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RESEARCH ARTICLE

Effect of sleep quality on cognition and psychomotor skill in women with premenstrual syndrome

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ABSTRACT

Background: Women with premenstrual syndrome (PMS) suffer from insomnia and sleep deprivation thereby reporting difficulties pertaining to cognitive and psychomotor skill performance. Reaction time (RT) being a simple objective tool was used to measure their performance in our study. **Aims and Objectives:** The aim of the study was (1) to determine the sleep quality and cognition, psychomotor skill in women with and without PMS and (2) to assess the correlation between sleep quality and cognition, psychomotor skill in women with different grades of PMS. **Materials and Methods:** The study was conducted on 60 female nursing students aged 18–20 years. Sleep quality was assessed using Pittsburgh sleep quality index and Insomnia Severity Index (ISI) questionnaire and the RT (visual and auditory) was assessed using PC1000Hz RT. The parameters were then compared in different grades of PMS, which was assessed using Moos questionnaire. **Results:** Among the 60 females, 20 each belonged to moderate, mild, and absent PMS (control) category. Analysis of variance was used to compare the sleep score, ISI, and RT in different severity of PMS. There was a statistically significant difference between the groups with a *P* value of 0.001 each. This suggests that sleep score ISI and RT were higher in moderate PMS when compared to mild and control group. **Conclusion:** As the severity of PMS increased, the RT also increased, implying poor cognition and psychomotor skill**.** Furthermore, individuals with increased severity of PMS reported a poor quality of sleep and insomnia which could be the probable reason for poor RT. Thus, education on enhancing the sleep quality may improve the quality of life in PMS.

KEY WORDS: Premenstrual Syndrome; Sleep Quality; Insomnia; Cognition; Reaction Time

INTRODUCTION

Premenstrual syndrome (PMS) is defined as the repeated occurrence of variable clusters of troublesome ill-defined symptoms and signs developing 10 days before the onset of menses thereby subsiding once the menstruation occurs.

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This may be mainly due to the normal hormonal disturbances that occur during the late luteal phase of the menstrual cycle. Sleep disturbances are one of the most important variables that are encountered during PMS which, in turn, can affect the cognition and psychomotor skill. Moreover, this could be due to a decreased response to melatonin due to hormonal disturbances in the late luteal phase as quoted by other studies. Thus, mood-related symptoms have known to occur due to sleep deprivation or restriction resulting in decreased mental ability and alertness. Thus, normal sleep is essential for individual's physical and mental wellbeing. Although there are a lot of variations in sleep requirement among individuals, most adults require 7 h sleep on a regular basis for the promotion of optimal health.[1] It is seen that women

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have more disturbed sleep than men due to menstrual related hormonal fluctuations[2] resulting in irritability, anger, mood swings 6 days before menses, and with a peak severity 2 days before menses. These constellations of symptoms tend to occur from month to month.[3] The common problems encountered are sleep onset insomnia, frequent night awakening, non-restoration of sleep as a result of which daytime consequences occur such as poor concentration, daytime sleepiness, decreased alertness, and poor performance at work.[4] Reaction time (RT) being an indirect measurement of sensory skills, cognitive processing, and motor performance is very much affected thereby decreasing the capability of central nervous system processing which is very crucial for our everyday lives.[5]

Thus, in this study, we wanted to see if the RT is affected and if so, whether there is any correlation with the sleep quality leading to a decline in the RT. As the RT is a simple non-invasive tool that has a physiological significance in assessing the above parameters,[6] it was used to measure the cognition levels and was correlated with sleep quality which, in turn, was assessed using standard questionnaires.

MATERIALS AND METHODS

This is a cross-sectional study conducted on 60 first-year nursing students in the age group 18–20 years. Students with a history of hearing or visual disorder, cardiovascular and respiratory disease and on medication affecting cognitive performance were excluded from the study. Ethical clearance for the study was obtained from the Institutional Ethical Committee. Participation in the test was voluntary and informed written consent was taken from every participant. Auditory RT (ART) and visual RT (VRT) were done using PC1000Hz RT.

Visual RT Measurement

When the examiner pressed the "start" button in the component (A) which was out of the view of the subject and the subject was instructed to press the "Stop" button in component (B) with the right index finger first as soon as he/she sees the red light in the instrument. RT was recorded in audacity software.

Auditory RT Measurement

Examiner presses the start button (A) which will be out of the view of the subject, and the subject is instructed to press the stop button (B) as soon as he/she hears the sound (1000 hertz's tone) through the headphone connected to it. RT is recorded in audacity software.

All subjects must be right-handed and use their right index finger to press the switch to stop the quartz clock of the apparatus. Each subject was instructed to press the switch as soon as she/he saw the light or heard the sound. Minimum five trials are given for both VRT and ART measurement. Minimum time recorded is calculated as final VRT and ART. The readings were taken between 10 a.m. and 12 p.m. in a quiet secluded room.

Furthermore, sleep was assessed using 19-item Pittsburgh sleep quality index (PSQI) (Buysse *et al*.) which consisted of a self-report scale involving totally 19 items and seven subscales (subjective sleep quality, sleep latency, sleep duration, habitual sleep efficiency, sleep disturbances, use of sleeping medication, and daytime dysfunction) that evaluate the sleep quality and disorder within the past 1 month[7,8]. Further insomnia was assessed using 7-item based Insomnia Severity Index (ISI) scale. The above parameters were compared in different grades of PMS which was assessed using 28-item designed PMS questionnaire with scaling from 0 to 3 (0-no symptom, 1 - mild, 2 - moderate, and 3 - severe) (modified Moos).

Statistical Analysis

Descriptive statistical analysis has been carried out in the present study. Results on continuous measurements are presented as mean ± standard deviation. The significance is assessed at 5% level of significance. Analysis of variance was used to compare the RT, sleep score, and ISI in different severity of PMS. Pearson correlation has been used to find the significance of the relationship between RT and sleep quality.

RESULTS

Among 60 females, 20 each belonged to moderate, mild and absent PMS (control) category. On comparing the sleep score, ISI and RT in the different severity of PMS, there was a statistically significant difference between the groups ($P < 0.001$). That is, the RT and ISI were higher in moderate PMS when compared to mild and control group, whereas the sleep score was less in moderate PMS when compared to the other groups proving a poor quality of sleep [Table 1].

Furthermore, on Pearson correlation there was a significant positive correlation of VRT and ART with sleep scores and ISI which proves that as the value of sleep score increases there was a significant increase in the RT scores as well, indicating that poor sleep is responsible for the decreased cognition with increased RT. Thus, increased RT means decreased alertness and cognition which could be due to poor sleep quality as indicated by high sleep scores. This is depicted in Figures 1-4.

DISCUSSION

Previous studies have correlated PMS with sleep and RT separately. However, in our studies, we have compared the sleep quality and RT in different grades of PMS which is the

Table 1: Correlation of VRT and ART with sleep scores

Parameters	PMS	Mean±SD	ANOVA	*P* value
VRT	Mod	217.90±14.378	183.033	0.0001***
	Mild	180.65±15.928		
	No	139.35±6.124		
ART	Mod	206.40±27.590	137.351	0.0001***
	Mild	156.9±13.696		
	No	110.05±8.082		
Sleep score	Mod	8.35±1.872	101.968	0.0001***
	Mild	4.00±1.414		
	No	2.25±0.550		
ISI	Mod	12.70±2.515	74.218	0.001***
	Mild	8.90±1.373		
	No	5.10±1.861		

***There is statistical significance difference between the groups at 95% (P<0.05). ANOVA: Analysis of variance, VRT: Visual reaction time, ART: Auditory reaction time, ISI: Insomnia severity index

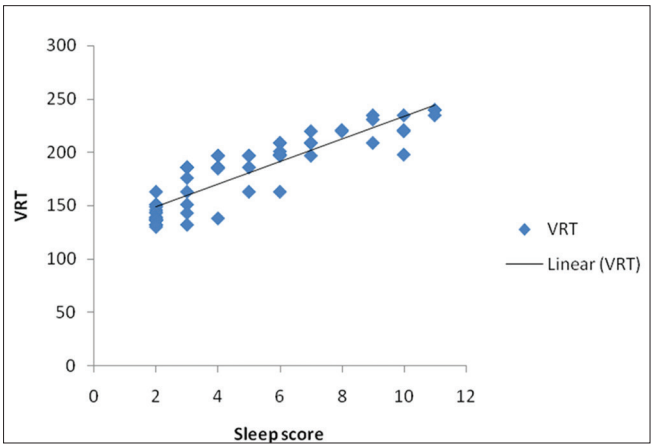

Figure 1: Correlation of sleep score with visual reaction time

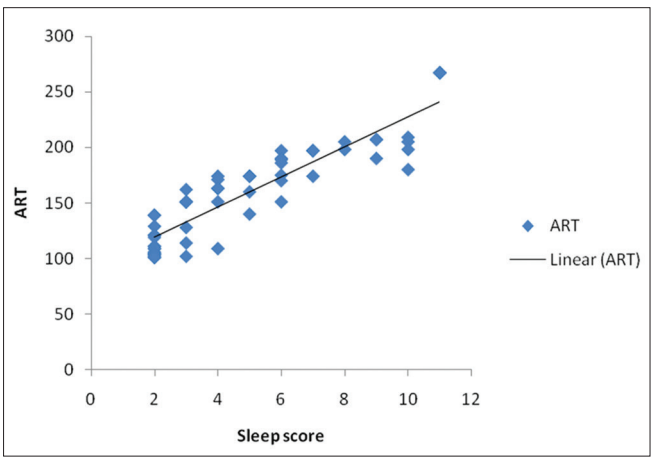

Figure 2: Correlation of sleep score with auditory reaction time

first of its kind and also have seen if there is any correlation between sleep quality and the RT in PMS. There are very few studies in literature supporting the above evidence; hence, this study was conducted. The results of our study have proved that the RT duration increased as the sleep score and ISI increased.

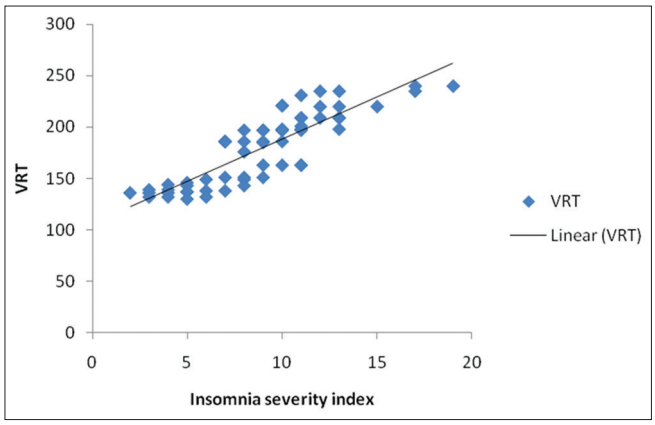

Figure 3: Correlation of insomnia severity index with visual reaction time

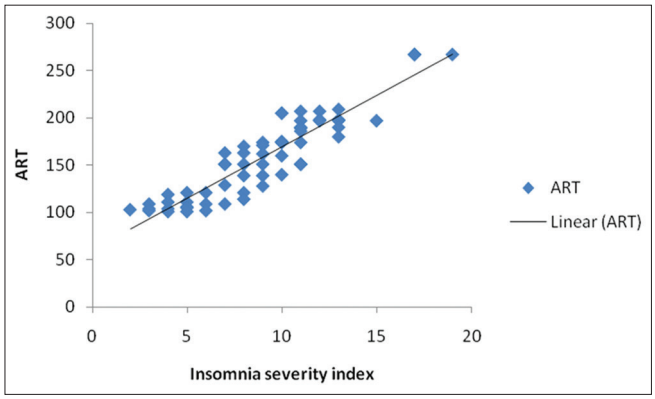

Figure 4: Correlation of insomnia severity index with auditory

This proves the fact that, the RT being one of the key tool in assessing the cognition and psychomotor skill, is very much affected in moderate PMS when compared mild and no PMS category and this could be due to poor good quality sleep in higher grades of PMS. Women with PMS suffer from various symptoms such as anxiety, depression, irritability, fatigue, headache, abdominal bloating, breast tenderness, severe dysmenorrhea, insomnia, and sleep disturbance.[9] The cause could be due to hormonal disturbances that occur in the late luteal phase.[10] Further recent studies have reported that there is decreased melatonin secretion and also decreased response to melatonin in the late luteal phase which could be the cause for sleep disturbances.[11]

Further women with PMS experience excessive daytime sleepiness and fatigue in the late luteal phase leading to a declined function of various activities[12] which could be one of the reasons for an increased RT in these individual. There is an only limited number of studies addressing sleep pattern across the menstrual cycle in healthy women. However, these studies have indicated that sleep homeostasis[8,13,14] and quality[15] remains quite stable and observable changes are noted only in sleep architecture.[11-14,16] Further women often report subjective complaints of disturbed sleep though polysomnographic changes are less frequent. Thus, in our study, we did a subjective analysis of sleep quality using PSQI

and ISI which is still considered to be gold standard testing. The studies on polysomnography have shown to increase the NREM sleep and Stage 2 sleep percentage while a decrease in REM sleep percentage was noted.[11] Yet another study has noted an increase in Stage 2 sleeps but no change in SWS or REM sleep.[17]

Our study also showed that sleep quality was poor as the severity of PMS increased. Furthermore, the study showed an increase in the RT as the severity of PMS increased. Further, our study also proved that there was a direct correlation between sleep quality and RT, that is, the more the sleep core and ISI score the more the RT duration indicating poor quality of sleep thereby a decline in cognition and psychomotor skill performance. This goes in accordance with other studies which showed that the reaction was poor in sleep-deprived subjects.[18-20]

However, studies have also explained a different theory for an increased RT in PMS. They suggest that retention of water and sodium due to variation in sex steroidal levels might influence the axonal conduction time and the availability of neurotransmitter at the synapse thereby leading to decreased CNS processing and sensory-motor association causing an increase in RT. However, there is no direct evidence-based study that has been done to explain the above theory. Further, even in sleep disturbances, there is decreased CNS processing and sensory-motor association[21-23] that could have led to increase in the RT,[24] suggesting a decreased alertness, cognition, and sensory motor skill performance.[19]

Limitation of the Study

The sample size could be increased along with the inclusion of the severe PMS category. In this study, we had only 4 students who were in the severe category, and so we could not include them due to statistical reason. Polysomnography could have been done to quantify the sleep disturbance so that the study would have been more valid. Hormonal changes could also have been included in the study to make it more defensive.

CONCLUSION

Although PMS is on the rise among females, the grading of PMS and studying their RT and sleep quality is first of its kind. In this study, we have concluded that as the severity of PMS increases, a significant decrease in sleep quality and an increase in RT duration are noted. The cause for the sleep disturbances may due to the hormonal changes that occur during the late luteal phase which could have caused a decrease in the RT duration. Thus by enhancing the sleep quality in PMS, the RT can also be improved which thereby improves the cognition and sensory motor skill performance.

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