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ORIGINAL ARTICLE

Pre-Sleep Media Device Use and Psychomotor Vigilance Performance

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ABSTRACT

Background: Sleep is a biological requirement for human well-being and daily function, which can affect mental and physical health. Using electronic devices can have a significant negative effect on the individual's sleep. The current study aimed to determine the impact of average minutes of pre-sleep media device use (MDU) on the psychomotor vigilance task (PVT) as one of the measures of vigilance in a sample of Iranian nurses.

Methods: A cross-sectional study was conducted on 200 nurses from Tehran, Iran, who underwent PVT testing. The association between PVT and the average minutes of pre-sleep MDU was evaluated using a multiple regression model and the Spearman correlation coefficient.

Results: After adjusting for age as a confounder, the mean PVT score significantly increased with longer average minutes of pre-sleep MDU ($\beta = 0.85$, $p < 0.001$). Notably, this increase was more substantial among nurses who used media devices for less than 100 minutes ($\beta = 1.53$, $p < 0.001$).

Conclusion: Our findings show that higher durations of pre-sleep MDU were associated with poorer PVT performance among nurses who used media devices for less than 100 minutes and were younger than 35 years old. Thus, it is essential to promote awareness among nurses about the average duration of pre-sleep MDU.

KEYWORDS: *Media devices, Psychomotor vigilance performance, Nurse*

INTRODUCTION

Sleep is essential for human health, well-being, daily functioning, and survival, significantly impacting both mental and physical health [1]. This naturally occurring state is characterized by reduced consciousness and limited responsiveness to external stimuli and is regulated by several processes, including circadian rhythms [2]. Circadian rhythm refers to the body's internal 24-hour clock that regulates sleep-wake cycles and influences alertness, mood, and overall health based on environmental cues such as light and darkness [3]. The psychomotor vigilance task (PVT), on the other hand, is a neurobehavioral assessment tool commonly used to objectively measure vigilance and sustained attention deficits, particularly under conditions of partial sleep loss, sleep restriction, or sleepiness [4].

A good night's sleep—especially at the appropriate time—can enhance energy levels, learning capabilities, and memory during the day [5]. Given that sleep

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regulation is highly sensitive to environmental and behavioral influences, the use of electronic devices is particularly relevant, as these devices emit blue light that can disrupt circadian rhythms and suppress melatonin production [6]. With the rise of technological advancements over the past decade, electronic devices—such as smartphones, personal computers, video game systems, laptops, tablets, and televisions—have become integral to daily life due to their accessibility and perceived benefits. However, these devices can adversely affect physical and psychological health, leading to issues such as headaches, visual disturbances, chronic neck and back pain, stress, anxiety, and sleep disruption [2].

In sleep research, the psychomotor vigilance task (PVT) has emerged as one of the most widely used objective indicators of vigilance and sustained attention deficits under a variety of experimental conditions, including partial sleep loss, chronic sleep restriction, napping, and sleepiness [7]. PVT is highly sensitive to the effects of sleep loss, disruption, and deprivation, enabling the collection of large volumes of data within a relatively short time period [8]. Thus, assessing PVT as a clinical diagnostic tool for evaluating sleep performance may be pivotal.

One well-known factor contributing to sleep disruption is shift work—a common reality for nurses due to the necessity of 24-hour patient care. Studies indicate that shift work is strongly associated with sleep disorders among healthcare professionals, particularly nurses. For instance, an extensive survey by Garbarino et al. (2016) reported that over 44% of shift-working nurses experience significant sleep disturbances, primarily due to irregular sleep patterns and insufficient recovery time between shifts [9].

The use of electronic devices before bedtime further exacerbates sleep issues among nurses. Like many others, nurses often rely on electronic devices to unwind after demanding shifts; however, research indicates that screen exposure prior to sleep—particularly the blue light emitted by these devices—can delay sleep onset and reduce sleep quality [6]. These effects are especially concerning in the nursing profession, where poor sleep quality has been linked to cognitive deficits in sustained attention and memory—both essential for accurate clinical decision-making. This was underscored in a study by Weaver et al. (2018), which reported that nurses experiencing sleep disturbances were twice as likely to make medical errors as those with adequate sleep [10].

These findings underscore the importance of promoting sleep health among nurses by encouraging practices that limit electronic device usage before bedtime. Addressing these issues may enhance cognitive function and overall health, ultimately improving both patient outcomes and job satisfaction for nurses. The primary aim of the current study is to investigate whether average pre-sleep media device usage (MDU) affects psychomotor vigilance task (PVT) performance among nurses. It is anticipated that the findings will demonstrate a significant relationship between increased pre-sleep MDU and poorer PVT performance, reflecting decreased cognitive function and vigilance. This study could offer valuable insights into the negative impact of electronic device usage on nurses' sleep quality, which may, in turn, influence their job performance and patient safety.

The potential implications of this research for nursing practice include the development of targeted sleep health interventions aimed at reducing electronic device usage before bedtime. Such interventions may improve sleep quality, reduce fatigue, and enhance cognitive function among nurses—ultimately benefiting both individual health and patient care outcomes.

MATERIALS AND METHODS

Data Collection

We retrospectively analyzed data from nurses working at a hospital in Tehran, Iran. A total of 200 nurses underwent PVT examinations. The study population consisted of nurses on the same work shift, specifically selecting those who did not work night shifts. The following inclusion criteria were defined for participation: (i) no use of sedatives or hypnotics, (ii) no diagnosed sleep disorders, (iii) no night shift assignments, (iv) no caregiving responsibilities for parents or other sick or elderly individuals at home, and (v) no secondary employment. Nurses who did not meet these criteria were excluded from the study.

Sampling was performed using a convenience sampling method. To determine the appropriate sample size, we utilized Cochran's formula:

$$n0 = pqz^2 \div d^2$$

Substituting the values into the formula:

$$n_0 = \frac{(0.5) \times (0.5) \times (1.96)^2}{(0.10)^2}$$

$$n_0 = \frac{(0.25) \times (3.8416)}{0.01}$$

$$n_0 = \frac{0.9604}{0.01} = 96.04$$

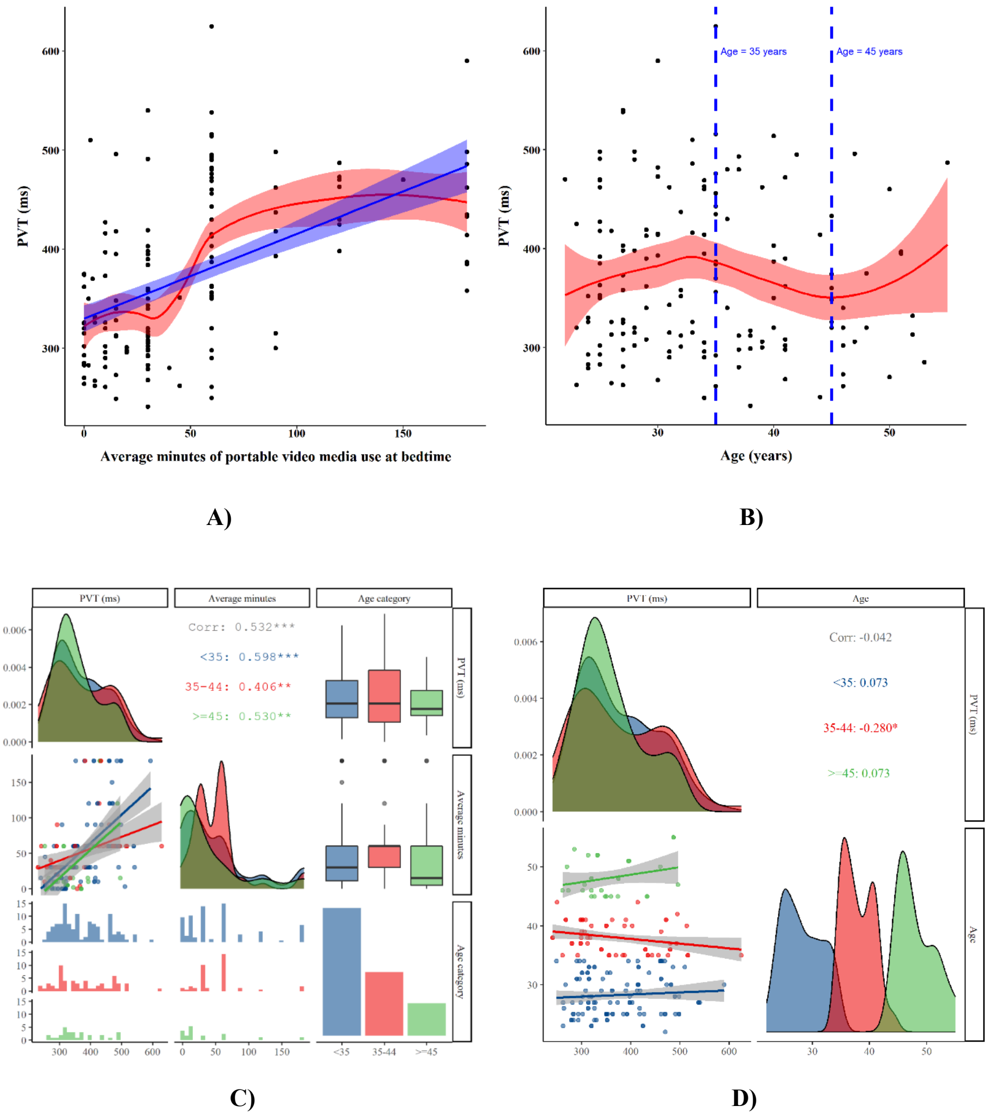

Figure 1. A) The relation between PVT (ms) and average minutes of pre sleep MDU (note: blue color shows the linear model fitted to the data and red color is the loess method); B) the relation between PVT (ms) and age (years) ; C) the correlation between PVT and average minutes of pre sleep MDU by age group; D) The correlation between PVT and age. $^{*}p<0.05$, $^{**}p<0.001$, $^{***}p<0.001$

where p=0.5 (estimated proportion), $q=1-p$, z=1.96 (z-value for a 95% confidence level), and d=0.10 (margin of error).

This calculation yielded a minimum sample size estimate of approximately 96. Ultimately, the actual sample size was 200, reducing the margin of error to approximately 7%, which enhances the reliability of our findings.

Instruments

In this cross-sectional study, data collection tools included demographic variables such as age and the PVT. The Sleep-2-Peak mobile app (iOS version) was specifically used to measure PVT performance. This app provides a user-friendly platform for administering the PVT, which assesses reaction time in response to visual stimuli. It enables real-time tracking of attention and cognitive performance and has been validated for use among various populations, including healthcare professionals. The app's validity has been confirmed through rigorous testing, demonstrating its accuracy in detecting fatigue-related changes in reaction times, particularly during sleep deprivation [11, 12].

For the Persian version of the app, no separate validation was conducted, as it was presented in a pictorial format with no written content requiring translation or modification. Therefore, the core functionality of the app remained unchanged, and validation of the original version was deemed sufficient.

Table 1. The influence of average minutes of pre sleep MDU on PVT in unadjusted and adjusted linear regression model stratified by Types 1 and 2

Type	Category	Independent variable	Unadjusted		Adjusted	
			β (95% CI)	p-value	*β* (95% CI)	p-value
1	Average minutes<100	Average minutes	1.50 (1.09, 1.90)	<0.001	1.53 (1.10,1.96)	<0.001
	Average minutes>=100	Average minutes	-0.09 (-0.74, 0.56)	0.774	-0.04 (-0.70,0.63)	0.910
	Total	Average minutes	0.86 (0.66, 1.05)	<0.001	0.85 (0.66,1.05)	<0.001
2	Total	Average minutes >=100 vs. <100	88.88 (58.89, 118.86)	<0.001	90.52 (60.30,120.73)	<0.001

Note: The predictors in types 1 and 2 are numeric and binary variables, respectively. In adjusted model, the effect of independent variable was assessed after controlling for categorical age variable. *CI* confidence interval, *PVT* psychomotor vigilance task

Statistical analysis

The Spearman's rank correlation coefficient was used to measure the relationship between numerical variables. Both unadjusted and adjusted regression models were employed to evaluate the impact of average pre-sleep media device usage (MDU) on PVT performance using two approaches. In Type 1, the effect of average pre-sleep MDU was assessed in two categories: less than 100 minutes and more than 100 minutes. In Type 2, the binary form of MDU (more than 100 minutes vs. less than 100 minutes) was examined. Given that age may be a confounding variable, analyses were stratified by age group (<35 years, 25–44 years, and ≥45 years). A p-value of less than 0.05 was considered statistically significant. Additionally, 95% confidence intervals (CIs) were calculated. All analyses were conducted using R (version 4.2.0) and SPSS (version 16).

RESULTS

A total of 200 nurses were recruited for this study. The correlation between PVT performance and average minutes of pre-sleep media device usage (MDU) was examined by age category (<35, 35–44, and ≥45 years), as shown in Figure 1. PVT scores increased with average pre-sleep MDU up to 100 minutes but not beyond (Figure 1A). Figure 1B demonstrates that the association between age and PVT varied across different age categories. As illustrated in Figure 1C, the highest Spearman correlation coefficient between average pre-sleep MDU and PVT ($r_s = 0.60$, $p < 0.001$) was observed among nurses under 35 years of age. In contrast, Figure 1D shows a significant negative correlation between age and PVT among nurses aged 35–44 years ($r_s = -0.28$, $p < 0.05$).

In Type 1, multiple regression analysis (adjusted model) revealed that average pre-sleep media device usage (MDU) among nurses who used media devices for less than 100 minutes was a strong predictor of PVT performance. The impact of average pre-sleep MDU on PVT was statistically significant across the entire dataset. Specifically, the mean PVT score increased by 1.53 units for each additional minute of pre-sleep MDU among nurses using media devices for less than 100 minutes. Similarly, when considering the full sample, the mean PVT score increased by 0.85 units per additional minute of pre-sleep MDU.

In Type 2, the binary comparison of MDU duration revealed a significant impact on PVT performance ($p < 0.001$). Nurses who used media devices for more than 100 minutes had a mean PVT score that was 90.52 units higher than those who used them for less than 100 minutes. Notably, the results from unadjusted and adjusted regression models were consistent across both Type 1 and Type 2 analyses (Table 1).

DISCUSSION

To conclude, the present study contributes to the literature by demonstrating an association between pre-sleep MDU and psychomotor PVT performance. According to our findings, the strongest correlation between PVT and pre-sleep MDU was observed among participants aged 35 years and younger. This suggests that younger individuals who use media devices at bedtime may be particularly susceptible to sleep disturbances. One possible explanation is that this age group tends to maintain higher activity levels than older adults. Indeed, younger age may negatively affect sleep quality, as individuals in this group are less likely to adapt their activities to their energy levels. Consequently, sleep may undergo macrostructural and microstructural changes that impair PVT performance [13].

These findings align with a recent epidemiological study reporting that individuals under 30 years of age experienced the highest frequency of sleep problems when engaging with technology within an hour before bedtime, indicating that technology use may be a contributing factor to sleep disruption [14]. Additionally, Thomann et al. [8] concluded that age significantly influences PVT outcomes in healthy individuals. Therefore, the relationship between PVT and pre-sleep MDU should be analyzed with age as a potential confounder. However, in our study, age did not significantly confound the association between PVT and average minutes of pre-sleep MDU.

Moreover, studies focusing on healthcare professionals have shown that sleep deprivation impairs both cognitive and motor functions, contributing to an increased incidence of medical errors. For example, a study on Sudanese healthcare workers reported heightened sleep disturbances that adversely affected performance in high-pressure environments such as hospitals. These findings align with our results, where nurses who used media devices for less than 100 minutes before sleep exhibited significant declines in PVT performance [15].

Similarly, a review of the literature on sleep deprivation among healthcare professionals found that reduced sleep can impair clinical judgment and elevate error risk, particularly among night shift workers [16]. Our findings reinforce this trend, suggesting that even relatively brief periods of pre-sleep media device use may disrupt sleep to a degree that meaningfully impairs cognitive performance. Previous research has shown that even moderate sleep deprivation can produce cognitive deficits comparable to those experienced during night shift work [17].

Likewise, our modeling approach showed that the average minutes of pre-sleep MDU significantly increased the PVT score in all participants. Sadly, these results show that this factor adversely affects the quality of sleep and causes other adverse effects as well. Therefore, raising the level of awareness about using media devices is very essential.

This study has a number of strengths. It focused on an important topic, showing how pre-sleep media device use affects cognitive performance in healthcare professionals. By specifically examining nurses under 35, the study targets a group that may be particularly susceptible to sleep disturbances. The use of objective measures, like the psychomotor vigilance task (PVT), strengthens the findings. Additionally, the study's results align with existing research, making the conclusions more credible.

However, there are also some limitations. The sample size and context might limit how widely these findings can be applied. Other factors, such as stress or workload, weren't fully considered and could influence the results. Also, while the study shows a link between media use and cognitive decline, it doesn't prove causation, so further research is needed to confirm whether media use directly leads to sleep disturbances and performance issues. Lastly, the focus on short-term effects means the long-term impact of media use on sleep and work performance remains unclear.

CONCLUSION

In conclusion, our study demonstrated a significant relationship between pre-sleep MDU and PVT performance among nurses. The findings indicate that younger nurses, particularly those aged 35 and under, are more susceptible to the negative effects of pre-sleep MDU on sleep quality and cognitive performance. This age group showed the strongest correlation between PVT and pre-sleep MDU, suggesting that they are at a higher risk of sleep disturbances due to their media device usage habits.

Our results align with existing literature, which highlights the adverse impact of electronic media use on sleep quality. The positive correlation between PVT and average minutes of pre-sleep MDU, especially under 100 minutes, underscores the importance of moderating media device use before bedtime to improve sleep quality and overall health. Given the potential negative effects on sleep and cognitive performance, it is crucial to raise awareness about the impact of pre-sleep media device use. Interventions aimed at reducing media device use before bedtime could be beneficial in enhancing sleep health among nurses and other shift workers.

Future research should focus on longitudinal studies to examine the long-term effects of pre-sleep media device use on sleep quality and PVT performance. Additionally, culturally tailored interventions to reduce pre-sleep media device use could be more effective in mitigating its negative impact on sleep and cognitive functions.

REFERENCES

1. AlShareef SM. The impact of bedtime technology use on sleep quality and excessive daytime sleepiness in adults. Sleep Sci. 2022;15(Spec 2):318.
2. Qanash S, Al-Husayni F, Falata H, Halawani O, Jahra E, Murshed B, et al. Effect of electronic device addiction on sleep quality and academic performance among health care students: cross-sectional study. JMIR Med Educ. 2021;7(4):e25662.
3. Czeisler CA, Buxton OM, Khalsa SBS. The human circadian timing system and sleep-wake regulation. In: Principles and Practice of Sleep Medicine. Philadelphia: Elsevier Inc.; 2005. p. 375–94.
4. Dinges DF, Powell JW. Microcomputer analyses of performance on a portable, simple visual RT task during sus-

tained operations. Behav Res Methods Instrum Comput. 1985;17(6):652–5.

5. Pham HT, Chuang HL, Kuo CP, Yeh TP, Liao WC, editors. Electronic device use before bedtime and sleep quality among university students. Healthcare (Basel). 2021.
6. Chang AM, Aeschbach D, Duffy JF, Czeisler CA. Evening use of light-emitting eReaders negatively affects sleep, circadian timing, and next-morning alertness. Proc Natl Acad Sci U S A. 2015;112(4):1232–7.
7. Lee IS, Bardwell W, Ancoli-Israel S, Natarajan L, Loredo JS, Dimsdale JE. The relationship between psychomotor vigilance performance and quality of life in obstructive sleep apnea. J Clin Sleep Med. 2011.
8. Thomann J, Baumann CR, Landolt HP, Werth E. Psychomotor vigilance task demonstrates impaired vigilance in disorders with excessive daytime sleepiness. J Clin Sleep Med. 2014;10(9):1019–24.
9. Garbarino S, Lanteri P, Durando P, Magnavita N, Sannita WG. Co-morbidity, mortality, quality of life and the healthcare/welfare/social costs of disordered sleep: a rapid review. Int J Environ Res Public Health. 2016;13(8):831.
10. Weaver MD, Vetter C, Rajaratnam SM, O'Brien CS, Qadri S, Benca RM, et al. Sleep disorders, depression and anxiety are associated with adverse safety outcomes in healthcare workers: a prospective cohort study. J Sleep Res. 2018;27(6):e12722.
11. Brunet JF, Dagenais D, Therrien M, Gartenberg D, Forest G. Validation of Sleep-2-Peak: a smartphone application that can detect fatigue-related changes in reaction times during sleep deprivation. Behav Res Methods. 2017;49:1460–9.
12. Basner M, Dinges DF. Maximizing sensitivity of the psychomotor vigilance test (PVT) to sleep loss. Sleep. 2011;34(5):581–91.
13. Bartolacci C, Scarpelli S, D'Atri A, Gorgoni M, Annarumma L, Cloos C, et al. The influence of sleep quality, vigilance, and sleepiness on driving-related cognitive abilities: a comparison between young and older adults. Brain Sci. 2020;10(6):327.
14. Gradisar M, Wolfson AR, Harvey AG, Hale L, Rosenberg R, Czeisler CA. The sleep and technology use of Americans: findings from the National Sleep Foundation's 2011 Sleep in America poll. J Clin Sleep Med. 2013;9(12):1291–9.
15. Amin MHJ, Elmahi MAME, Fadlalmoula GAAGA, Amin JHJ, Alrabee NHK, Awad MH, et al. Assessment of the importance of sleep quality and the effects of deprivation on Sudanese healthcare professionals amidst conflict in Sudan. Sleep Sci Pract. 2024;8(1):10.
16. Patient Safety Network. Fatigue, sleep deprivation, and patient safety. 2017.
17. Lazzari C, Shoka A, Mousailidis G. Sleep deprivation in healthcare professionals and medical errors: how to recognize them. Sleep Med Disord Int J. 2018;2(1):15–6.