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ASSESSMENT OF CARDIO-RESPIRATORY PARAMETERS DURING PRE-MENSTRUAL AND POST-MENSTRUAL PHASES OF THE MENSTRUAL CYCLE AMONG ADOLESCENT GIRLS WITH PREMENSTRUAL SYNDROME

T Dinesh[1*], K Chandrakala[2], M Thirumaran,[3] V Hema[4]

[1*]Associate Professor, Department of Physiology, Government Medical College, Nagapattinam, drtdineshmd@gmail.com
[2]Senior Resident, Department of Biochemistry, Vinayaka Missions Medical College, Karaikal
[3]Professor &Head, Department of Physiology, Vinayaka Missions Medical College, Karaikal
[4]Final MBBS, Government Thiruvarur Medical College

***Corresponding Author:** T Dinesh
[*]Associate Professor, Department of Physiology, Government Medical College, Nagapattinam, drtdineshmd@gmail.com

Introduction

The menstrual cycle is commonly divided into three phases: the menstrual, follicular, and luteal phases. Premenstrual Syndrome (PMS) is characterized by a variety of bodily and psychological symptoms that typically occur during the late luteal phase of the menstrual cycle. Symptoms of PMS reported in the literature fall into three domains: emotional, physical, and behavioural. These symptoms include irritability, mood swings, breast tenderness, bloating, and fatigue[1].

It has been reported that up to 85-90% of menstruating women report having one or more premenstrual symptoms, and 2 to 10% report disabling and incapacitating symptoms described as premenstrual dysphoric disorder[2]. The etiology of PMS is complex and multi-factorial. It has been attributed to hormonal changes, neurotransmitters, prostaglandins, diet, drugs, and lifestyle. PMS can significantly affect quality of life, especially in adolescent girls who are already dealing with the physical and emotional changes associated with puberty[3].

Previous studies have postulated that cardiorespiratory parameters, including heart rate variability (HRV), pulse rate, respiratory rate, and maximum oxygen uptake (VO_2 max), fluctuate throughout the menstrual cycle[4,5,6]. These fluctuations are primarily driven by hormonal changes, particularly estrogen and progesterone levels. The effects of female sex hormones on cardiorespiratory parameters have been reported in various previous studies[7,8,9].

During the premenstrual phase, there is often an increase in body weight, pulse rate, and respiratory rate, along with a decrease in VO_2 max, which indicates reduced cardiorespiratory efficiency. These findings support the hypothesis that the luteal phase, particularly the premenstrual period, is associated with significant physiological changes that can affect overall health and wellbeing[9,10].

In view of the background, the present study was planned to assess the cardio-respiratory parameters during the premenstrual and postmenstrual phases of the menstrual cycle among adolescent girls with premenstrual syndrome.

Materials and Methods:
Study Design: This study is a cross-sectional observational study aimed at assessing variations in cardiorespiratory parameters in premenstrual and postmenstrual phases in adolescent girls diagnosed with Premenstrual Syndrome (PMS).

Study Population:
Study Participants were recruited among the healthcare students of Government Thiruvarur Medical College, Tamil Nadu.

Methodology:
Premenstrual Symptoms Screening Tool (PSST)[11] was given to 250 medical and paramedical students. Study participants who were diagnosed with PMS (n=30) based on the PSST screening tool, who met the following inclusion and exclusion criteria, were included in the study by obtaining informed, written consent from them.

Inclusion Criteria:
1. Adolescent girls aged 18- 19 years.
2. Regular menstrual cycles (21-35 days).
3. Diagnosed with PMS based on PSST screening tool
4. Willingness to participate and provide informed consent.

Exclusion Criteria:
1. History of cardiovascular or respiratory diseases.
2. Use of medications affecting cardiovascular or autonomic function.
3. Presence of endocrine disorders or irregular menstrual cycles.
4. Active participation in competitive sports (which might affect baseline cardiorespiratory parameters).
Cardiorespiratory Parameters such as Heart rate, Systolic blood pressure, Diastolic blood pressure, Respiratory rate, Breath-holding time, and SPO_2 were recorded in all the study participants.

Phases of Assessment:
1. Premenstrual phase (3 days before the start of the menstrual/bleeding phase)
2. Post-menstrual phase (3 days after completion of menstrual/bleeding phase)

Statistical Analysis
The data were computerized in Microsoft Excel. Statistical analysis was done in SPSS v.21. Students' paired t-test was used to compare cardiovascular parameters in the premenstrual and post-menstrual phases. p-value <0.05 was considered statistically significant.

Results: The average age of the study group (n=30) was 19.73 ± 0.34. The results of our study are given in Table 1.

Discussion:
Most women of reproductive age have some physical discomfort or dysphoria in the weeks before menstruation. Symptoms are often mild, but can be severe enough to substantially affect daily activities. About 5-8% of women thus suffer from severe premenstrual syndrome (PMS)[5].
Results of our study indicate that cardiovascular parameters such as heart rate and systolic blood pressure significantly increased in the premenstrual phase compared to the postmenstrual phase. This study's observed increase in heart rate and systolic blood pressure during the premenstrual phase is consistent with earlier findings, suggesting that hormonal fluctuations, particularly of estrogen and progesterone, significantly affect cardiovascular regulation.

Specifically, the observed increase in heart rate and systolic blood pressure during the premenstrual phase supports the notion of heightened sympathetic nervous system (SNS) activity—a finding corroborated by multiple studies[1,12,13,14]. For instance, Grrishma et al. (2015) documented similar autonomic changes, highlighting that women with PMS exhibit altered cardiovascular autonomic functions, particularly an increased sympathetic tone during the late luteal phase[1]. This is further supported by Koifman et al. (2018), who observed distinct cardiovascular autonomic profiles in women with PMS, characterized by lower parasympathetic and higher sympathetic activity during the premenstrual phase[12].

Sato et al. (1995) demonstrated similar results, noting that heart rate and blood pressure tend to increase during the luteal phase due to heightened sympathetic nervous system (SNS) activity. The luteal phase, which encompasses the premenstrual period, is characterized by elevated progesterone levels, which have been shown to modulate autonomic function and induce vasoconstriction, thereby elevating blood pressure[13].

In contrast, Velloso et al. (2009) reported no significant changes in blood pressure across menstrual phases in healthy women, indicating that the presence of premenstrual syndrome may exacerbate or influence the cardiovascular effects. The adolescent age group may have heightened sensitivity to hormonal fluctuations compared to adults, which could explain the more pronounced cardiovascular changes observed in this study[14].

Respiratory parameters such as Breath-holding time after quiet inspiration, quiet expiration, SPO2, and PEFR were significantly reduced in the premenstrual phase compared to postmenstrual phase. The significant decrease in respiratory parameters, including breath-holding time, SpO2, and PEFR during the premenstrual phase, can be attributed to changes in autonomic regulation and hormonal influence on respiratory centers. This reduction in respiratory parameters could be attributed to increased SNS activity as well as hormonal influences, particularly the effects of progesterone and estrogen on respiratory control, as discussed by Baker et al. (2008)[15]. Furthermore, the significant decreases in PEFR and breath-holding time observed in this study may be related to the overall reduced physical working capacity during the premenstrual phase, as documented by Girija and Veeraiah (2011)[2].

This improvement in pulmonary function during the luteal phase is attributed to increased serum progesterone levels, which promote smooth muscle relaxation and hyperventilation Dabhoiwala et al., (2012)[16]. The FEV1/FVC ratio also showed similar patterns across studies. These findings suggest a potentially beneficial role of progesterone in managing respiratory conditions, particularly premenstrual asthma, and highlight the importance of considering menstrual cycle phases when assessing cardiorespiratory parameters in adolescent girls. Interestingly, Raj et al. (2000) found that PEFR remains stable across the menstrual cycle in healthy women, but this stability was not observed in our study. The discrepancy may be attributed to the presence of PMS in our cohort, as well as the younger, adolescent population studied. Adolescents may exhibit different respiratory control mechanisms compared to adults due to ongoing developmental changes. The reduced PEFR during the premenstrual phase in our study could reflect airway constriction or altered lung function associated with hormonal shifts[17].

Autonomic Nervous System Influence: The role of the autonomic nervous system (ANS) in modulating these changes is well-established. The premenstrual phase is associated with a shift toward sympathetic dominance, as supported by Sloan et al. (2001), who found increased heart rate variability and sympathetic activity during the luteal phase. The findings of increased heart rate and systolic blood pressure in our study further corroborate this autonomic shift. Elevated sympathetic activity, coupled with diminished parasympathetic tone, can result in the cardiovascular and respiratory changes we observed. The ANS's influence on respiratory parameters, such as BHT and PEFR, is similarly significant[18].

Hormonal Influence and Pathophysiology of PMS Estrogen and progesterone have well-documented effects on the cardiovascular and respiratory systems. During the premenstrual phase, progesterone levels are elevated, which has a stimulatory effect on the respiratory centers, as noted by Bertin et al. (2014)[19]. However, progesterone's effects on cardiovascular function are more complex, as it can both promote vasodilation and increase SNS activity, leading to elevated blood pressure and heart rate, as observed in our study. Estrogen's cardioprotective effects, noted by Mendelsohn and Karas (2005), are reduced during the luteal phase, which may further contribute to the cardiovascular changes. The reduction in estrogen levels during the luteal phase could explain the observed increase in systolic blood pressure and heart rate, as estrogen typically promotes vasodilation and reduces blood pressure through its effects on nitric oxide synthesis[20].

Limitations and Future Directions

The present study contributes valuable insights; a few limitations should be addressed. The sample size of 30 participants limits the generalizability of the findings, and future studies should aim for larger cohorts to confirm these results. Furthermore, including biochemical markers such as estrogen, progesterone, and cortisol levels would enhance the understanding of the hormonal mechanisms driving these cardio-respiratory changes.

Conclusion

Findings of the present study demonstrate significant cardio-respiratory changes during the premenstrual phase in adolescent girls with premenstrual syndrome. These findings suggest that autonomic nervous system dysregulation and hormonal fluctuations play a crucial role in modulating these physiological changes. Focusing on lifestyle factors such as diet, physical activity, and stress management reduces the severity of PMS symptoms, potentially by enhancing the autonomic balance and cardiorespiratory efficiency.

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