase already present symptoms of mood disorders[26]. Furthermore, neural pathways associated with sleep are closely related and partly overlap with neural pathways of affect, cognition, and other important brain functions[27].

It is known that physical activity level is associated with regulating physiological indicators that affect sleep parameters and anxiety and depression symptoms[5]. Most of the participants in our study maintained a moderate or high physical activity level, however, our findings showed that there was no influence of physical activity levels on sleep quality or excessive daytime sleepiness. The data collection period in our study covered moments of relative control over the pandemic (October 2020 to July 2021), with variation in the contamination/mortality curve, and a consequent decrease in fear of contamination and restriction measures. It is also noteworthy that the composition of physical activity level includes activities performed during the working day (among other components), visibly overloaded at the time of a health emergency. These factors could justify the presence of a high/moderate physical activity level, despite evidence to the contrary in favor of a large-scale increase in sedentary behavior[28].

The stress factor additionally promoted by the pandemic could outweigh the benefits of a higher physical activity level on sleep quality and excessive daytime sleepiness. These factors could justify the divergence of our result, which does not indicate an association between physical activity level and sleep parameters. Such results must be interpreted with caution, with a need for studies that additionally assess the physical activity level objectively, since the applied subjective form can be influenced by factors such as memory.

Linear regression analysis in our study confirmed evidence of associations between sleep quality and mood disorders, in which anxiety and depression symptoms are predictors of sleep quality. Our findings support a previous study which found an increased risk of sleep disturbances in individuals with anxiety and depression symptoms[18]. These results suggest that health professionals deal with these problems simultaneously, and their sleep quality can consequently be improved if psychological suffering is reduced. Several potential mechanisms by which disrupted sleep conditions may increase the risk or perpetuation of these anxiety and depression are reported, including alterations in monoamine neurotransmission, hypothalamic-pituitary-adrenal axis abnormalities involved in stress, and chronic, glutamatergic and

orexinergic inflammation, alteration in brain-derived neurotrophic factors (BNDF), dysfunction of cerebral neuroplasticity and dysregulation of circadian systems[6,7].

Knowledge about the association between sleep quality and anxiety and depression symptoms can guide the planning of actions to prevent and/or recover the psychological health of these professionals. Some studies have suggested measures such as implementing rest/leisure areas within recovery centers, training on patient care and telephone support lines, especially for professionals working in intensive care units[29].

Some limitations of this study need to be reported. As it is an observational study with a cross-sectional design, it does not allow to determine the time effect in the causal relationship. The inclusion of the rotational shift workers in this study can also affect the sleep quality and the excessive daytime sleepiness as well. The use of subjective outcome measures (self-report) performed through online questionnaires cannot rule out recall bias. The impact of the COVID-19 pandemic as it spans over more than a year is dynamic, and it may be influenced by the time it was evaluated, depending on the contamination/mortality curve and consequent combat measures.

CONCLUSIONS

In summary, we observed a high prevalence of poor sleep quality. Sleep quality and anxiety and depression symptoms are associated in the frontline healthcare professionals during COVID-19 pandemic. No association was found between anxiety and depression symptoms and excessive daytime sleepiness, nor the influence of physical activity levels on the sleep parameters evaluated in the study. We suggest carrying out further studies with a methodological design that can better define causal relationships and longitudinal follow-up. With the results presented, it is also suggested to adopt special protective measures for these health professionals who are subjected to great emotional and physical stress aggravated at this time of pandemic, such as periodic assessments of the psychological state, and therapeutic follow-up aimed at possible physical repercussions.

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