Overview of the post-night shift syndrome in the COVID-19 pandemic era: predictors in a North African sample of physicians

Sirine Bouzid, Rim Karray, Amine Abdelhedi, Haifa Snoussi, Kais Bouzid,Mouna Jerbi, Abdennour Nasri, Olfa Chakroun-Walha, Noureddine Rekik.

Emergency department, Habib Bourguiba university hospital, Faculty of Medicine; Sfax university; Tunisia

Corresponding Author: *Olfa CHAKROUN-WALHA, email: chakroun_olfa@medecinesfax.org*

Abstract

OBJECTIVES: This study aimed to detect the post-night shift syndrome among physicians and to evaluate its predicting factors.

METHODS: Observational cross-sectional study involving physicians working night shifts during the study period (December 2019-February 2021). The post-night shift symptoms are divided into four dimensions: somatic, behavior, mood, and psychological.

RESULTS: Sixty-five participants have developed PNS syndrome (25.70%).

The independent predictors of developing PNS syndrome were working in a COVID-19 unit, the number of admissions, and the number of sleeping hours.

CONCLUSION: The night shift is a condition that primarily affects physicians. The PNS may cause several disorders and may decrease the physicians' well-being. At the beginning of the COVID-19 pandemic, working in a COVID-19 unit was a predictor of the development of PNS syndrome.

KEYWORDS: Post-night shift syndrome; Symptoms; COVID-19; Predictors.

INTRODUCTION

Physician well-being is an increasing focus in the medical community. Increased workload and long work hours among residents can contribute to increased stress. Past studies have shown that night shift work is a major factor in career dissatisfaction, burnout, work-family conflict, and dysphoria [1]. Furthermore, the risk of night shifts is such that the World Health Organization International Agency for Research of Cancer has listed it as a possible Carcinogen [2].

Post-night shift syndrome was recently described in an observational, multicentric study in the emergency units of Hérault and Gard [3]. In addition, there is no room for doubt that COVID-19 has introduced unique stresses to the healthcare system, namely to caregivers. It is, therefore, argued that the experience of a global pandemic like COVID-19 could be considered a mass traumatic event [4,5]. In this view, it is unsurprising that night shifts during the pandemic could be more stressful and disturbing.

A few studies have investigated post-night shift syndrome, particularly during the COVID-19 pandemic [6–8]. This study aimed to detect the post-night shift syndrome among physicians and to evaluate its predicting factors.

METHODS

It was an observational cross-sectional study conducted in the two university hospitals, including all the physicians working night shifts during the study period.

We have enrolled 253 physicians who agreed to participate in the study. Inclusion criteria concerned all physicians (intern, resident, university hospital doctors, specialists, generalists) working night shifts whatever their specialty or department.

This study was conducted for 15 months, from December 2019 to February 2021, 3 months before the pandemic, and 12 months after the beginning of the pandemic in Tunisia(Figure 1) [9].

A computerized and anonymized questionnaire was spread among all physicians via Google Forms. It was published on Facebook and via e-mail.

The questionnaire consisted of 2 parts: the first for a normal day and the second for a post-night shift.

During a normal day, we assessed the Perceived Stress Scale (PSS), and a questionnaire compiled the post-night shift symptoms divided into four dimensions: somatic, behavior, mood, and psychological. Symptoms collected were based on a synthesis of questionnaires elaborated by a recent study ([3].

We have used the visual analogical scale (VAS) to rate the different symptoms felt. Higher scores indicated greater levels of irritability, anxiety, etc.

VAS is less sensitive to confusion bias and is quick and easy to perform [10]

After a night shift, another questionnaire gathered the shift feelings, the day after shift feelings, and data about the shift.

- Used scales:
  - The Perceived Stress Scale is the most widely used psychological instrument for measuring the perception of stress. The original version of the PSS was shortened from 14 to 10 items to improve completion rates and ease of scoring. It has been proven that the shorter version has higher internal consistency and

construct validity and is thus psychometrically superior [11].

Participants were asked about their feelings and thoughts during the past and to indicate how often they felt or thought a certain way in response to 10 questions.

Each item was rated 0 (never), 1 (rarely), 2 (sometimes), 3 (fairly often), or 4 (very often), four items were reverse coded (On questions 4, 5, 7, and 8 the scores are changed like this: 0 = 4, 1 = 3, 2 = 2, 3 = 1, 4 = 0), and all items were summed to obtain scale scores. The total scores range from 0 to 40, with higher scores indicating greater perceived stress (11).

- Scores ranging from 0-13 would be considered low stress.
- Scores ranging from 14-26 would be considered moderate stress.
- Scores ranging from 27-40 would be considered high perceived stress.

The internal validity of the PSS score was verified, with an alpha Cronbach coefficient of 0.92

- Post-nightshift symptoms and attitude: To be able to assess, compare, and analyze the characteristics of the post-nightshift syndrome, we have chosen to establish a score. The VAS of the different symptoms (somatic, behavior, mood, psychological) collected were averaged and reduced to a score out of 200.
  - Somatic symptoms: tiredness, discomfort, gastralgia, headaches, diffuse pain.
  - Behavioral symptoms: unfinished activities, reckless spending, Verbal fluency disorders, over-commitment, Cynicism.
  - Mood disorder: irritability, mood swings, intolerance, anxiety, Impulsivity.
  - Psychological symptoms: attention disorder, memory disorder, Word finding difficulties, feeling of being easily influenced, Slow thinking.
  - Consumption: tea, coffee, tobacco, alcohol, stimulant drugs, hypnotic drugs.

We have chosen the highest quartile as a cut-off to indicate PNS syndrome. The internal validity of the PSS score was verified, with an alpha Cronbach coefficient of 0.94.

- Data about the shift
  - The number of night shifts per month, and duration of the night shift.
  - Compensatory rest before and or after the night shift.
  - The number of doctors per night shift.
  - The number of sleep hours, and admissions (planned and unplanned) during the night shift.
  - Time of each meal, if taken.

- Accessibility to additional exams, quality of teamwork, and accessibility to specialist advice.

- Data added after the COVID-19 pandemic: when the COVID-19 pandemic began, we decided to add these parameters to the questionnaire.
  - The number of COVID-19 samples was carried out personally.
  - The number of suspected patients with a COVID score is greater than 4.
  - The number of COVID + patients.
  - In this section, we compared the group of participants with PNS syndrome to those with no PNS syndrome.
  - Statistical analyses: Spearman correlation was realized to describe the relationship between the PNS and each item of the same questionnaire and the total score of PSS. The level of significance was set at 0.05.

To compare qualitative variables, we used the Person Chi-square test and the Fisher exact test. Considering the small number of senior physicians answering the questionnaire, we have chosen to exclude them from this analytical study; only the residents' and interns' data were analyzed (n=244).

To compare quantitative variables, we used the Mann–Whitney U test. In the multivariate analysis, we used a multiple logistic stepwise regression procedure to elucidate the independent predictors of developing PNS syndrome. Odds ratios were estimated from the b coefficients obtained, with respective 95% confidence intervals (CI 95%). The significance level was a two-sided $p < 0.05$ for all the used tests.

RESULTS

Among the six hundred and twelve physicians invited to participate in the study, 253 completed the questionnaire representing a 41.34% response rate (Figure 1).

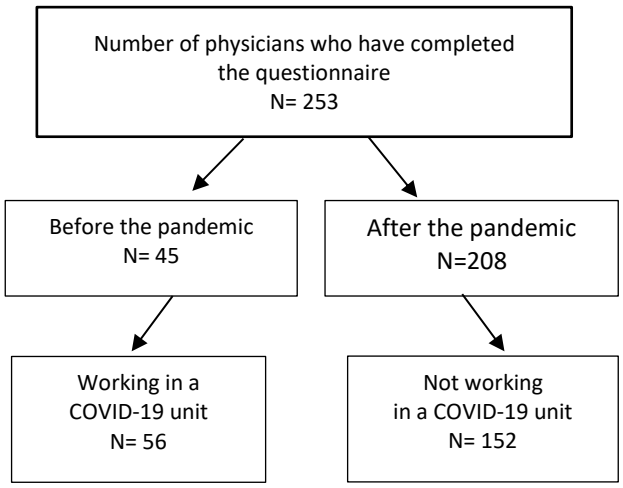

Figure: Study's flow chart

The median age of the participants was 27 years [26-28.5] with an M/F sex ratio of 0.77 (143 women). The residents represented the most responding participants (196, 77.6%), among whom 28.5% were second-year residents. The most represented specialties among residents, specialists, and university hospital physicians (n=202) were family medicine (64, 25.3%) and emergency medicine (22, 8.7%). Fifty-one participants have not indicated their specialty. The median number of shifts per month was 6

[4.75-7]. Two hundred and eight of the physicians included have had shifts after the beginning of the COVID-19 pandemic (82.21%).

Table 1. Correlation between PNS scale and sociodemographic and shifts' characteristics

	***PNS scale* p (r)**
Sociodemographic characteristics	
Age	0.40 (0.05)
Number of children	0.41 (0.05)
Marital status	NS
Data about the shift	
Number of shifts per month	0.002 (0.20)
Number of physicians per shift	0.57 (0.036)
Compensatory rest before the shift	10^{-3} (-0.23)
Compensatory rest after the shift	0.59 (-0.03)
Number of sleep hours	10^{-3} (-0.26)
Number of admissions	10^{-3} (0.29)
Planned admissions	10^{-3} (0.24)
Unplanned admissions	0.002 (0.20)
Quality of teamwork	0.072 (-0.17)
Accessibility to complementary exams	10^{-3} (-0.25)
Accessibility to specialist advice	0.01 (-0.164)
Data related to COVID-19	
Number of COVID-19 samples carried out personally	0.008 (0.32)
Number of suspected patients with a COVID score greater than 4	0.002 (0.22)
Number of COVID + patients	10^{-3} (0.30)

The median PNS score was 85 [57.00-111.50] ranging from 7 to 200. Considering the highest quartile (111) as the cutoff to indicate a PNS syndrome, we have found that 65 physicians have developed PNS syndrome (25.70%).

The post-night-shift scale was correlated neither with age nor with the number of children. Data related to the COVID-19 pandemic were strongly correlated with the PNS scale mainly the number of COVID-19 patients seen during the shift (10^{-3}) (Table 1). The PSS was correlated with the PNS scale (p=0.01) but this correlation was weak (r=0.162).

Table 2. Correlation between the four dimensions of the PNS scale with the overall

Post nightshift symptoms	PNS scale P (r)
Somatic symptoms	
Tiredness	10^{-3} (0.65)
Discomfort	10^{-3} (0.71)
Gastralgia	10^{-3} (0.61)
Diffuse pain	10^{-3} (0.68)
Headaches	10^{-3} (0.63)
Behavioral symptoms	
Unfinished activities	10^{-3} (0.61)
Verbal fluency disorders	10^{-3}(0.66)
Over-commitment	10^{-3} (0.50)
Cynicism	10^{-3} (0.51)
Reckless spending	10^{-3} (0.45)
Mood disorders	
Irritability	10^{-3} (0.80)
Mood swings	10^{-3} (0.73)
Intolerance	10^{-3} (0.76)
Anxiety	10^{-3} (0.70)
Impulsivity	10^{-3} (0.69)
Psychological symptoms	
Attention disorder	10^{-3} (0.76)
Word finding difficulties	10^{-3} (0.75)
Memory disorder	10^{-3} (0.73)
The feeling of being easily influenced	10^{-3} (0.62)
Slow thinking	10^{-3} (0.73)

The median libido away from a night shift was 6 [3-8] and on post-nightshift was 4 [1-7]. Concerning the variation of libido, 48 participants have had an increase in libido The delta libido was correlated with the PNS scale (p=0.007).

Table 3. Predictors of PNS syndrome

	PNS syndrome (n=61) Mean rank	*No PNS syndrome (n=183) Mean rank*	*Mann- Whitney U*	*P value*
Age	128.20	120.60	5234.00	0.46
Gender	107.00	127.67	4636.00	0.021
Number of children	125.43	121.52	5402.50	0.48
Number of shifts per month	143.65	115.45	4291.50	0.006
Compensatory rest before the shift	116.50	124.50	5215.50	0.074
Compensatory rest after the shift	125.00	121.67	5429.00	0.71
Number of COVID-19 samples carried out	48.08	32.90	197.00	0.007
Number of suspected patients with a COVID score greater than 4	111.58	86.86	2641.50	0.004
Number of COVID+ patients	110.73	84.93	2525.50	0.002
number of physicians per shift	117.20	124.27	5258.00	0.49
Number of sleep hours per shift	88.26	113.21	3378.00	0.008
Number of admissions	139.22	116.93	4561.50	0.032
Planned admissions	147.31	114.23	4068.00	0.001
Unplanned admissions	129.02	120.33	5184.00	0.40
Accessibility to complementary exams	106.15	127.95	4584.00	0.035
Quality of teamwork	115.30	124.90	5142.00	0.35
Accessibility to specialist advice	110.97	126.34	4878.00	0.137
Consumption of hypnotic drugs	122.00	122.67	5246.00	0.111
Consumption of stimulant drugs	120.50	123.17	5520.50	0.75
PSS	134.58	118.47	4844.50	0.120

We have found that coffee, tobacco, and alcohol consumption increased after a night shift. Tobacco consumption was 5.34 (± 9.86) on a normal day ranging from 0 to 30 cigarettes while it was 6.43 (± 13.11) on post-night-shift ranging from 0 to 60 cigarettes.

The four dimensions of the PNS scale were strongly correlated with the overall scale (Table 2). The number of shifts per month, the number of sleep hours, as well as the number of admissions and planned admissions (U=4068.00, p=10-3), were associated with a higher risk of developing PNS syndrome (Table 3). The number of suspected patients with a COVID-19 infection (U=2641.50, p=0.004), the number of COVID+ patients (U=2525.50, P=0.002), as well as the number of samples carried out (U=197.00, p=0.007 were predictors of developing PNS syndrome (Table 3). Working during the pandemic was not correlated with the development of PNS syndrome (p=0.194) while working in a COVID-19 unit was a strong predictor of PNS syndrome (10-3).

Table 4: Independent predictors of Post-night shift

	p-value	*Odds ratio*	*Confidence interval*
Working in a COVID-19 unit	10^{-3}	1.44	[1.09 ,1.92]
The number of admissions	10^{-3}	1.52	[1.21 ,1.90]
The number of sleeping hours	10^{-3}	1.40	[1.10 ,1.80]

The independent predictors of developing PNS syndrome were working in a COVID-19 unit, the number of admissions, and the number of sleeping hours (Table 4).

DISCUSSION

Post-night-shift syndrome can lead to major health concerns and can negatively impact physicians' performance. Our study has confirmed that the night shift is not just a hard-working circumstance but also a highly distressing condition that can lead to a defined syndrome: the post-night-shift syndrome. Most of the physicians have had moderate stress.

Physicians' wellness is frequently discussed, though it is not sufficiently prioritized. The necessity of providing uninterrupted healthcare services worldwide requires many healthcare professionals to work in the night-shift system. Nighttime duty is an important component of physicians' training in most specialties.

During the night shift, physicians are on duty during their biological resting phase and are forced to schedule sleep to their biological active phase. Post-night-shift syndrome was recently described in an observational, multicentric study in the emergency units of Hérault and Gard [3]. Its mechanisms are still debated. It seems to be related to increased levels of Interleukin-8, measured as a stress biomarker, after working a 24-hour shift, indicating an increase in inflammatory processes [12]. Moreover, circadian rhythms [diurnal rhythms of cortisol] alert us in the morning hours [pre-shift] but cause us to feel fatigued as cortisol concentrations gradually decline over the day [post-shift] [13]. For example, it has been reported that one night of sleep deprivation increases cortisol release [14]. Human physiology is arranged to sleep at night and to be awake in the daytime. This can be evidenced by hormones released in the circadian rhythm. Among these hormones, melatonin is released during nighttime sleep, but not during daytime sleep. Sudden changes in melatonin release can produce a jet-lag-like condition, disrupting human mental health and sleep rhythm [8].

Furthermore, according to Cakan et Yildiz, a whole-night shift lowered platelet numbers, visual attention, and estradiol levels but increased NRBC, IL-1β, TNF-α, and IL-6 levels. All of these data suggest that night shifts disrupt homeostatic and circadian mechanisms, but the effects of whole-night shifts were much more dramatic than half-night shifts [15]. Furthermore, recent research conducted by Cuesta et al. showed that after a night shift, cytokine release was partly altered in response to the change in the sleep-wake cycle [16]. Another study provides the first time evidence that insufficient sleep restoration over circumscribed cortical areas leads to aberrant behavior. In chronically sleep-restricted subjects, low slow-wave sleep intensity over the right prefrontal cortex - which is linked to risk behavior – may lead to increased and subjectively unnoticed risk-seeking [17].

The COVID-19 pandemic may allegedly have exacerbated occupational fatigue and burnout among doctors. Several studies have found that the COVID-19 pandemic has had an impact on

physicians' well-being [15,16]. We have assessed stress among physicians working nightshifts using the perceived stress scale. We have found that most of the residents have had moderate stress [80.24%]. Similarly, in a cross-sectional study including resident physicians working night shifts, Hassan et al. found that most of the residents have had moderate job stress [18].

In our study, age was not correlated with the development of PNS syndrome. Leso et al demonstrated that shift work (particularly night shifts) has serious immediate negative effects on cognitive functions, especially regarding the cognitive domains related to attention, memory, and response inhibition. These findings found that increasing age is the most important risk factor for cognitive detriment [6]. Gender differences in work injury risk among shift workers have also been explored. However, there is limited empirical evidence showing an interaction between shift work and gender that definitively points to shift work as more adverse for either women or men. In our study, gender was not associated with PNS syndrome. In contrast, Wong et al have proven that shift work is a greater challenge for women than men due to cyclical menstrual changes [19][20].

We found that the number of sleep hours during the shift is a strong predictor of PNS syndrome [p=0.008]. Similarly, the results of Wali et al' study indicate that the factor that significantly affects mood and performance post-night-shift is the number of hours slept during the night shift [P = 0.03] [21]. Furthermore, Osterode et al have found in their series, including physicians from different departments, that although mean sleep deprivation during night-shift was relatively small [1.5 h] the impairment in participants' mental state was high in all three dimensions [mood, vigilance, and agitation]; $p \leq 0.001$ [22]. Thus, it is crucial to fight against sleep deficiency during night shifts. Indeed, the Accreditation Council for Graduate Medical Education Task Force has recommended strategic napping for residents, especially after 16 hours of continuous duty and between 10 PM and 8 AM [23].

The number of shifts per month was also correlated with PNS syndrome. Several studies have found that physicians working 1 to 4-night shifts per month have lower stress compared to those working more than 9 shifts per month [22-24]. Besides, work control includes also the number of physicians. Being a single resident is associated with job stress [18]. Oppositely, in our study, the number of physicians per shift was not associated with the development of PNS syndrome.

The total number of unplanned admissions also seems to be an important parameter. It was directly linked with tachycardia in emergency physicians working night shifts: each admission increased

the number of minutes of tachycardia ≥100 bpm by 2.0 min [p < 0.019],

and increased the number of minutes of tachycardia ≥ 120 bpm by 0.2 min [p < 0.027] [25]. In contrast, in our study, the number of total admissions and planned admissions were associated with the development of PNS syndrome. Yet, the number of unplanned admissions was not associated with the development of PNS syndrome. This result may be explained by the fact that unplanned admissions concern mainly emergency physicians who are more comfortable with unplanned visits than other specialists.

When caring for patients during a pandemic, physicians are exposed to repeated and prolonged stressors, while their health is endangered due to direct exposure to an infectious disease. It is therefore expected that these stressors have an impact on mental health. In a tertiary infectious disease hospital for COVID-19 in China, the incidence of anxiety was as high as 23.04%, and the incidence of post-traumatic stress disorder was estimated at 27.39% [26]. We have found that the median PNS scale was 85 [57.00-111.50]. Similarly, Fasula et al found that the median PNS scale was 89 among emergency physicians [73.5-157.5] [3]. Indeed, the high-risk contacts [working in the department of respiratory, emergency, intensive care unit, and infectious disease staff were twice more likely to suffer anxiety [p=0.01] and depression [p=0.02] than the non-clinical staff [working in administrative, technical operations] [5]. In a cross-sectional study conducted by Abdulah et Musa, the physicians who dealt with suspected or confirmed cases of COVID-19 were more likely to develop sleep problems and stress after the night shift [27].

LIMITATIONS

A few limitations are to be highlighted. First, the study was conducted on a single site. The results may not reflect the shift conditions across Tunisia. Second, this study was limited by the small size of the sample. Indeed, although physicians tend to adapt to technological advances, it should be kept in mind that some of them have limited technological literacy and do not utilize social media. The results should be replicated in larger samples to validate the contribution of the analyzed variables. Finally, we cannot exclude the possibility that other factors not assessed in our study, such as patient-doctor communication and social support, may also contribute to the development of PNS syndrome.

Despite the limitations abovementioned, we hope that our study findings will provide data support for the targeted interventions on psychological health in Tunisian physicians, especially during the COVID-19 pandemic.

CONCLUSION

The night shift is a condition that primarily affects physicians. The PNS may cause several disorders and may decrease the physicians' well-being. At the beginning of the COVID-19 pandemic, working in a COVID-19 unit was a

predictor of the development of PNS syndrome, as well as the number of COVID-19 patients confirmed and suspected and the number of samples carried out.

These findings suggest the need to reappraise the efficacy and feasibility of current policy regulating the scheduling of physicians and, if warranted, place further limitations on working hours and increase the number of junior physicians

REFERENCES

1. *Smith-Coggins R, Broderick KB, Marco CA. Night Shifts in Emergency Medicine: The American Board of Emergency Medicine Longitudinal Study of Emergency Physicians. The Journal of Emergency Medicine. 2014;47(3):372-8.*
2. *Known and Probable Human Carcinogens [Internet]: https://www.cancer.org/cancer/cancer-causes/general-info/known-and-probable-human-carcinogens.html*
3. *Fasula C, Marchal A, Krebs H, Moser C, Genre-Grandpierre R, Bobbia X, et al. Le syndrome postgarde de nuit chez les médecins urgentistes : caractéristiques et facteurs influençants. Ann Fr Med Urgence. 2018;8(5):301-8.*
4. *Lai J, Ma S, Wang Y, Cai Z, Hu J, Wei N, et al. Factors Associated With Mental Health Outcomes Among Health Care Workers Exposed to Coronavirus Disease 2019. JAMA Netw Open. 2020;3(3):e203976.*
5. *Thatrimontrichai A, Weber DJ, Apisarnthanarak A. Mental health among healthcare personnel during COVID-19 in Asia: A systematic review. Journal of the Formosan Medical Association. 2021;120(6):1296-304.*
6. *Leso V, Fontana L, Caturano A, Vetrani I, Fedele M, Iavicoli I. Impact of Shift Work and Long Working Hours on Worker Cognitive Functions: Current Evidence and Future Research Needs. IJERPH. 2021;18(12):6540.*
7. *Costa C, Mondello S, Micali E, Indelicato G, Licciardello AA, Vitale E, et al. Night shift work in resident physicians: does it affect mood states and cognitive levels? Journal of Affective Disorders. 2020;272:289-94.*
8. *Zupancic N, Buick V, Ihan A, Dolenc-Groselj L. Sleep and Safety Improve Physicians' Psychological Functioning at Work During Covid-19 Epidemic. Front Psychol. 2021;11:569324.*
9. *Chakroun H, Lasfar NB, Fall S, Maha A, Moussi AE, Abid S, et al. Premier cas confirmé de COVID-19 importé en Tunisie First case of imported and confirmed COVID-19 in Tunisia. :3.*
10. *Lesage FX, Berjot S, Deschamps F. Clinical stress assessment using a visual analog scale. Occupational Medicine. 2012;62(8):600-5.*
11. *Almadi T, Cathers I, Hamdan Mansour AM, Chow CM. An Arabic version of the Perceived Stress Scale: Translation and validation study. International Journal of Nursing Studies. 2012;49(1):84-9.*
12. *Dutheil F, Trousselard M, Perrier C, Lac G, Chamoux A, Duclos M, et al. Urinary Interleukin-8 Is a Biomarker of Stress in Emergency Physicians, Especially with Advancing Age — The JOBSTRESS* Randomized Trial. Xia Y, éditeur. PLoS ONE. 2013;8(8):e71658.*
13. *Kumari M, Badrick E, Chandola T, Adam EK, Stafford M, Marmot MG, et al. Cortisol secretion and fatigue: Associations in a community-based cohort. Psychoneuroendocrinology. 2009;34(10):1476-85.*
14. *Schwarz J, Gerhardsson A, van Leeuwen W, Lekander M, Ericson M, Fischer H, et al. Does sleep deprivation increase the vulnerability to acute psychosocial stress in young and older adults? Psychoneuroendocrinology. 2018;96:155-65.*
15. *Cakan P, Yildiz S. Effects of Half- or Whole-Night Shifts on Physiological and Cognitive Parameters in Women. The American Journal of the Medical Sciences. 2020;360(5):525-36.*
16. *Cuesta M, Boudreau P, Dubeau-Laramée G, Cermakian N, Boivin DB. Simulated Night Shift Disrupts Circadian Rhythms of Immune Functions in Humans. JI. 2016;196(6):2466-75.*
17. *Maric A, Montvai E, Werth E, Storz M, Leemann J, Weissengruber S, et al. Insufficient sleep: Enhanced risk-seeking relates to low local sleep intensity: Insufficient Sleep Increases Risk-Seeking. Ann Neurol. 2017;82(3):409-18.*
18. *Hassan NM, Abu-Elenin MM, Elsallamy RM, Kabbash IA. Job stress among resident physicians in Tanta University Hospitals, Egypt. Environ Sci Pollut Res. 2020;27(30):37557-64.*
19. *Wong IS, Smith PM, Mustard CA, Gignac MA. For better or worse? Changing shift schedules and the risk of work injury among men and women. Scand J Work Environ Health. 2014;40(6):621-30.*
20. *Kling RN, McLeod CB, Koehoorn M. Sleep Problems and Workplace Injuries in Canada. Sleep. 2010;33(5):611-8.*
21. *Wali S, Qutah K, Abushanab L, Basamh R, Abushanab J, Krayem A. Effect of on-call-related sleep deprivation on physicians' mood and alertness. Ann Thorac Med. 2013;8(1):22.*

22. Osterode W, Schranz S, Jordakieva G. Effects of the night shift on the cognitive load of physicians and urinary steroid hormone profiles – a randomized crossover trial. Chronobiology International. 2018;35(7):946-58.

23. Nasca TJ, Day SH, Amis ES. The New Recommendations on Duty Hours from the ACGME Task Force. N Engl J Med. 2010;363(2):e3.

24. Çalişkan Tür F, Toker İ, Şaşmaz CT, Hacar S, Türe B. Occupational stress experienced by residents and faculty physicians on night shifts. Scand J Trauma Resusc Emerg Med. déc 2016;24(1):34.

25. Dutheil F, Marhar F, Boudet G, Perrier C, Naughton G, Chamoux A, et al. Maximal tachycardia and high cardiac strain during night shifts of emergency physicians. Int Arch Occup Environ Health. 2017;90(6):467-80.

26. Huang Y, Zhao N. Generalized anxiety disorder, depressive symptoms, and sleep quality during COVID-19 outbreak in China: a web-based cross-sectional survey. Psychiatry Research. 2020;288:112954.

27. Abdulah DM, Musa DH. Insomnia and stress of physicians during COVID-19 outbreak. Sleep Medicine: X. 2020;2:100017.