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Original Research Article

A study of cognitive function, quality of sleep, and Stroop effect among adolescent girls with premenstrual syndrome

T Dinesh[1], M Abarna[2], JB Ashraf Ali[3]*

[1]Dept. of Physiology, Government Medical College, Nagapattinam, Tamil Nadu, India
[2]Government Thiruvarur Medical College, Thiruvarur, Tamil Nadu, India
[3]Dept. of Physiology, Government Thiruvarur Medical College, Thiruvarur, Tamil Nadu, India

Abstract

Background: Premenstrual syndrome (PMS) involves various somatic and psychological symptoms related to the luteal phase of the menstrual cycle, ranging from mild discomfort to disability and impacting daily life.
Objective: To compare cognitive function, sleep quality, and the Stroop effect between adolescent girls with PMS and healthy controls.
Materials and Methods: This cross-sectional study included 60 adolescent girls (30 with PMS and 30 controls) at the Department of Physiology, Government Thiruvarur Medical College. The participants were selected using the Premenstrual Symptoms Screening Tool (PSST). Cognitive function was assessed using the Montreal Cognitive Assessment (MoCA), sleep quality using the Pittsburgh Sleep Quality Index (PSQI), and attention processing using the Stroop effect. Measurements were taken three days before menstruation.
Results: The mean age was similar in both groups (PMS: 18.97 ± 0.81; controls: 18.93 ± 0.78). MoCA scores were significantly lower in the PMS group (23.9 ± 2.97) than the controls (25.93 ± 1.76, $P < 0.05$). PSQI scores were higher in the PMS group (6.67 ± 1.65 vs. 5.3 ± 1.3, $P < 0.05$), indicating poorer sleep quality. The Stroop effect duration was significantly shorter in the PMS group (48.67 ± 15.18) than in controls (66.7 ± 19.13, $P < 0.05$).
Conclusion: PMS significantly impairs cognitive function, sleep quality, and Stroop task performance in adolescent girls. Early recognition and intervention are crucial to mitigate these impacts on academic and daily activities.

Keywords: Premenstrual syndrome (PMS), Cognitive function, Sleep quality, Stroop effect, Adolescent girls, Montreal cognitive assessment (MoCA), Pittsburgh sleep quality index (PSQI)**.**

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1. Introduction

A significant proportion of women and adolescent girls in their reproductive years experience premenstrual syndrome (PMS), a multifaceted and intricate condition. PMS symptoms typically occur during the luteal phase of the menstrual cycle, which is the period between ovulation and the beginning of menstruation. These symptoms can vary widely in both nature and severity, encompassing physical discomforts, such as bloating, breast tenderness, and headaches, as well as psychological and emotional disturbances including mood swings, irritability, and anxiety.[1]

The cognitive aspects of PMS can also be significant, with many individuals reporting difficulties with concentration and memory during this period. The impact of PMS on adolescent girls can be particularly pronounced as they simultaneously navigate the challenges of puberty, academic pressure, and social development. Research has shown that PMS can negatively affect academic performance, decreasing concentration, increased absenteeism, and reduce overall achievement. Furthermore, this condition can strain interpersonal relationships, contribute to low self-esteem, and impair participation in extracurricular activities. Given the potential for PMS to significantly disrupt various aspects of an adolescent's life, it is crucial for healthcare providers, educators, and parents to

*Corresponding author: JB Ashraf Ali
Email: jeybeeaa@hotmail.com

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be aware of the condition and its manifestations and to provide appropriate support and interventions to mitigate its impact on young women's overall well-being and prospects.[1,2.]

Recent research has indicated that cognitive function and sleep quality may be impacted by premenstrual syndrome, which is an intriguing finding.[3]

Cognitive function, which encompasses processes such as attention, memory, and executive functions, is an essential component of academic success and overall functioning. Evidence suggests that poor sleep quality, which is commonly reported in individuals with premenstrual syndrome, can have a detrimental impact on cognitive performance.[3] Furthermore, sleep deprivation and other factors related to premenstrual syndrome affect the Stroop effect, a well-established measure of cognitive control and inhibition.[4]

2. Materials and Methods

This study sought to examine the interrelationship between premenstrual syndrome, cognitive performance, sleep quality, and the Stroop effect among teenage girls. The present study aimed to explore these interconnected factors within an adolescent girls population.

2.1. Study design and setting

This cross-sectional, observational study was conducted in the Department of Physiology at the Government Thiruvarur Medical College, Thiruvarur, Tamil Nadu. This study investigated cognitive function, sleep quality, and the Stroop effect in adolescent girls with premenstrual syndrome (PMS) compared with healthy controls.

2.2. Study population

This study included 60 adolescent female healthcare students, aged 17-19 years, attending the Government Thiruvarur Medical College. Participants were categorized into two groups:

1. Study group (n=30): Adolescent girls identified with PMS.
2. Control group (n=30): Healthy adolescent girls without PMS.

2.3. Inclusion criteria

1. Study group: Girls participants who qualifies the criteria for Premenstrual syndrome (PMS) based on the assessment using the Premenstrual Symptoms Screening Tool (PSST).
2. Control group: Girls who did not meet the PSST criteria for PMS. Both groups were assessed during the luteal phase, 3 days before menstruation.

2.4. Exclusion criteria

1. Girls with a history of psychiatric, neurological, or chronic medical conditions.
2. Those on medications affecting cognitive function or sleep.
3. Girls with irregular menstrual cycles or using hormonal contraceptives.

2.5. Ethical considerations

The study received approval from the Institutional Ethics Committee of Government Thiruvarur Medical College, Thiruvarur. All participants provided written informed consent before their enrollment in the research.

2.6. Study tools and parameters

2.6.1. Premenstrual symptoms screening tool (PSST)[5]

This validated tool was used to screen the participants for PMS. The PSST assesses both physical and emotional symptoms of PMS. Based on their PSST scores, participants were classified into study or control groups.

2.6.2. Montreal cognitive assessment (MoCA)[6]

The MoCA was used to evaluate cognitive function, focusing on domains such as memory, executive function, attention, language, and visuospatial ability. The maximum achievable score was 30, with elevated scores indicating enhanced cognitive abilities.

2.6.3. Pittsburgh sleep quality index (PSQI)[7]

The Pittsburgh Sleep Quality Index (PSQI) was used to evaluate sleep quality, assessing both specific sleep disturbances and overall sleep patterns during the preceding month.Higher PSQI scores reflected poorer sleep quality.

2.6.4. Stroop test[8]

The Stroop test was used to assess cognitive processing speed and selective attention. Participants were asked to identify the ink color of the words while ignoring the written words. The time taken to complete the task (Stroop effect duration) was recorded.

2.7. Relevance

Understanding the effects of PMS on cognitive abilities and sleep patterns in teenage girls is crucial. The high prevalence of PMS among adolescents can lead to impaired cognition during the luteal phase, potentially affecting their academic performance and everyday activities.

Table 1: Comparison of age, MOCA (Montreal cognitive assessment score), Pittsburg sleep index, and Stroop time in the study group (n=30) and control groups (n=30) is given below. Values expressed as Mean±SD.

Parameters	Study	Control	Two-tailed p Value	Confidence Interval
Age	18.97 ± 0.81	18.93 ± 0.78	0.846	-0.451 to 0.371
MOCA Score	23.9 ± 2.97**	25.93 ± 1.76	0.002	0.769 to 3.296
PSI Score	6.67 ± 1.65**	5.3 ± 1.3	0.007	-2.137 to -0.602
Stroop Time (ms)	48.67 ± 15.18**	66.7 ± 19.13	0.002	9.105 to 26.955

Analysis was performed using the Student's unpaired t-test. *P<0.05, **P<0.01, ***P<0.001.

2.8. Data collection

Data were collected during the premenstrual phase (3 days before menstruation) for all participants. After screening with the PSST, the participants were administered the MoCA, PSQI, and Stroop test in a controlled environment. Each participant's cognitive function and sleep quality were assessed and the Stroop effect duration was recorded.

2.9. Statistical analysis

Data are expressed as the mean ± standard deviation. To evaluate differences between the study and control groups for each parameter, the Student's t-test was used. The level of statistical significance began at p-value < 0.05, enabling a thorough examination of variations in Cognitive function, Sleep quality, and Stroop effect across the two groups.

3. Result

The results of our study are given in **Table 1**.

4. Discussion

This study on cognitive function, sleep quality, and the Stroop effect among adolescent girls with Premenstrual Syndrome (PMS) provides valuable insights into the impact of PMS on various aspects of cognitive and physiological functioning. The key findings of the study are as follows:

1. Cognitive function: This study revealed a significant difference in cognitive performance between the PMS and control groups. Adolescent girls with PMS scored notably lower on the Montreal Cognitive Assessment (MoCA), with an average of 23.9 ± 2.97, compared to the control group's average of 25.93 ± 1.76 (P < 0.05). These findings indicate that PMS might have a detrimental impact on cognitive abilities in teenage girls.
2. Sleep quality: In this study, Individuals with Premenstrual Syndrome (PMS) showed significantly higher Pittsburgh Sleep Quality Index (PSQI) scores compared to those without PMS (6.67 ± 1.65 versus 5.3 ± 1.3, P < 0.05). This finding suggests that girls experiencing PMS tend to have worse sleep quality than their counterparts.
3. Stroop effect: In this study, Girls with PMS exhibited a significantly reduced Stroop effect duration (48.67 ± 15.18) compared to the control group (66.7 ± 19.13, P < 0.05), indicating potential differences in attention processing among those with PMS.

These findings align with those of previous studies on PMS and its effects on cognitive function and sleep quality. However, they also present contradictions and nuances, which warrant further investigation.

4.1. Cognitive function

Research has shown no notable disparities in cognitive abilities between women experiencing PMS and control groups. These studies examined various aspects of cognition, including attentiveness, recall, mental adaptability, and overall cognitive sharpness. While women with PMS may perceive themselves as cognitively impaired, objective assessments have not demonstrated any actual decline in their mental performance.[9,10]

Women with PMS have shown heightened sympathetic nervous system activity and diminished cognitive abilities, indicating that gonadal hormones may negatively impact cognitive functioning.[11,12]

PMS is associated with increased anxiety and depression; however, these mood changes do not consistently correlate with cognitive test performance.[13] Cognitive therapy and psycho-educational interventions have been shown to alleviate PMS symptoms, including cognitive complaints, suggesting that mood improvements may indirectly improve cognitive function.[14,15]

In our study, we found that there was cognitive deficits in the PMS group, in contrast to the previous mixed results. Some studies detected no cognitive differences between PMS sufferers and controls despite perceived cognitive issues, whereas others noted cognitive delays. The discrepancy between subjective cognitive difficulties and objective findings underscores PMS's complex cognitive effects of PMS. Mood disturbances linked to PMS, such as increased anxiety and depression, may lead to perceived cognitive difficulties without affecting actual cognitive function.

4.2. Quality of sleep

Women experiencing Premenstrual Syndrome commonly report disrupted sleep patterns. Those affected by PMS often describe their subjective sleep quality as inferior, particularly

during the late luteal phase of their menstrual cycle. However, objective sleep measurements, such as polysomnography, do not indicate significant alterations in sleep patterns.[16] Women experiencing premenstrual syndrome saw improvements in sleep quality and efficiency through the practice of yoga, which helped reduce sleep disturbances.[17] Research indicates that a considerable number of women experiencing PMS also suffer from poor sleep quality. Studies have revealed that 75.6% of individuals with PMS reported suboptimal sleep, in contrast to 58.8% of those without PMS who experienced similar sleep issues.[18]

A strong relation was observed between the intensity of PMS symptoms and reduced sleep quality. Individuals experiencing moderate to severe PMS were found to have a higher likelihood of reporting poor sleep compared to those with mild or no PMS symptoms.[19,20] Women experiencing PMS are more likely to encounter certain sleep issues, including prolonged periods of wakefulness after initially falling asleep and a longer time to fall asleep initially.[21]

The perceived quality of sleep in women with PMS is significantly impacted by symptoms related to anxiety and mood. Women experiencing PMS who report higher levels of anxiety tend to have worse subjective evaluations of their sleep quality. [(16)]. Women experiencing PMS exhibit a strong correlation between their psychological symptoms and poor sleep quality, which significantly affects their daily functioning.[20]

The results of our investigation into sleep quality align with previous researches, which has repeatedly demonstrated that women experiencing PMS report lower subjective sleep quality, especially during the late luteal phase. This is in accordance with other investigations that discovered a considerable number of women with PMS had poor sleep quality in comparison to those without PMS.

4.3. Stroop effect

During the luteal phase of their menstrual cycle, females experiencing premenstrual syndrome (PMS) demonstrate an enhanced emotional Stroop effect compared to control subjects, particularly when presented with pictorial and facial stimuli. This finding suggests that PMS may impair cognitive inhibition when processing emotional information.[22]

The shorter Stroop effect duration in the PMS group is an intriguing finding and warrants further investigation. Previous research has shown that women with PMS exhibit a greater emotional Stroop effect, particularly with picture and facial stimuli, during the luteal phase of their menstrual cycle. This finding suggests that PMS may impair cognitive inhibition when processing emotional information.

5. Limitations and Future Directions

The cross-sectional design of this study restricts causal inferences. Future longitudinal research should clarify the temporal relationships between PMS, cognitive function, and sleep quality. Investigating the mechanisms behind the observed differences, particularly the Stroop effect, could enhance our understanding of hormonal fluctuations in cognitive processes. This may include neuroimaging studies to observe brain activity during cognitive tasks in individuals with PMS and detailed hormonal analyses to link specific hormonal changes with cognitive performance. Future research should also identify protective factors and resilience mechanisms that mitigate PMS's negative effects of PMS on cognitive function and sleep quality, potentially informing better prevention and intervention strategies.

6. Conclusion

These findings emphasize the importance of early recognition and intervention to mitigate the potential negative effects of PMS on academic performance and overall well-being. By adopting a comprehensive approach that addresses the physical, cognitive, and sleep-related aspects of PMS, healthcare providers, and educators can better support adolescent girls in managing their symptoms and optimizing their potential for success in both academic and personal domains.

7. Source of Funding

None.

8. Conflicts of Interest

None declared.

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