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Effect of Sleep Hygiene Orientation on Social Cognition Impairments Due to Chronic Sleep Restriction in Mexican Medical Residents

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Abstract

Introduction: Sleep is critical to human physiological function, cognitive performance, and emotional regulation. Healthcare personnel, especially physicians, are chronically exposed to long working hours, which are often accompanied by decreased sleep time. Clinical evidence indicates that these conditions affect their cognitive function and professional practice, but researchers in the field have not sufficiently explored the possible effects of reductions in sleep time on social cognition. **Objective:** The aim of this is to further explore the effects of sleep restriction among medical residents, the specific impairments in social cognition that it produces, and the effects of a sleep hygiene orientation on those impairments. **Method:** There were 124 medical residents (50 males, 74 females) who completed a daily sleep/work log, a battery of sleep tests/questionnaires, and neuropsychological evaluations. The participants then received a short course (8 hours) on basic concepts of sleep hygiene and sleep psychoeducation. Once the course was completed, participants filled out the questionnaires again. **Results:** The results indicate that sleep disturbances in medical residents were associated with severe neurocognitive and social cognition impairments. After the sleep hygiene intervention, neuropsychological function and sleep parameters improved, awareness increased, and social cognition performance significantly improved. **Conclusion:** Using sleep psychoeducation and sleep hygiene intervention in medical residents is a simple strategy to mitigate the effects of sleep restriction.

Keywords

Sleep Hygiene, Shift Work, Sleep Restriction, Cognitive Performance

1. Introduction

Sleep has a restorative effect on the brain and enables the reorganization of neural activity [1]. However, in modern societies, there is an increasing tendency to restrict daily sleep time, particularly in urban contexts [2]. Misleading beliefs about sleep, excessive use of electronic devices, long working hours, and shift work lead to a significant decrease in daily sleep time [3]. In this regard, even one hour of sleep restriction per night may induce cognitive deterioration, complaints of daytime sleepiness, irritability, weight gain, and increased risk of developing diabetes, obesity, hypertension, heart disease, strokes, and depression [4].

Sleep restriction (SR) has several deleterious effects on cognitive functions, which are observed after 15.84 hours of continuously being awake. SR negatively affects multiple brain processes, particularly by disrupting the integrative functioning of the prefrontal cortex, leading to overall impairments in different cognitive functions [5]. Concerning health professionals, their working schedules commonly induce serious impairments in circadian rhythm regulation and sleep time.

In 2001, several scientific and academic societies held the Conference on Sleep, Fatigue, and Medical Training [6]. This meeting aimed to analyze the effects of sleep deprivation and fatigue on the performance of medical doctors and other professionals in the health field. In addition, the conference also addressed the generation of countermeasures to overcome these deleterious effects. The participants in the conference recognized that fatigue and SR are a risk to both physician's and patient safety. Since then, several efforts have been made to limit extended shifts to less than 16 hours. Levine *et al.* [7] reviewed reports supporting the notion that the reduction of shifts over 16 hours has beneficial effects on patient health and the quality of life of medical residents.

Nevertheless, most health institutions continue to use long shifts (more than 16 hours) and frequent night shifts with scarce opportunities for rest and sleep. Papp *et al.* [8] reviewed the impacts of SR among resident physicians, which resulted in deleterious effects on professional capabilities and relationships with patients, work groups, and families. The authors emphasize the need for sleep training, circadian rhythms, and sleep disorders to cope with stressful working conditions. The consequences of SR and circadian misalignment on alertness and performance in health workers have been reported repeatedly [9]. Recently, Harrison *et al.* [10] reported on the beneficial effects of countermeasure strategies to diminish the negative effects of SR on health professionals due to shift work.

Unfortunately, these strategies are not yet generalized. Health professionals in several countries still keep working schedules longer than 24 hours. In Mexico, medical residents still work long hours with almost no recuperation time. In the present study, we analyzed the effect of a one-week informative course about sleep hygiene on the alertness, performance, and cognitive functions of shift-work medical residents.

2. Materials and Methods

2.1. Participants

This study examined 124 medical residents from Hospital General La Raza in Mexico City (50 males and 74 females; age 26.7 ± 3.48 years). All participants provided written informed consent. The human data were performed under the Declaration of Helsinki [11] and Mexican legislation on Bioethics. The ethical approval was awarded by the Academic Ethics Committee of the Division of Biological and Health Sciences of the Universidad Autónoma Metropolitana-Iztapalapa (CECBS20-05).

During a 6-week rotation period, we evaluated the participants in four different service units (emergency medicine, perinatology, neurosurgery, and pediatrics). The shift schedule included 36 continuous hours on duty, followed by 24 hours off duty and a normal diurnal working schedule (8 to 17 hours) on the next day. Participants were evaluated in two different conditions: 1) sleep deprivation (SD), in which participants were analyzed immediately after finishing their on-duty schedule, and 2) SR, in which participants were studied after five weeks of the shift schedule during the daytime. After the initial assessment, all the participants received a sleep hygiene orientation as an intervention, which consisted of four talks for two hours per day for one week. Then, all the participants completed the questionnaires again.

2.2. Sleep Assessment

Residents completed a daily sleep/work log throughout the study. Sleep logs were used to collect data on sleep timing and duration, sleep quality, awakenings, and work schedules and were available for 20 nights. Additionally, they completed a range of sleep tests/questionnaires, including the Sleep Habits Questionnaire (SHQ), the Sleep Quality Scale (SQS), the Athens Insomnia Scale (AIS), the Pittsburgh Sleep Quality Index (PSQI), the Epworth Sleep Scale (ESS), and Karolinska Sleepiness Scale (KSS).

2.3. Psychomotor Vigilance Test (PVT)

Residents completed the PVT on four occasions throughout the experiment. Participants were instructed to press a key as fast as possible whenever a red circle appeared in the middle of a computer screen. The test was performed at the start and end of each shift for each extended shift. The mean reaction time (RT), the mean of the 10% slowest responses, and the number of lapses (response times ≥

500 ms) were used as measures of neurobehavioral performance. To normalize the data distribution, the mean RT was expressed as the log of the mean RT, and lapses were normalized.

2.4. Neurocognitive Questionnaires

Participants completed the Mayer-Salovey-Caruso Emotional Intelligence Test (MSCEIT), which is based on an ability model of emotional intelligence. The model's two principal areas are experiential (CIEX) and strategic (CIES) areas and its four classes or branches of emotional abilities are perceiving emotions (CIEP), facilitating thought (CIEF), understanding emotions (CIEC), and managing emotions (CIEM). It has eight individual task scores: faces, pictures, facilitation, sensations, changes, blends, management, and relationships [12]. Raw test data are scored online according to the MSCEIT through https://www.teacorrige.com.

2.5. Sleep Hygiene Orientation

Personalized mitigation strategies were designed so that participants could increase their sleep and rest during their free time. General information on sleep hygiene was provided for the correct use of strategies and improvement of sleep habits. In addition, those who had a sleep disorder (apnea, insomnia, etc.) were independently evaluated and supported with consultations and sleep studies. The program included explanations and examples of relevant sleep factors (diet, exercise, substance use, light, noise, temperature, and bedding), which are personal and environmental determinants that can positively or negatively affect sleep. The goal of sleep hygiene was to avoid behaviors that interfere with a normal sleep pattern and to perform those that promote good sleep.

The intervention was provided in four sessions of two hours each for two weeks and started one week after finishing the tests in SD and SR conditions. In week one, at sessions one and two, a presentation of the sleep hygiene program was made to provide information to the participants for a correct understanding of sleep and recognition of the importance of sleep for daily activities. The topics that were given in the sessions were the following: What is sleep and why is it important for health? Why do we need sleep? What is normal sleep? What are the stages of sleep? Sleep and circadian rhythms: what they are and how they work. Sleep's impact on the immune system. What influences the quality and length of sleep? Factors related to the quality of sleep among daytime workers. How much sleep do we need? What is sleep deprivation (negative impacts of sleep deprivation, the role of sleep deprivation in immune-related disease risk and outcomes)? What is shift worker syndrome? Sleep problems and mental disorders. Common *sleep disorders.* How does lack of sleep affect cognitive impairment? Sleep for cognitive enhancement. What can we do about it?

In week two, at sessions three and four, the sleep hygiene program was presented to provide information about good sleep habits (myths and facts). We implemented strategies for the correct use of free time and provided information for the correct use of electronic devices and stimulus control. The topics of the sessions were the following: What is sleep hygiene? The importance of sleep hygiene for shift workers. What are the signs of poor sleep hygiene? How do you practice good sleep hygiene? How to reset your sleep routine. How to build a better bedtime routine. Tips for having a good night's sleep. How to build healthy daily habits. Ways to optimize your bedroom for better sleep. Healthy s*leep hygiene* habits for shift workers. Sleep myths debunked fascinating facts about sleep. How long should a nap be? All about naps. General recommendations (what you eat and drink can influence your sleep, your bedroom could be keeping you awake, planning meals around shifts, using light to your advantage, transitioning between shifts, the relationship between sleep and routine, napping and the body clock, shift work can affect your health and insomnia). Most used techniques for sleep hygiene and insomnia. Strategies to solve noise and light problems when sleeping during the day. Cognitive behavioral treatment for insomnia. Finally, participants were instructed on relaxation techniques.

2.6. Data Analysis

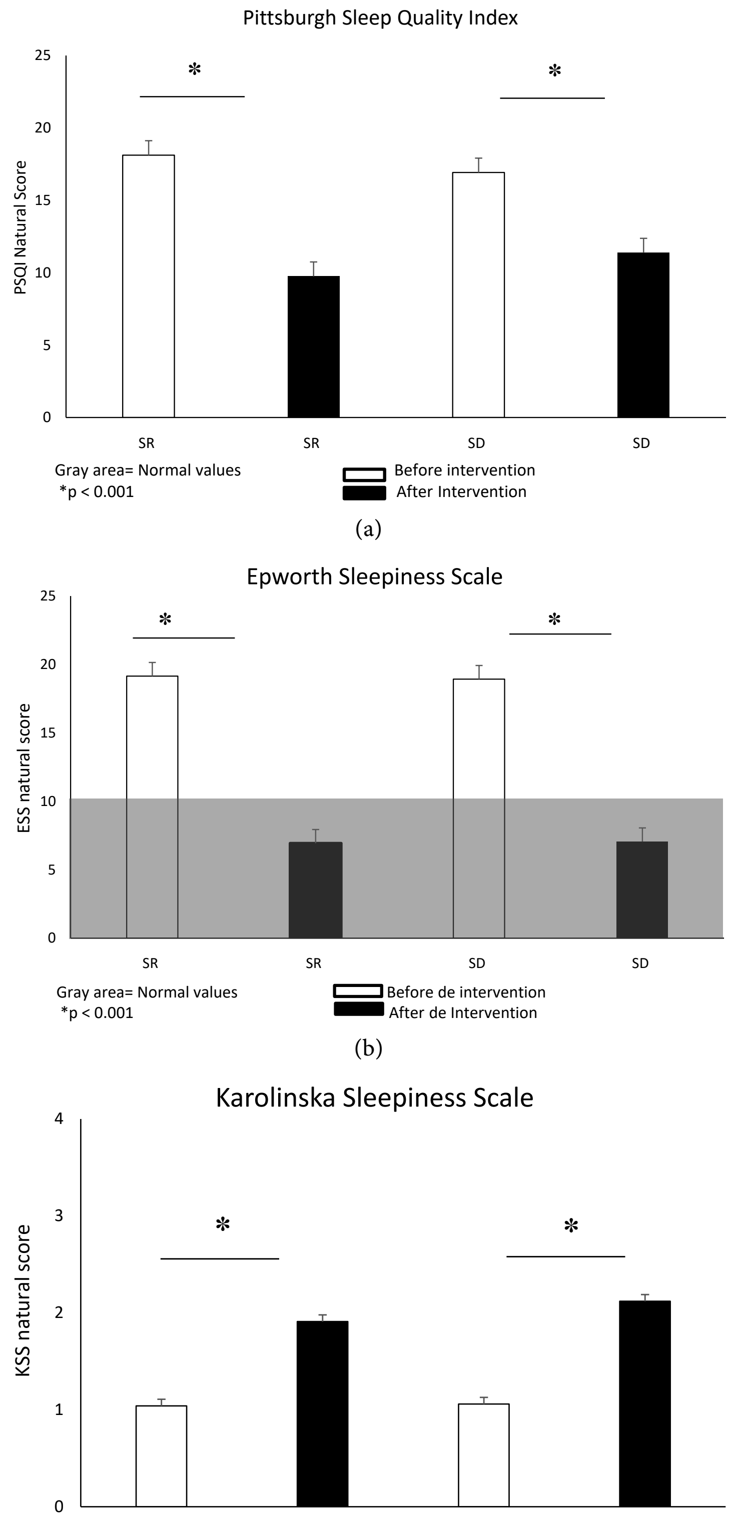
Data were analyzed by a repeated-measures two-way analysis of variance (2W RM ANOVA), which considered the condition (SR vs. SD) and intervention (before vs. after sleep hygiene instruction) as the repeated measure. To analyze changes in the RT distribution for cognitive and perceptual processing speed, the 95th percentiles were assessed for the PVT. Data obtained with sleep tests and questionnaires (KSS, ESS, PSQI, AIS, SQS, SHQ,) were analyzed using 2W RM ANOVA with the condition (SR vs. SD) as a factor and the intervention (before vs. after sleep hygiene instruction) as the repeated measure. Significant ANOVA results were followed by Sidak multiple comparisons tests (correction for multiple comparisons). The significance of statistical differences was established at the 0.05 level. The data that support the findings of this study are available from the corresponding author upon reasonable request.

3. Results

3.1. Sleep Assessment

Pittsburgh sleep quality index showed a significant improvement in both SR and SD groups after intervention ($F_{(1,246)} = 7421$; $p < 0.001$) (**Figure 1(a)**). The Gray area in the graph indicates the values in which this index is in the normal range. No significant differences were observed between groups, indicating that quality of sleep is affected in both groups. PSQI global score > 6 indicates that subjects present severe difficulties and are considered poor sleepers (Buysse *et al.*, 1989).

No significant differences were observed between groups, indicating that the quality of sleep is affected in both groups. Similarly, the Epworth Sleepiness Scale indicated that after the intervention, both SR and SD groups displayed normal somnolence values after the intervention ($F_{(1,246)} = 7188$; $p < 0.001$) (**Figure 1(b)**). The gray area inside the graph indicates the normal range of somnolence.

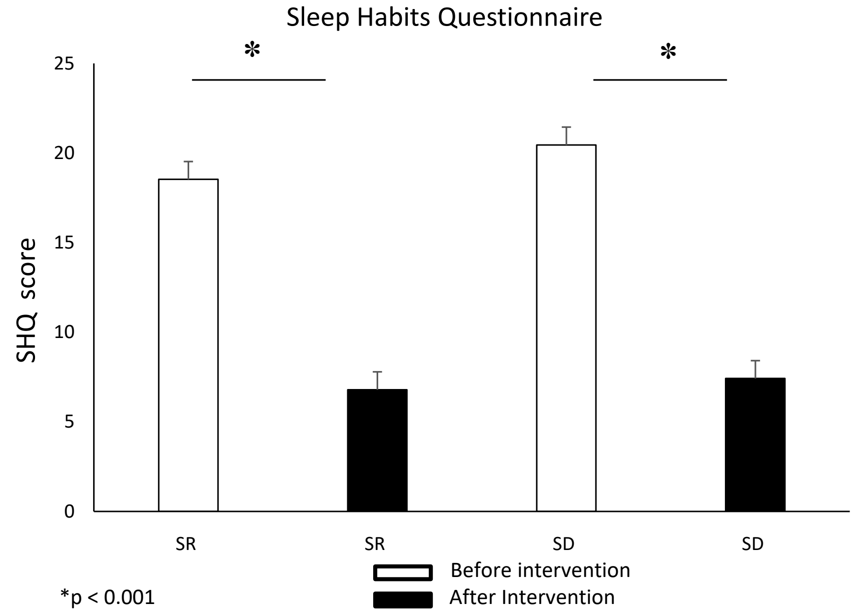


(c)

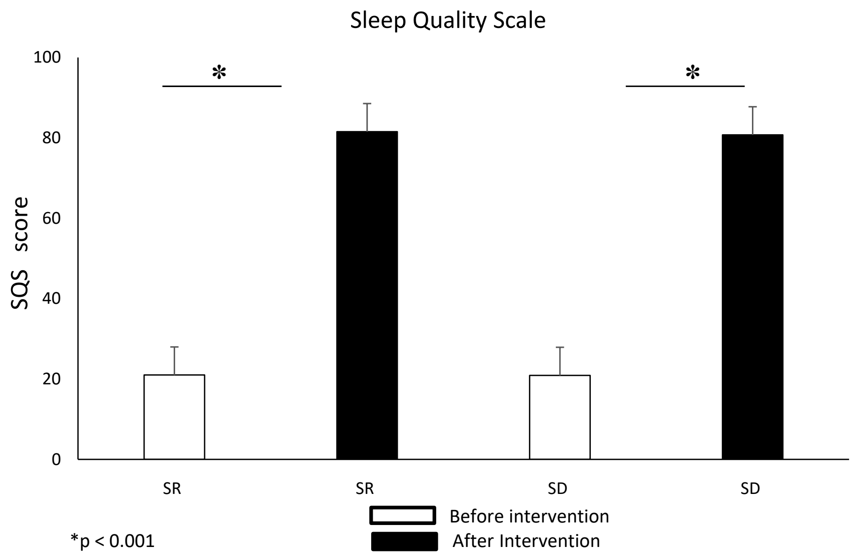
Figure 1. Sleep questionnaires. Sleep measurements in chronic sleep-restricted subjects (SR) and acute sleep-restricted subjects (SD). The gray area in the graph indicates the normal range of values. Mean ± standard deviation. *$p < 0.001$.

We did not find significant differences between the SR and SD groups. However, the Karolinska scale showed a significant increase after the intervention in both SR and SD groups ($F_{(1,246)} = 225$; $p < 0.001$), but no significant differences were detected when groups were compared (SR vs. SD, Figure 1(c)).

Sleep habits (SHQ) improved significantly after the intervention in both SR and SD groups ($F_{(1,246)} = 11303$; $p < 0.001$) (Figure 2(a)). Low scores on the global SHQ indicate that a participant has better sleep habits. Sleep quality measured by SQS revealed that this parameter was severely affected in SR and SD groups, and the sleep hygiene intervention significantly improved sleep quality ($F_{(1,246)} = 4998$; $p < 0.001$) (Figure 2(b)). Higher scores on the global SQS indicate that a participant has better sleep quality. Finally, the intervention improved



(a)



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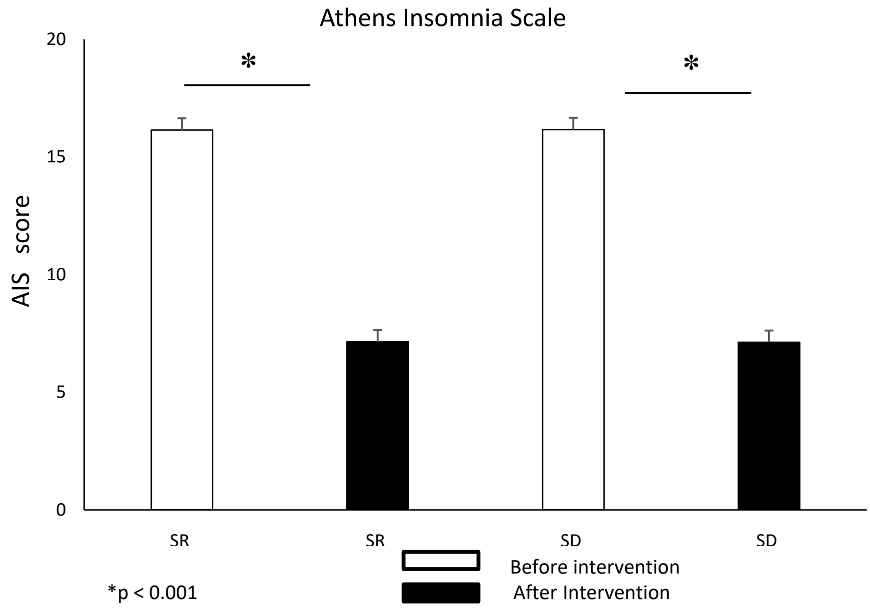

(c)

Figure 2. Sleep parameters in chronic sleep-restricted subjects (SR) and acute sleep-restricted subjects (SD). See the explanation in the text. Mean ± standard deviation. *p < 0.001.

the participants' scores on the AIS in both the SR and SR groups (**Figure 2(c)**). The severity criteria of the AIS include three levels of insomnia: absence of insomnia (0 - 5), mild insomnia (6 - 9), moderate insomnia (10 - 15), and severe insomnia (16 - 24) (Mayer and Salovey, 1997). The differences in SHQ, SQS, and AIS scores between groups did not reach statistical significance (SR vs. SD).

3.2. Psychomotor Vigilance Test (PVT)

RT in the PVT was significantly slower in the SD group than in the SR group ($F_{(1,246)} = 187.7$; $p < 0.001$). After the intervention, the SD group improved significantly, but values remained far from the normal range (**Figure 3(a)**). Concerning lapses, the SD group showed significant differences from the SR group and had a modest but significant improvement after the intervention ($F_{(1,246)} = 10.16$; $p = 0.002$). This suggests that the test is more sensitive to total sleep deprivation (**Figure 3(b)**).

3.3. Neurocognitive Assessment

Before conducting the comparisons, a missing-value analysis was performed to confirm the validity of the participant's responses. According to criteria from Mayer *et al.* [13], the responses in this study were complete and valid. The sample had low scores in the emotional intelligence quotient of the MSCEIT, reflecting affected social cognition in both SR and SD groups before the intervention ($F_{(1,246)} = 11$; $p < 0.001$). Nevertheless, after the intervention, the EIQ of the participants significantly improved in both groups. In some cases, participants obtained scores described as proficient after the intervention (**Figure 4**).

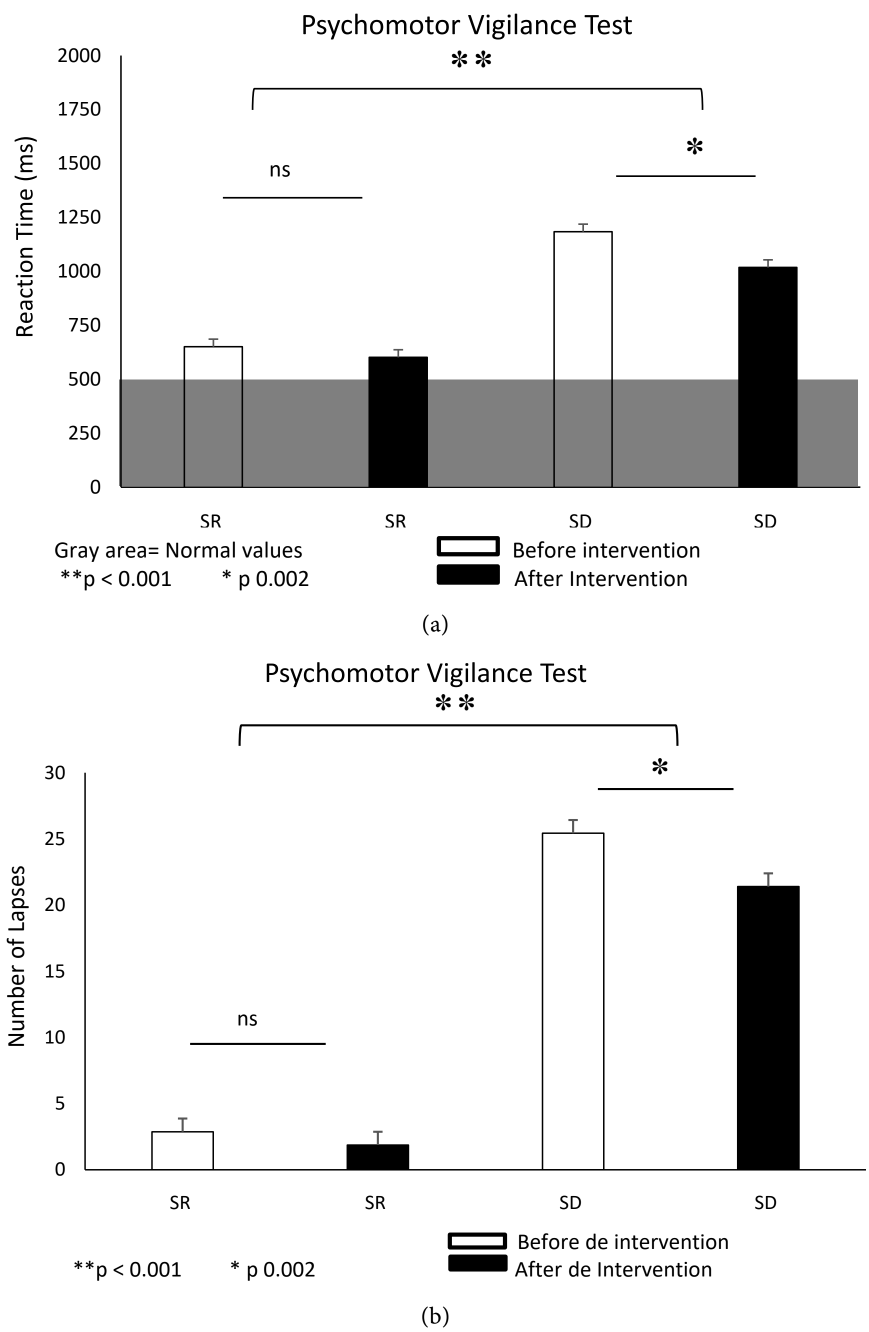

Figure 3. Psychomotor Vigilance Test. Reaction time (a) and number of lapses (b). More than 500 ms are considered an abnormal slow reaction. The gray area in the graph indicates the normal range of values. SR = Chronic sleep-restricted group; SD = Acute sleep-deprived group; ms: milliseconds. Mean ± standard deviation. $^{**}p < 0.001$; $^{*}p < 0.05$; ns = non-significant changes.

Experiential (CIEX) and strategic areas (CIES) of the MSCEIT were subnormal before the sleep hygiene course and improved after the intervention ($F_{(1,246)} = 686$, $p < 0.001$, $F_{(1,246)} = 927$; $p < 0.001$, respectively) (**Figure 5**). Results were similar for emotional abilities (perceiving emotions, CIEP; facilitating thought, CIEF; understanding emotions, CIEC; and managing emotions, CIEM) ($F_{(1,246)}$ =

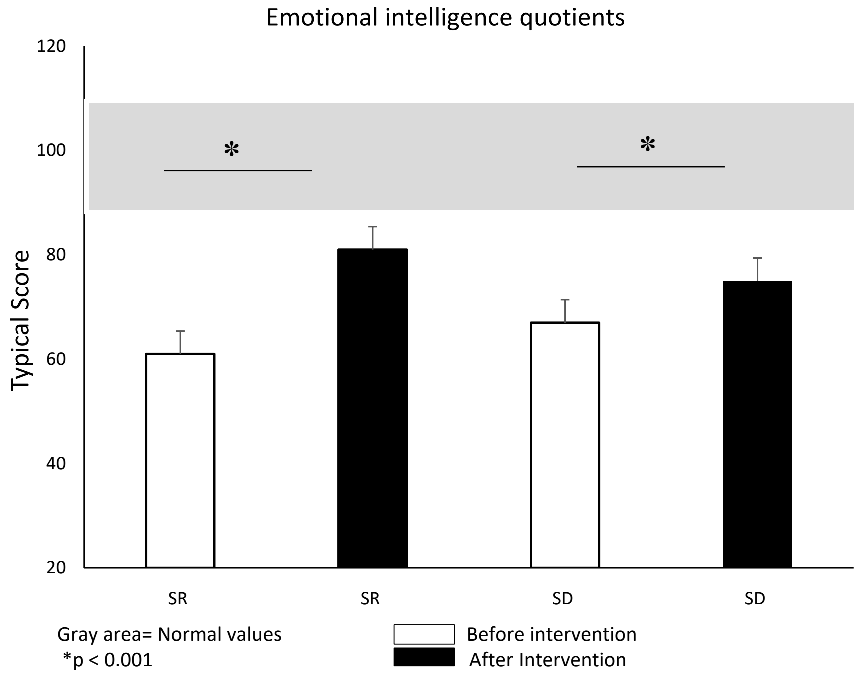

Figure 4. Emotional intelligence quotients. The gray area in the graph indicates the range of proficient scores. SR = Chronic sleep-restricted group; SD = Acute sleep-deprived group. Mean± standard deviation. *p < 0.001.

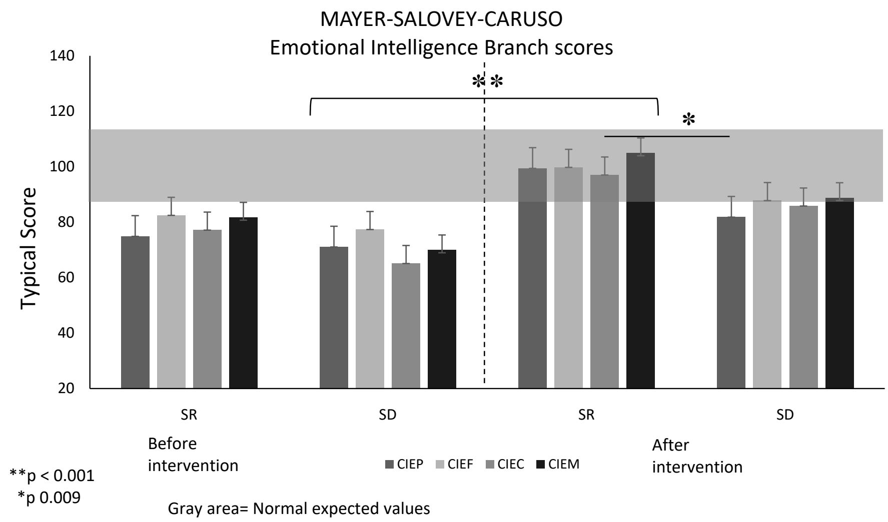

Figure 5. MSCEIT Test Area scores. The gray area in the graph indicates the normal range of values. SR = Chronic sleep-restricted group; SD = Acute sleep-deprived group. CIEX = experiential coefficient; CIES = strategic coefficient. Mean± standard deviation. *p < 0.05; **p < 0.001.

1010; $p < 0.001$; $F_{(1,246)} = 1149$; $p < 0.001$; $F_{(1,246)} = 527$; $p < 0.001$; $F_{(1,246)} = 1192$; $p < 0.001$; respectively) (Figure 6). Table 1 shows the improvement of individual tasks scores (faces, pictures, facilitation, sensations, changes, blends, management, and relationships) after the intervention ($F_{(1,246)} = 1199$; $p < 0.001$, $F_{(1,246)} = 1221$; $p < 0.001$, $F_{(1,246)} = 1149$; $p < 0.001$, $F_{(1,246)} = 1229$; $p < 0.001$, $F_{(1,246)} = 1060$;

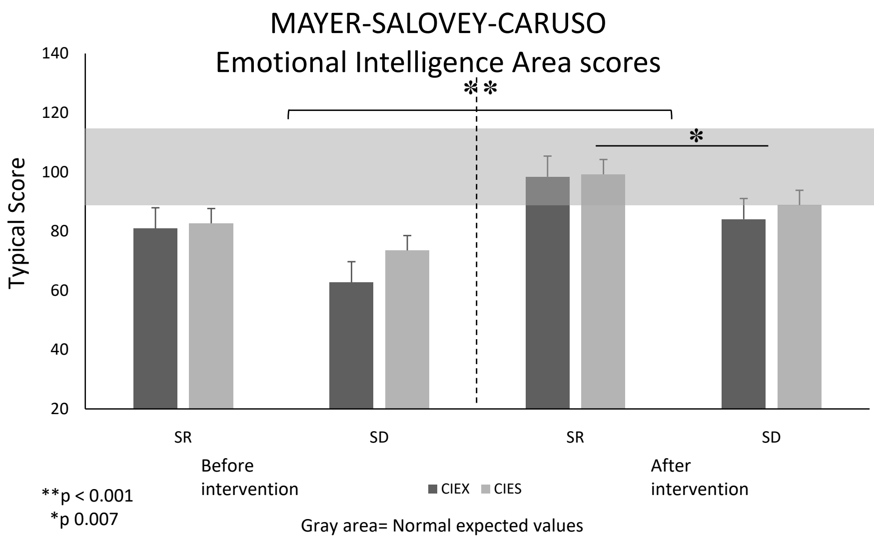

Figure 6. MSCEIT Branch scores. The gray area in the graph indicates the normal range of values. CIEP = Perceiving Emotions; CIEF = Facilitating Thought; CIEC = Understanding Emotions; CIEM = Managing Emotions. Mean± standard deviation. *p < 0.05; **p < 0.001.

Table 1. MSCEIT eight individual task scores in sleep-restricted (SR) and sleep deprived (SD) participants.

	SR participants. Mean (± S.D.)	SD participants. Mean (± S.D.)	F	p
Faces				
Before intervention	77 (5.6)	70 (5.7)	1199	<0.001
After intervention	98 7.6)	87 (8.6)		
Pictures				
Before intervention	67 (4.3)	64 (9.5)	1221	<0.001
After intervention	93 (4.8)	90 (4.5)		
Facilitation				
Before intervention	73 (8.6)	64 (8.8)	1149	<0.001
After intervention	101 (7.5)	90 (7.1)		
Sensations				
Before intervention	79 (6.3)	71 (5.2)	1229	<0.001
After intervention	96 (4.5)	89 (5.7)		
Changes				
Before intervention	78 (7.4)	72 (6.8)	1060	<0.001
After intervention	97 (6.7)	92 (6.4)		
Blends				
Before intervention	80 (7.3)	67 (5.9)	1933	<0.001
After intervention	95 (4.1)	91 (3.7)		

Continued

Management				
Before intervention	78 (8.5)	68 (9.6)	725	<0.001
After intervention	95 (7.5)	88 (5.6)		
Relationships				
Before intervention	78 (7.1)	70 (6.4)	956	<0.001
After intervention	96 (6.4)	91 (7.1)		

Table 2. Sleep duration in sleep-restricted participants Mean (±S.D.)

	Before interventon	After intervention
Bedtime	1:02 (0:58)	23:10 (0:10)*
Time in bed (hrs.)	3:40 (0:25)	5:00 (0:20)*
Wake up	4:03 (0:30)	4:00 (0:20)

*p < 0.001.

$p < 0.001$, $F_{(1,246)} = 1933$; $p < 0.001$, $F_{(1,246)} = 725$; $p < 0.001$, $F_{(1,246)} = 956$; $p < 0.001$. Finally, collected data from the logs allowed us to identify that the intervention increased sleep duration in the SR group, while this parameter remained unaffected in the SD group. Bedtime decreased significantly after the intervention in both groups ($F_{(1,246)} = 122.5$; $p < 0.001$; **Table 2**).

4. Discussion

The present results corroborate the deleterious effects of SR on medical residents due to long and frequent shift work. In addition, the study emphasizes the neurocognitive impairments that SR induces in health professionals. From this analysis, it can be concluded that health professionals show very limited knowledge of circadian rhythms and sleep. The participants generally showed poor sleep hygiene, which significantly improved after the educational intervention. Moreover, initially detected neurocognitive impairments also improved significantly after the intervention. These results support the notion that awareness training on sleep significantly improves neurocognitive impairments in medical residents due to long and frequent shift work.

Recently, Harrison *et al.* [10] reviewed different strategies implemented to relieve the harmful effects of shift work. Most of the reviewed studies deal with strategies oriented toward the working environment, which are particularly devoted to lighting and napping conditions. Due to the multiple schedules of shift work and the variability of work settings, we emphasize the need to identify enablers and barriers that facilitate or inhibit reaching the goals of the different strategies.

Some studies reported educational strategies to improve the health of shift workers. Holbrook *et al.* [14] applied sleep hygiene training for police officers to improve their performance and fatigue complaints. Scarce changes were observed, and the authors reported little adherence to sleep hygiene practices. However, in 2005, Kerin and Aguirre [15] reported positive results concerning sleep and fatigue indices in workers after receiving sleep and circadian educational training.

Concerning health professionals, a group of nurses received a cognitive behavioral intervention (Sleep Enhancement Training System for Shift Workers). After the intervention, nurses reported better sleep and well-being improvements, although no significant changes were observed in wrist actigraphy [16]. Furthermore, a group of firefighters received training on sleep (Sleep Health Program). The authors reported a significant decrease in injuries and disabilities in firefighters after the sleep-training program [17]. Even acute exposure to sleep deprivation affects the cognitive performance of health personnel. Egyptian anesthesiologists exposed to 24-hour working shifts had increased daytime sleepiness and RTs and performed poorly on tasks that assess alertness, problem-solving, psychomotor skills, attention, and mental flexibility [18].

Although the negative impact of sleep impairments on cognitive functioning has been widely demonstrated [19], our results showed that particular cognitive functions are specifically affected when individuals are exposed to SR or SD. Most importantly, we found that a short intervention with a sleep hygiene orientation is an effective strategy to improve cognitive deterioration related to inappropriate sleep patterns. This educational process seems to increase self-consciousness about the importance of good sleep to cope with the stressful conditions of professional medical activity in public health institutions.

Since medical residents support the attention most of the medical attention in health institutions, they must have good cognitive health (including motor and emotional processes) to perform their professional duties correctly. Awareness of the importance of adequate sleep for the proper functioning of medical residents emphasizes the need to review shift schedules in hospitals and educational medical courses on sleep physiology. One significant finding of our study is that medical residents who work long work shifts of 33 to 36 hours in alternate shifts exhibit impaired social cognition and neurobehavioral performance at the end of each long shift due to acute sleep loss.

Thus, a need to deepen and focus research on executive functioning (including social cognition) has been evidenced, especially in this population since they are exposed to such shifts regularly. Supporting this rationale, several researchers have shown that memory, attention, and executive functioning disorders (planning, inhibition, cognitive flexibility, working memory, self-monitoring, and inhibition) are frequent problems in people with chronic SR [20] [21]. Thus, educational training with sleep hygiene concepts is a promising strategy to mitigate health impacts due to shift work.

The limitations of the present research, On the one hand, behavioral interventions had to be limited and adapted to the shifts and activities of medical residents; same that are subject to the needs of the hospital. For future studies, it would be important to have actigraphy to confirm the schedules and the total sleeping time of the participants. Finally, it would be enriching to increase the sample to identify differences between medical specialties and years of residency.

5. Conclusion

In populations vulnerable to developing shift work, or developing sleep disorders secondary to long working hours, such as medical residents, to use sleep psychoeducation and sleep hygiene intervention is a viable, brief, and easily accessible strategy to mitigate the effects of sleep restriction.

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Declaration

All authors certify that they have no affiliations with or involvement in any organization or entity with any financial interest or non-financial interest in the subject matter or materials discussed in this manuscript.

Conflicts of Interest

The authors declare no conflicts of interest regarding the publication of this paper.

References

[1] Raven, F., Van der Zee, E., Meerlo, P. and Havekes, R. (2018) The Role of Sleep in Regulating Structural Plasticity and Synaptic Strength: Implications for Memory and Cognitive Function. *Sleep Medicine Reviews*, **39**, 3-11. https://doi.org/10.1016/j.smrv.2017.05.002

[2] Belenky, G., Wesensten, N.J., Thorne, D.R., Thomas, M.L., Sing, H.C., Redmond, D.P., *et al.* (2003) Patterns of Performance Degradation and Restoration during Sleep Restriction and Subsequent Recovery: A Sleep Dose-Response Study. *Journal of Sleep Research*, **12**, 1-12. https://doi.org/10.1046/j.1365-2869.2003.00337.x

[3] Thompson, B. (2019) Does Work-Induced Fatigue Accumulate across Three Compressed 12 Hour Shifts in Hospital Nurses and Aides? *PLOS ONE*, **14**, e0211715. https://doi.org/10.1371/journal.pone.0211715

[4] Watson, N.F., Badr, M.S., Belenky, G., Bliwise, D.L., Buxton, O.M., Buysse, D., *et al.* (2015) Recommended Amount of Sleep for a Healthy Adult: A Joint Consensus Statement of the American Academy of Sleep Medicine and Sleep Research Society. *Sleep*, **38**, 843-844. https://doi.org/10.5665/sleep.4716

[5] Van Dongen, H.P., Maislin, G., Mullington, J.M. and Dinges, D.F. (2003) The Cumulative Cost of Additional Wakefulness: Dose-Response Effects on Neurobehavioral Functions and Sleep Physiology from Chronic Sleep Restriction and Total Sleep Deprivation. *Sleep*, **26**, 117-126. https://doi.org/10.1093/sleep/26.2.117

[6] Buysse, D.J., Barzansky, B., Dinges, D., Hogan, E., Hunt, C.E., Owens, J., *et al.* (2003) Sleep, Fatigue, and Medical Training: Setting an Agenda for Optimal Learning and Patient Care. A Report from the Conference "Sleep, Fatigue, and Medical Training: Optimizing Learning and the Patient Care Environment". *Sleep*, **2**, 218-225. https://doi.org/10.1093/sleep/26.2.218

[7] Levine, A.C., Adusumilli, J. and Landrigan, C.P. (2010) Effects of Reducing or Eliminating Resident Work Shifts over 16 Hours: A Systematic Review. *Sleep*, **33**, 1043-1053. https://doi.org/10.1093/sleep/33.8.1043

[8] Papp, K.K., Miller, C.M. and Strohl, K.P. (2006) Graduate Medical Training, Learning, Relationships, and Sleep Loss. *Sleep Medical Reviews*, **10**, 339-345. https://doi.org/10.1016/j.smrv.2006.04.003

[9] Basner, M., Dinges, D.F., Shea, J.A., Small, D.S., Zhu, J., Norton, L., *et al.* (2017) Sleep and Alertness in Medical Interns and Residents: An Observational Study on the Role of Extended Shifts. *Sleep*, **40**, zsx027. https://doi.org/10.1093/sleep/zsx027

[10] Harrison, E.M., Easterling, A.P., Yablonsky, A.M. and Glickman, G.L. (2021) Sleep-Scheduling Strategies in Hospital Workers. *Nature and Science of Sleep*, **13**, 1593-1609. https://doi.org/10.2147/NSS.S321960

[11] World Medical Association (2013) Declaration of Helsinki: Ethical Principles for Medical Research Involving Human Subjects. *Journal of the American Medical Association*, **310**, 2191-2194. https://doi.org/10.1001/jama.2013.281053

[12] Mayer, J.D., Salovey, P. and Caruso, D. (2002) Mayer-Salovey-Caruso Emotional Intelligence Test (MSCEIT) User's Manual. Multi-Health Systems, Toronto.

[13] Mayer, J.D., Salovey, P. and Caruso, D.R. (2000) Models of Emotional Intelligence. In: Sternberg, R.J., Ed., *Handbook of Intelligence*, Cambridge University Press, Cambridge, 396-420. https://doi.org/10.1017/CBO9780511807947.019

[14] Holbrook, M.I., White, M.H. and Hutt, M.J. (1994) Increasing Awareness of Sleep Hygiene in Rotating Shift Workers: Arming Law-Enforcement Officers against Impaired Performance. *Perceptual and Motor Skills*, **79**, 520-522. https://doi.org/10.2466/pms.1994.79.1.520

[15] Kerin, A. and Aguirre, A. (2005) Improving Health Safety and Profits in Extended Hours Operation (Shift-Work). *Industrial Health*, **43**, 201-208. https://doi.org/10.2486/indhealth.43.201

[16] Lee, K.A., Gaya, C.L. and Alstenb, C.R. (1013) Home-Based Behavioral Sleep Training for Shift Workers: A Pilot Study. *Behavioral Sleep Medicine*, **12**, 455-468. https://doi.org/10.1080/15402002.2013.825840

[17] Sullivan, J.P., O'Brien, C.S., Barger, L.K., Rajaratnam, S.M.W., Czeisler, C.A. and Lockley, S.W. (2017) Randomized, Prospective Study of the Impact of a Sleep Health Program on Firefighter Injury and Disability. *Sleep*, **40**, zsw001. https://doi.org/10.1093/sleep/zsw001

[18] Abdelhamid, B.M., Omar, H., Hassan, M.M., Embaby, S.A., Rady, A. and Aly, H.M. (2020) Effects of Partial Sleep Deprivation Following Night Shift on Cognitive Functions of Egyptian Anesthesiologists: A Prospective Observational Study. *Egyptian Journal of Anaesthesia*, **36**, 61-68. https://doi.org/10.1080/11101849.2020.1768630

[19] Killgore, W., Balkin, T.J., Yarnell, A.M. and Capaldi, V.F. (2017) Sleep Deprivation Impairs Recognition of Specific Emotions. *Neurobiology of Sleep and Circadian Rhythms*, **3**, 10-16. https://doi.org/10.1016/j.nbscr.2017.01.001

[20] Goel, N., Rao, H., Durmer, J.S. and Dinges, D.F. (2009) Neurocognitive Consequences of sleep deprivation. *Seminars in Neurology*, **29**, 320-339. https://doi.org/10.1055/s-0029-1237117

[21] Ochab, J.K., Szwed, J., Oleś, K., Bereś, A., Chialvo, D.R., Domagalik, A., *et al.* (2021) Observing Changes in Human Functioning during Induced Sleep Deficiency and Recovery Periods. *PLOS ONE*, **16**, e0255771. https://doi.org/10.1371/journal.pone.0255771