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Impact of Sleep Deprivation on Sleepiness, Fatigue, and Psychomotor Vigilance Among Anesthesiology and Intensive Care Residents in Tunisia: A Multicenter Cross-Sectional Study

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Research Article

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Abstract

Background

Overnight on-call duty frequently leads to sleep deprivation among anesthesiology and intensive care residents, potentially impairing vigilance and increasing the risk of medical errors. This study assessed daytime sleepiness, fatigue, and psychomotor vigilance after overnight on-call duty among Tunisian residents and explored the association between sleepiness, fatigue, and psychomotor performance.

Methods

A multicenter cross-sectional study was conducted from 24 March to 24 April 2025 in four Tunisian teaching hospitals. Residents completing a scheduled 12-hour overnight on-call shift completed the Epworth Sleepiness Scale (ESS), the Pichot Fatigue Scale, and a standardized Psychomotor Vigilance Test (PVT). Psychomotor outcomes included mean reaction time, omission, and commission errors, fastest and slowest 10% reaction times, and reaction time variability. Associations were analyzed using Student's t-test and the Chi-square test.

Results

Fifty-six residents participated (mean age 28.7 ± 2.4 years; 51.8% male). Excessive daytime sleepiness (ESS >10) was present in 82.1% and excessive fatigue (Pichot ≥22) in 60.7%. Mean PVT reaction time was 401.2 ± 48.1 ms. Residents with excessive sleepiness had significantly longer reaction times (413.5 vs. 344.9 ms; $p = 0.001$), more omission and commission errors (both $p = 0.001$), and slower fastest reaction times ($p = 0.013$). Excessive fatigue was also associated with poorer psychomotor performance across all PVT measures (all $p \leq 0.007$).

Conclusions Excessive daytime sleepiness and fatigue were highly prevalent after overnight on-call duty and were associated with impaired psychomotor vigilance among Tunisian anesthesiology and intensive care residents. Measures to reduce fatigue and optimize post-call recovery may improve both resident performance and patient safety

Introduction

Sleep is a fundamental determinant of both physical and mental health (1). According to the American Academy of Sleep Medicine (AASM), adults should obtain at least seven hours of sleep per night to maintain optimal neurophysiological functioning (2). In healthy adults, insufficient sleep has been associated with increased stress susceptibility, somatic pain, impaired cognitive, memory, and executive functions, as well as a reduced quality of life (3).

Sleep deprivation is highly prevalent among healthcare professionals. Physicians in training, particularly anesthesiology and intensive care residents, are especially vulnerable to insufficient sleep because of prolonged on-call duties, frequent alternation between day and night shifts, and the continuous need to

make high-stakes clinical decisions. This substantial deterioration in sleep quality represents a major concern for both physicians' well-being and patient safety (4). Indeed, inadequate sleep significantly increases daytime sleepiness, impairs cognitive performance, and reduces the level of vigilance required for the management of critical situations in the operating room (4).

A French study reported that 45% of anesthesiologists working in public hospitals experienced sleep disorders, while 44% suffered from excessive daytime sleepiness (5). Likewise, an international survey including more than 5,000 anesthesiologists from 119 countries found that over 40% experienced excessive daytime sleepiness and nearly 70% reported moderate-to-severe fatigue following overnight on-call duty (6). In Tunisia, a study conducted among medical residents revealed a high prevalence of anxiety and depressive symptoms, indirectly reflecting the considerable psychological burden associated, at least in part, with chronic sleep deprivation (7). However, to date, no published Tunisian study has specifically investigated the impact of sleep deprivation related to overnight on-call duty on daytime sleepiness, fatigue, and psychomotor performance among anesthesiology and intensive care residents.

The present study aimed to assess the impact of sleep deprivation on daytime sleepiness, fatigue, and psychomotor vigilance among anesthesiology and intensive care residents in Tunisia during 2025.

Methods

Study design and setting

This multicenter cross-sectional study was conducted in the Departments of Anesthesiology and Intensive Care of three university hospitals in Tunisia : Sahloul University Hospital (Sousse), Farhat Hached University Hospital (Sousse), and Fattouma Bourguiba University Hospital (Monastir), as well as the Monastir Maternity and Neonatology Center. Data collection was carried out over a one-month period, from 24 March to 24 April 2025.

Study population

Eligible participants were anesthesiology and intensive care residents enrolled in accredited residency training programs at the participating hospitals during the study period. Residents were included if they:

were actively involved in clinical duties;

completed a scheduled 12-hour overnight on-call shift; and

provided informed consent.

Residents were excluded if they:

were on annual, sick, maternity, or academic leave;

did not complete the overnight on-call shift;

declined participation; or

had incomplete questionnaire or Psychomotor Vigilance Test (PVT) data

Sample size

Because the number of anesthesiology and intensive care residents in the participating hospitals was limited, all eligible residents were invited to participate. Consequently, no formal sample size calculation was performed, and the study was designed as an exhaustive multicenter survey.

Study instruments

Questionnaire

Data were collected using a structured questionnaire developed for this study, consisting of 20 closed-ended single-choice questions organized into three sections: sociodemographic and professional characteristics, the Epworth Sleepiness Scale (ESS), and the Pichot Fatigue Scale. The Frensh version of the questionnaire is provided as Supplementary file 1

- **Sociodemographic and professional characteristics**: age, sex, year of residency training, and affiliated hospital.
- **Epworth Sleepiness Scale (ESS)**: Excessive daytime sleepiness was assessed using the Epworth Sleepiness Scale (ESS), a validated self-administered questionnaire comprising eight items (8). The validated French version was used in this study (9). Each item is scored on a four-point Likert scale ranging from 0 (would never doze) to 3 (high chance of dozing), yielding a total score between 0 and 24. An ESS score > 10 was considered indicative of excessive daytime sleepiness.
- **Pichot Fatigue Scale**: Developed by the French psychiatrist Pierre Pichot in 1985, this scale evaluates perceived fatigue and its impact on daily functioning (10). It consists of eight items scored on a five-point Likert scale ranging from 0 ("not at all") to 4 ("extremely"), resulting in a total score between 0 and 32. A total score ≥ 22 indicates excessive fatigue.

Psychomotor Vigilance Test

Psychomotor vigilance was assessed using the mobile application Alertness Test: PVT, which is based on the Psychomotor Vigilance Test (PVT) originally developed by Dinges and Powell in 1985 (11,12). The PVT is a sustained-attention task designed to measure reaction time (RT) in response to visual stimuli

presented at random intervals. It is highly sensitive to sleep deprivation, fatigue, cognitive impairment, and the effects of certain medications (11,12).

The Alertness PVT mobile application, developed in 2024, consists of a 5- to 10-minute test including ten trials. Participants were instructed to respond as rapidly as possible by tapping the screenwhenever a red visual stimulus appeared. Reaction times was automatically recorded for each trial. The following parameters were analyzed (13):

- Mean reaction time (RT, ms); values exceeding 300 ms were considered indicative of reduced vigilance.
- Lapses (omission errors), defined as reaction times > 500 ms.
- Commission errors, defined as anticipatory responses with reaction times < 100 ms.
- Fastest 10% and slowest 10% of reaction times.
- Reaction time variability, calculated from the distribution of reaction times.

Study procedure

Data collection

Data collection was conducted by trained investigators during scheduled visits to each participating department. Immediately after completing the scheduled 12-hour overnight on-call shift, participants completed the self-administered questionnaire, followed immediately by the Psychomotor Vigilance Test (PVT) using the same mobile application under standardized conditions. All assessments were performed individually in a quiet environment to minimize external distractions

Both the questionnaire and the psychomotor vigilance test were completed during the morning immediately following a 12-hour overnight on-call shift for each participating resident.

Statistical analysis

Data was entered and analyzed using Statistical Package for the Social Sciences (SPSS) version 27.0.

Categorical variables are presented as frequencies and percentages, whereas continuous variables are expressed as mean ± standard deviation (SD). Comparisons between continuous variables were performed using the student’s t-test, while categorical variables were compared using the Chi-square test. A two-sided p value < 0.05 was considered statistically significant.

Results

Participants' characteristics

All anesthesia and critical care residents (n = 56) from the participating hospitals completed the questionnaire, corresponding to a response rate of 100%. The mean age was 28.7 ± 2.39 years (range: 25–34 years). Slightly more than half of the participants were male (51.8%), and most were senior residents (third to fifth year of training, 64.2%). Nearly half were affiliated with Sahloul University Hospital (42.9%).

Daytime sleepiness and fatigue

The mean Epworth Sleepiness Scale (ESS) score was 13.58 ± 3.14 (range: 8–22). Overall, 82.1% of residents had an ESS score > 10, indicating excessive daytime sleepiness. The mean Pichot Fatigue Scale score was 21.21 ± 6.39 (range: 3–30), and 60.7% of participants had a score ≥ 22, consistent with excessive fatigue (Table 1).

Table 1
Distribution of residents by level of daytime sleepiness and fatigue

Variable	Sample size (N = 56)	Pourcentage (%)
Epworth Sleepiness Scale		
Score d'ESS ≤ 10	10	17,9
Score d'ESS>10	46	82,1
Pichot Fatigue Test		
Pichot fatigue score < 22	22	39,3
Pichot fatigue score ≥ 22	34	60,7
ESS score > 10: excessive daytime sleepiness; **Pichot Fatigue Score ≥ 22**: excessive fatigue		

Psychomotor vigilance

The mean reaction time (RT) was 401.21 ± 48.11 ms (range: 301–492 ms), while the mean RT variability was 219.46 ± 110.03 ms (range: 47–519 ms). Detailed psychomotor vigilance test (PVT) results are presented in Table 2.

Table 2
Psychomotor vigilance test performance

Variable	Mean	Standard Deviation	Min	Max
Mean TR (ms)	401,21	48,11	301,00	492,00
Omission errors	0,91	0,87	0,00	3,00
Commission errors	1,05	0,86	0,00	3,00
Fastest 10% (ms)	314,37	33,10	251,00	382,00
Slowest 10% (ms)	533,83	117,03	367,00	815,00
Variability (ms)	219,46	110,03	47,00	519,00

TRM: **normal**: around 200–300 ms, **prolonged** > 300 ms, **omission errors** (TRs > 500 ms), **commission errors** (TRs < 100 ms), **variability** (ms): the fastest 10% – the slowest 10%

Association between daytime sleepiness and psychomotor vigilance

Residents with excessive daytime sleepiness (ESS > 10) showed significantly poorer psychomotor performance than those without excessive daytime sleepiness. They exhibited longer mean reaction times, as well as significantly higher omission and commission error rates. The reaction time of the fastest 10% of responses was also significantly prolonged in residents with excessive daytime sleepiness. No significant differences were observed for the slowest 10% of reaction times or RT variability. Detailed comparisons are presented in Table 3.

Table 3
Association between daytime sleepiness and psychomotor vigilance

TR (ms)	Normal daytime sleepiness (ESS score ≤ 10)	Excessive daytime sleepiness (ESS score>10)	*p*
	344,90 ± 33,05	**413,45 ± 41,86**	**0.001**
Omission errors	0,30 ± 0,48	1,04 ± 0,89	0.001
Commissionerrors	0,2 ± 0,42	1,23 ± 0,82	0.001
Fastest 10% (ms)	291,10 ± 20,47	319,43 ± 33,30	0,013
Slowest 10% (ms)	472,10 ± 106,54	547,26 ± 115,93	0,065
Variability (ms)	181,00 ± 103,92	227,82 ± 110,62	0,226

TRM: normal: around 200–300 ms, **prolonged** > 300 ms, **omission errors** (TRs > 500 ms), **commission errors** (TRs < 100 ms), **variability (ms)**: the fastest 10% – the slowest 10%

Association between fatigue and psychomotor vigilance

Residents with excessive fatigue (Pichot score ≥ 22) demonstrated significantly impaired psychomotor vigilance compared with those without excessive fatigue. They had significantly longer mean reaction times, more omission and commission errors, prolonged fastest and slowest reaction times, and greater RT variability. The detailed results are shown in Table 4.

Table 4
Association between fatigue and psychomotor vigilance

TR (ms)	**Normal fatigue (Pichot fatigue score < 22)**	**Excessive fatigue (Pichot fatigue score ≥ 22)**	***p***
	361,50 ± 41,58	**426,91 ± 32,02**	**0.001**
Omission errors	0.22 ± 0,42	1,35 ± 0,81	**0.001**
Commission errors	0,54 ± 0,59	1,35 ± 0,81	**0.001**
Fastest 10% TR les plus rapides (ms)	292,90 ± 20,99	328,26 ± 32,25	**0.001**
Slowest 10% TR les plus lents (ms)	464,31 ± 80,80	578,82 ± 115,61	**0.001**
Variability (ms)	171,40 ± 82,68	250,55 ± 115,30	**0,007**
TRM: normal: around 200–300 ms, **prolonged >** 300 ms, **omission errors** (TRs > 500 ms), **commission errors** (TRs < 100 ms), **variability (ms)**: the fastest 10% – the slowest 10%			

Discussion

This study highlights a high prevalence of excessive daytime sleepiness and fatigue among anesthesiology-resuscitation residents, affecting 82.1% and 60.7% of participants, respectively. Moreover, the psychomotor vigilance test (PVT) revealed prolonged mean reaction times (RTm), with an average value of 401 ms, suggesting a significant impairment in sustained attention and psychomotor performance. These findings raise concerns regarding the potential impact of sleep-related impairment on clinical decision-making and the risk of medical errors following night shifts.

In our cohort, the mean Epworth Sleepiness Scale (ESS) score was 13.58 ± 3.14, indicating a substantial level of daytime sleepiness. This finding is consistent with previous research, particularly an Egyptian study conducted in 2020 that assessed the effects of partial sleep deprivation after night shifts on anesthesiologists' cognitive performance and reported a comparable mean ESS score of 14.86 ± 3.42 (14). In our study, 82.1% of residents had an ESS score above the pathological threshold (> 10), reflecting a high burden of excessive daytime sleepiness. Similar observations have been reported by Pakk et al., who found that 84% of residents experienced excessive daytime sleepiness (15). Likewise, a study conducted among anesthesia residents in Saudi Arabia reported that 70% experienced significant

daytime sleepiness after night shifts (16). Taken together, these findings suggest that excessive daytime sleepiness is a widespread issue among anesthesia trainees across different healthcare systems.

Several factors may contribute to this high prevalence, including demanding work schedules, frequent overnight duties, insufficient recovery periods, and the psychological stress associated with critical care environments. Persistent sleepiness among residents may negatively affect cognitive performance, professional well-being, and ultimately patient safety by impairing attention, reaction speed, and clinical judgment.

Fatigue was also highly prevalent in our population, with a mean Pichot fatigue scale score of 21.21 ± 6.39. More than half of the residents (60.7%) presented a score ≥ 22, indicating excessive fatigue. This proportion appears higher than that reported in other professional populations. For example, a study conducted among call center workers in Fez found that 34.6% of participants experienced excessive fatigue (17). Although occupational contexts differ considerably, these findings emphasize the particularly demanding nature of residency training in anesthesiology-resuscitation, where repeated night shifts, prolonged working hours, and limited opportunities for recovery may contribute to cumulative fatigue.

Regarding psychomotor vigilance, the PVT demonstrated considerable variability in reaction times, with a mean RT variability of 219.46 ± 110.03 ms (range: 47–519 ms). Such variability represents an important indicator of vigilance instability and fluctuating attentional capacity. Our results appear higher than those reported by the Digital Institute, where the mean difference between the fastest and slowest 10% of responses was 161.08 ± 20.32 ms (18). This increased variability may reflect the effects of sleep restriction on the ability to maintain consistent performance over time.

The analysis of the relationship between daytime sleepiness and psychomotor performance showed that residents with excessive daytime sleepiness had significantly longer mean reaction times compared with those without excessive sleepiness (413.45 ± 41.86 ms vs. 344.90 ± 33.05 ms). These findings are in agreement with those reported by Abdelhamid et al., who demonstrated impaired reaction times following night shifts compared with baseline measurements (14). Similarly, Saadat et al. observed a significant deterioration in reaction time among anesthesiologists after night duty, with an increase from 267 ± 38 ms during regular working hours to 298 ± 84 ms after sleep deprivation (19). This deterioration likely reflects impaired attentional resources and reduced vigilance associated with accumulated sleep debt.

In our study, omission errors (lapses) were more frequent among residents experiencing excessive daytime sleepiness than among those without sleepiness, suggesting a decline in sustained attention and increased vulnerability to vigilance failures. Although the observed lapse rates were lower than those reported by Anderson and Sullivan (12), the presence of such errors remains clinically relevant, as brief episodes of reduced attention may have important consequences in high-risk environments such as anesthesia practice.

Furthermore, residents with excessive daytime sleepiness demonstrated higher extreme reaction times, particularly among the fastest 10% of responses. These values exceeded those reported by Anderson et al. (12), suggesting that sleepiness may affect not only overall reaction speed but also the consistency and reliability of psychomotor performance.

Overall, our findings underline the significant burden of sleepiness and fatigue among anesthesiology-resuscitation residents and their association with impaired vigilance. These results support the implementation of strategies aimed at reducing fatigue-related risks, including optimized duty schedules, adequate recovery periods after night shifts, and increased awareness of sleep-related impairment among healthcare professionals.

Strengths and Limitations of the Study

This study has several strengths. To our knowledge, it is the first study conducted in Tunisia to evaluate the impact of overnight duty on sleepiness, fatigue, and psychomotor vigilance among anesthesia and critical care residents. Another major strength is the use of a multimodal assessment combining two validated subjective instruments, the Epworth Sleepiness Scale and the Pichot Fatigue Scale, with an objective evaluation of cognitive performance using the Psychomotor Vigilance Test (PVT). This complementary approach provides a more comprehensive assessment of the effects of overnight duty than relying exclusively on self-reported measures. In addition, the study achieved a 100% response rate, minimizing selection bias and enhancing the representativeness of the study population. Finally, the use of a smartphone-based application to assess reaction time represents an innovative and practical approach that could facilitate future large-scale studies in similar settings.

Several limitations should also be acknowledged. First, sleepiness and fatigue were assessed using self-administered questionnaires, which may be subject to recall and reporting bias. The inclusion of objective sleep measures, such as actigraphy or polysomnography, would provide a more accurate assessment of sleep deprivation. Second, the study was conducted in two university hospitals in central Tunisia, which may limit the generalizability of the findings to residents practicing in other regions or healthcare settings. Third, several potential confounding factors known to influence psychomotor performance, including caffeine intake, smoking status, medication use, cumulative sleep debt, number of monthly overnight shifts, and circadian preferences, were not evaluated. Finally, the relatively small sample size may have reduced the statistical power to detect weaker associations between sleep-related variables and psychomotor performance.

Conclusions

This study showed that most of the anesthesia and critical care residents experienced daytime sleepiness and excessive fatigue following a night shift. Furthermore, the results of vigilance tests revealed a significant increase in reaction times and a rise in errors among the most sleep-deprived residents. Our findings underscore the need to reassess the organization of residents' on-call schedules

to protect their health and improve patient safety. Corrective measures, such as optimizing schedules, introducing strategic breaks, or implementing sleep hygiene awareness programs, could help mitigate these effects.

Abbreviations

ESS
Epworth Sleepiness Scale
PVT
Psychomotor Vigilance Test
RT
Reaction Time
SD
Standard Deviation
SPSS
Statistical Package for the Social Sciences

Declarations

Ethics Approval and Consent to Participate

Permission to conduct the study and administer the questionnaire and mobile application was obtained from the heads of the participating departments. The study was conducted in accordance with the principles of the Declaration of Helsinki and relevant ethical guidelines and regulations. Ethical approval was obtained from the Ethics Committee of Sahloul Teaching Hospital, affiliated with Sahloul Teaching Hospital (Approval reference: HS:11-2026) Supplementary file 3). Written informed consent was obtained from all participants prior to their participation in the study. Participation was voluntary, and the confidentiality and anonymity of all collected data were ensured throughout the study (Supplementary file 2).

Competing interests.

All authors report no conflicts of interest relevant to this article.

Consent for publication:

Not Applicable

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Author Contribution

Chrigui Raoudha and Naouar Nizar conceived and designed the study.Ben Hamada Habiba and Ajmi Mohamed were responsible for data collection and participant recruitment across the participating centers.Balhi Salma performed the statistical analysis and contributed to the interpretation of the results.Chrigui Raoudha and Kahloul Mohamed drafted the initial manuscript.Habiba Ben Hamada and Naija walid critically revised the manuscript for important intellectual content.Chrigui Raoudha contributed to the literature review and manuscript preparation.Naija Walid contributed to the final revision of the manuscript. All authors reviewed and approved the final version of the manuscript and agreed to be accountable for all aspects of the work.

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Data Availability

The data collected and analyzed during the current study are not publicly available due to privacy and confidentiality considerations regarding the participants but are available from the corresponding author upon reasonable request.

References

1. Getu AA, Tesfaye W, Yeshaw Y, Dagnew B, Addis Y. Sleep deprivation among health-care workers: a cross-sectional study at the University of Gondar Comprehensive Specialized Hospital [Internet]. In Review. 2022 [cited 2026 May 30]. Available from: https://www.researchsquare.com/article/rs-1516915/v1. **doi**:10.21203/rs.3.rs-1516915/v1.
2. Watson NF, Badr MS, Belenky G, Bliwise DL, Buxton OM, Buysse D, et al. Recommended amount of sleep for a healthy adult: a joint consensus statement of the American Academy of Sleep Medicine and Sleep Research Society. **J Clin Sleep Med.** 2015;11(6):591-2. **doi**:10.5664/jcsm.4758.
3. Medic G, Wille M, Hemels ME. Short- and long-term health consequences of sleep disruption. **Nat Sci Sleep.** 2017;9:151 – 61. **doi**:10.2147/NSS.S134864.
4. Neuschwander A, Job A, Younes A, Mignon A, Faulhaber C, Jacquet H, et al. Impact de la privation de sommeil sur les compétences techniques et non techniques des internes d'anesthésie-réanimation: une étude basée sur la simulation. **Anesth Réanimation.** 2015;1:A189-90.
5. Richter E, Blasco V, Antonini F, Rey M, Reydellet L, Harti K, et al. Sleep disorders among French anaesthesiologists and intensivists working in public hospitals: a self-reported electronic survey. **Eur J Anaesthesiol.** 2015;32(2):132. *(*
6. Cortegiani A, Ippolito M, Lakbar I, Afshari A, Kranke P, Garcia CSR, et al. The burden of peri-operative work at night as perceived by anaesthesiologists: an international survey. **Eur J Anaesthesiol.**

2023;40(5):326 – 34. **doi**:10.1097/EJA.0000000000001786.
7. Marzouk M, Ouanes-Besbes L, Ouanes I, Hammouda Z, Dachraoui F, Abroug F. Prevalence of anxiety and depressive symptoms among medical residents in Tunisia: a cross-sectional survey. **BMJ Open.** 2018;8(7):e020655. **doi**:10.1136/bmjopen-2017-020655.
8. Johns MW. A new method for measuring daytime sleepiness: the Epworth Sleepiness Scale. **Sleep.** 1991;14(6):540-5. **doi**:10.1093/sleep/14.6.540.
9. Kaminska M, Jobin V, Mayer P, Amyot R, Perraton-Brillon M, Bellemare F. The Epworth Sleepiness Scale: self-administration versus administration by the physician, and validation of a French version. **Can Respir J.** 2010;17(2):e27-34. **doi**:10.1155/2010/423585.
10. Haba-Rubio J, Krieger J. Somnolence, fatigue et hypersomnie. **Médecine Sommeil.** 2011;8(1):5–14. **doi**:10.1016/S1769-4493(11)70002-2.
11. Dinges DF, Powell JW. Microcomputer analyses of performance on a portable, simple visual RT task during sustained operations. **Behav Res Methods Instrum Comput.** 1985;17(6):652-5. **doi**:10.3758/BF03200977.
12. Anderson C, Sullivan JP, Flynn-Evans EE, Cade BE, Czeisler CA, Lockley SW. Deterioration of neurobehavioral performance in resident physicians during repeated exposure to extended duration work shifts. **Sleep.** 2012;35(8):1137-46. **doi**:10.5665/sleep.1994.
13. Basner M, Mollicone D, Dinges DF. Validity and sensitivity of a brief psychomotor vigilance test (PVT-B) to total and partial sleep deprivation. **Acta Astronaut.** 2011;69(11–12):949 – 59. **doi**:10.1016/j.actaastro.2011.07.015.
14. Abdelhamid BM, Omar H, Hassan MM, Embaby SA, Rady A, Mohamed Aly H. Effects of partial sleep deprivation following night shift on cognitive functions of Egyptian anesthesiologists: prospective observational study. **Egypt J Anaesth.** 2020;36(1):61–68. **doi**:10.1080/11101849.2020.1722310.
15. Papp KK, Stoller EP, Sage P, Aikens JE, Owens J, Avidan A, et al. The effects of sleep loss and fatigue on resident physicians: a multi-institutional, mixed-method study. **Acad Med.** 2004;79(5):394–406. **doi**:10.1097/00001888-200405000-00007.
16. Arab AA, Khayyat HY. Risk of fatigue among anesthesia residents in Saudi Arabia. **Saudi Med J.** 2017;38(3):292-6. **doi**:10.15537/smj.2017.3.17193.
17. Elbiaze M, Moussaoui AE, Benjelloun M, Labyad S, Serraj M, Amara B, et al. La prévalence de la somnolence diurne excessive et ses facteurs déterminants chez les travailleurs d'un centre d'appel à Fès. **Médecine Sommeil.** 2017;14(1):44 – 5. **doi**:10.1016/j.msom.2016.10.095.
18. Tâche de vigilance psychomotrice (mesure de la vigilance) [Internet]. [cited 2025 Mar 22]. Available from: https://www.institut-numerique.org/tache-de-vigilance-psychomotrice-mesure-de-la-vigilance-4ff1663da0545.
19. Saadat H, Bissonnette B, Tumin D, Raman V, Rice J, Barry N, et al. Effects of partial sleep deprivation on reaction time in anesthesiologists. **Paediatr Anaesth.** 2017;27(4):358 – 62. **doi**:10.1111/pan.13090.

Supplementary Files

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