EFFECT OF PREMENSTRUAL STRESS ON REACTION TIME AMONG MEDICAL AND DENTAL STUDENTS OF A MEDICAL COLLEGE IN KATHMANDU, NEPAL

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ABSTRACT

The cyclical variation of ovarian hormones during the menstrual cycle has been implicated as the causative factor for many psychological and physical symptoms referred as premenstrual syndrome (PMS) causing varying degree of stress in females. This study is aimed to find out whether premenstrual stress might cause any alteration in the visual reaction time (VRT) in pre-menstrual and post-menstrual phase. Reaction time is an efficient non-invasive tool to evaluate the sensorimotor efficacy of a person. A cross sectional observational study was carried out in consenting and regularly menstruating 86 undergraduate medical and dental students of age ranging from 18-22 years, for a study period of April 2022 to June 2022. PMS was screened by using the PSST (premenstrual symptoms screening tool) to evaluate the incidence of PMS and the degree of premenstrual stress among the participants. All the participants showed some degree of PMS with 53.4% showing mild and 46.5% showing moderate to severe symptoms while none showed premenstrual dysphoric disorder (PMDD). A significant difference in body weight and visual reaction time (P<0.0001) was observed between the premenstrual phase and postmenstrual phase (54.6 ± 7.23 kg Vs 54.2 ± 7.24 kg and 0.959 ± 0.271ms vs 0.811 ± 0.138ms, respectively) irrespective of the PMS degree. The results indicate that premenstrual stress do affect the sensorimotor efficacy in females having PMS.

KEYWORDS

Visual reaction time (VRT), premenstrual syndrome (PMS), premenstrual dysphoric disorder (PMDD), premenstrual stress

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INTRODUCTION

Rhythmic fluctuation occurs in the female sex hormones during their menstrual cycle unlike males with high level of estrogen hormones during follicular phase and high level of progesterone during the luteal phase both of which are the premenstrual phase. However, these hormones wane away during the menstrual phase.[1-2] Hence, the role of the cyclical endocrine profile in maintaining psychic and physical harmony to bring about maximum work output from an individual is worth to enquire.[3] Premenstrual syndrome (PMS) is referred as a cluster of emotional, physical, psychological or behavioral symptoms that arise repeatedly during the luteal phase whose intensity can adversely affect women's relationship with other people or interfere with their normal activities.[4] The symptoms then slowly disappear with the beginning of menstruation or briefly thereafter.[5] PMS is one of the major problem encountered by the women of reproductive age.[6] Epidemiological data shows that 75% of women in reproductive age suffer from some PMS symptoms, while 3% to 8% reported extremely severe PMS symptoms[7] There are certain behavioral and neurological symptoms viz., headache, malaise, nervous irritability, emotional instability, decreased ability to concentrate, decrease in skin resistance and increased blood pressure, that has been reported during the premenstrual phase and are associated with salt and water retention.[8]

Thus, the behavioral and neurological symptoms that avail in such high percentage of women is obvious to effect the nervous integration that occurs in our brain for optimum working efficiency of a person. Reaction time is a simple non- invasive method that determines the time interval between the onset of stimulus and initiation of response under the condition that the subjects have been instructed to respond. This gives an idea about the time taken for the central nervous system processing and thus measures the sensorimotor association and performance of that individual.[8] Studies on the effect of premenstrual stress on the sensorimotor efficiency is very scanty[14-16] and such a study has not been commenced in Nepalese population at the best of our knowledge. Thus, this study aimed to find the effect of premenstrual stress on the reaction time to evaluate the sensorimotor efficiency on the female students of Nepal Medical College, Attarkhel, Gokarneswor-8, Kathmandu, Nepal.

MATERIALS AND METHODS

A cross sectional observational study was carried out among the consenting 86 undergraduate medical and dental female students who were regularly menstruating, for a study period of April 2022 to June 2022. The study was commenced after obtaining an ethical approval from Nepal Medical College Institutional Review Committee (Ref. No: 061-078/079). Those who have irregular and abnormal menstrual pattern, those who were under hormonal therapy, psychiatric treatment and those who were having skeletal muscle problems like myasthenia gravis, periodic paralysis or poliomyositis or having neural diseases like poliomyelitis and polyneuropathy were excluded. Since all the students have been already checked for visual acquity and color vision during their admission, further test for vision was not performed to check the visual integrity and the participants were included according reports obtained during their admission. Premenstrual symptoms was screened by using the PSST (Premenstrual symptoms screening tool).[9] PSST is a 19-item instrument consisting of two domains: the first domain includes 14 items related to psychological, physical, and behavioral symptoms and the second domain (five items) evaluates the impact of symptoms on women's functioning. Each item is rated on a four-point scale (not at all=0, mild= 1, moderate=2, severe=3). According to the instruction of the PSST devised by Steiner *et al.*[9] for diagnosis of PMS, a women must report at least five symptoms as moderate or severe where at least one should be from symptoms in 1–4 items which are namely the core symptoms related to PMS. Also, they must report if their symptoms interfere moderately or severely with their ability to function in at least one of five items in the second domain. Those whose do not validate to meet this criteria and reports even one of the symptoms is considered as women with mild symptoms. For diagnosis of PMDD, at least one of the symptoms in 1 to 4 item should be reported as severe and in addition, at least four of the symptoms in item 1 – 14 should be reported as moderate to severe; and at least one of the items in the second domain should be reported as severe.

The first day of vaginal bleeding was considered as the first day of menstrual cycle. The pre and post-menstrual phases was then calculated. 7th to 10th day of menstrual cycle was considered as the postmenstrual phase while 21st to 25th day of menstrual cycle was considered as premenstrual phase.[10] Our study recorded the

reaction time and weight in 25th day and 7th day as premenstrual phase and postmenstrual phase respectively. Their weight was measured by a digital weighing machine in kilograms during both the phases. Visual reaction time was recorded in both phases. The reaction time was recorded with the help of the software called "online reaction time". It consisted of a virtual red, yellow and green traffic lights. At the beginning of the trial, the yellow light was first illuminated. Then subject was asked to click on the "on screen button" that is present on the right side of the traffic lights. Once the button was clicked, the red light was illuminated for 7 seconds and at the end of this, green light was illuminated. The participant was asked to click on the "on screen" button again once the green light was illuminated as fast as possible. This registered the visual reaction time. The procedure was be repeated for 5 time as the program runs five time automatically. After the 5th reaction time was registered, the programme calculates the average of five

results and computes the average reaction time to thousandths of a second, i.e in milliseconds.[11]

The procedure was done in pre- and post-menstrual phase of each participants. The values obtained was recorded and compiled in Microsoft Excel 2007 and analyzed with EPI INFO version 7.2.4.0. and Stata 15 statistical software. Paired t test was used to test for difference in weight and visual reaction time. Independent t test was used to compare difference in weight and VRT among girls with mild, moderate to severe symptoms of PMS.

RESULTS

In the present study, 86 undergraduate medical and dental female students participated.Their age ranged from 18-22 years with mean age of 20.3 ± 0.77yeras. All the participant showed some degree of PMS with 53.5% showing mild and 46.5% showing moderate to severe symptom while none showed PMDD (Table 1).

Table 1: Frequency of PMS and the degree of stress among the participants.(n=86)					
PMS degree	**n**	**%**	**Cumulative %**	**Exact 95% LCL**	**Exact 95% ULC**
M	46	53.5	53.5	42.4%	64.3%
MS	40	46.5	100.0	35.7%	57.6%
PMDD	0	0.0			
Total	**86**	**100.0**	**100.0**		

PMS: premenstrual syndrome, M: mild, MS: moderate to severe, PMDD: premenstrual dysphoric disorder, LCL: Lower Confidence Limit, UCL: Upper Confidence Limit.
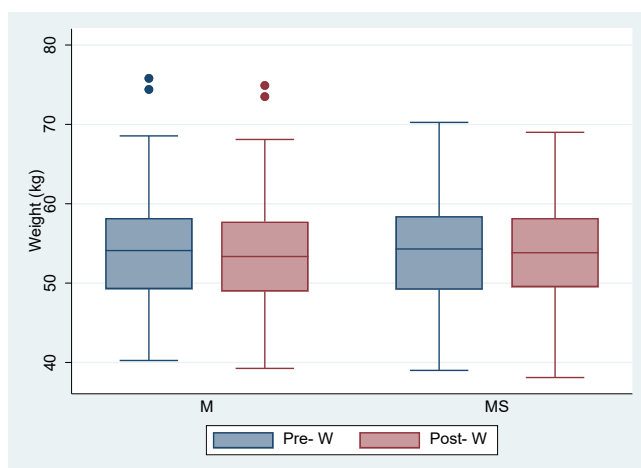

Fig. 1: Boxplot summary of premenstrual and postmenstrual weight categorized by degree of PMS (M mild and MS moderate to severe), Pre- W: Premenstrual Weight, Post- W: Postmenstrual weight.
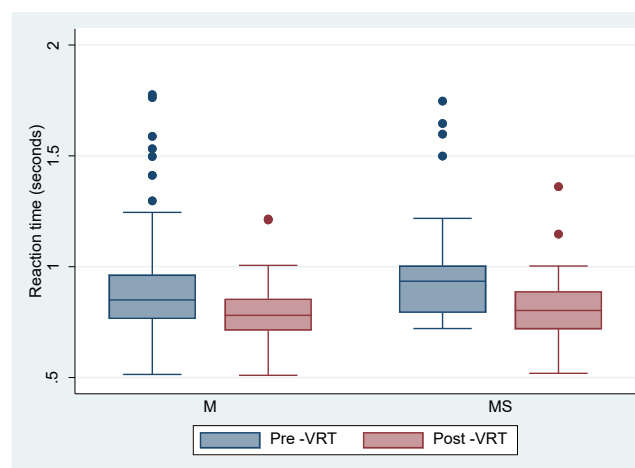

Fig. 2: Boxplot summary of premenstrual and postmenstrual VRT categorized by degree of PMS (M mild and MS moderate to severe), Pre- VRT: Premenstrual Visual Reaction Time, Post- VRT: Postmenstrual Visual Reaction Time.

Variable	Participants (n)	Mean	SD	95% CI	MD	P value*
Premenstrual weight (kg)	86	54.6	7.23	53.09-56.19	0.402 (0.278-0.526)	<0.0001
Post menstrual weight (kg)	86	54.2	7.24	52.68-55.79		
Premenstrual VRT (ms)	86	0.959	0.271	0.901-1.017	0.1479 (0.105-0.190)	<0.0001
Postmenstrual VRT (ms)	86	0.811	0.138	0.781-0.841		

*Paired t Test, Obs: VRT: Visual reaction time, Obs: observations, SD: Standard deviation, CI: confidence interval, MD: mean difference, kg: kilograms, ms: millisecond

As depicted in Table 2, the mean premenstrual weight was 54.6 ± 7.23 kg and the mean post menstrual weight was 54.2 ± 7.24 kg. The mean difference of pre and postmenstrual weight of 402 gm (278-526 gm) was highly significant (P <0.0001). The mean premenstrual VRT was 0.959 ± 0.271 ms while the mean postmenstrual VRT was 0.811 ± 0.138 ms with the mean difference of 0.1479 ms (0.105-0.190ms) which was also highly statistically significant (P<0.0001). A significant difference between pre and post menstrual weight and VRT was noted irrespective of the PMS degree as depicted in the box plots in Fig. 1 and Fig. 2.

DISCUSSION

PMS is one of the most common problem faced by women during their menstrual cycle every month. In our study, all the participant complained of one or more symptoms of PMS with 53.49% showing mild and 46.51% showing moderate to severe symptom while none showed PMDD. A study done among the students of medical college of Bhavnagar[12] reported 89.6% with mild symptoms, 14.7% were found to have moderate to severe symptoms of PMS and 3.7 facing PMDD amongst them. On the other hand, a similar study done by Chumpalova et al[13] among the Bulgarian women of 18-50 years noted 32.1% of the participants with PMS among whom 15.4% suffered from mild symptoms, 13.4% suffered from moderate to severe and 3.3% suffered from PMDD.[13] Psychosocial factors in the Asian regions and variation of age group may have some additional impacts on the PMS symptoms in comparison to the women of Bulgarian society.

Our study found a statistically significant difference (P < 0.0001) in premenstrual weight (54.6 kg) and the post menstrual weight (54.2kg) with the mean difference of 402gm (278-526) .Similarly, the premenstrual VRT was also higher(0.959 ± 0.271ms) than the postmenstrual VRT(0.811 ± 0.138ms) with the mean difference of 0.1479ms (0.105-0.190ms) which was also highly statistical significant (P<0.0001).

A study done by Das et al[14] in 105 female aged 17-20 years of age that observed similar results as in our study. A significant increase in weight and prolongation in auditory reaction time (ART) and VRT were observed during luteal premenstrual phase (P<0.001).

A study done by Kumar et al[15] in 30 regularly menstruating females aged 18-25years also recorded a significantly increased audio and visual reaction time in luteal phase of menstruation (P<0.05). However their study did not explore the changes in weight.

Pawar et al[16] observed the prolongation of ART and VRT in females during premenstrual phase to the female sex hormones. Estrogen highly increases in follicular phase and relatively to a lesser degree in luteal phase (premenstrual phases), causes some degree of salt and water retention. On the other hand, aldosterone hormone also increases moderately during the luteal phase and through similar mechanism adds to an already increased in weight due to estrogen.[17] This may explain an increase in weight during the luteal premenstrual phase in the studies.

Reaction time measures the time taken for central nervous system processing and thus is an useful index to grade the sensorimotor association and performance of an individual[8] and thus requires intact sensory skills, cognitive processing and motor performances.[14] Psychological stress is one of the factors that

play a role in prolonging the reaction time.[11,18] The female suffering from premenstrual stress during PMS due to hormonal fluctuations can be a factor that increased visual reaction time in this study.

Locally applied progesterone enhanced the GABA (Gamma-Aminobutyric acid) and suppressed the glutamate responsiveness leading to anxiolytic action in a study done by Smith *et al*.[19] When transmagnetic stimulation was done on the cerebral cortex, greater cortical inhibition was observed in luteal premenstrual phase of menstrual cycle[20] which coincides with greater levels of progesterone during this phase.[1,2] This may direct towards the possible inhibitory effect of progesterone in the brain. On the other hand, Estrogen that peaks up during the follicular premenstrual phases,[1,2] stimulates the secretion of GABA and delays the axonal conduction of impulses via its inhibitory effect.[21]

Bovine adrenochromaffin cell study by Callachan *et al*[22] stated that prenanolone, a progesterone metabolite potentiates action of GABA and directly activate GABA-A receptors. Estrogen induced up-regulation of GABA receptors in the rodents neurons is evident.[23]

Thus, the combine effect of increased level of estrogen and progesterone levels during the premenstrual period might affects the sensorimotor efficacy of females sensitized to PMS.

Although an increased premenstrual weight and VRT was observed in our study, it could not find the possible effect of the various degrees of stress levels on the VRT and weight among the participants. This is because the changes so observed were statistically significant irrespective of the PMS degrees. In our study, all the participant showed some degree of PMS. Therefore, the variables could not be compared between PMS group and the non PMS group.

The study depicts the possible effect of the ovarian hormones causing PMS and decreasing the working efficiency in females at sensorimotor levels. Therefore, clinician should take this into considerations while informing their patients of the possible side effect while prescribing hormonal therapies with estrogen and progesterone.

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REFERENCES

1. Bijlani RL, Manjunatha S. Understanding Medical Physiology. 4th ed. Jaypee Brothers Medical Publishers 2011; 493-95.

2. Windmaier EP, Raff H, Strang KT. Vander's Human Physiology. 10th ed. Mc Graw Hill 2006; 673-79.

3. Girija B, Veeraiah S. Effect of 2 different phases of menstrual cycle on physical working capacity in Indian population. *Indian J Physiol Pharmacol* 2011; 55: 165-9.

4. Reid RL. Premenstrual Syndrome. Danforth's Obstetrics and Gynecology, 10th ed. Philadelphia: Lippincott Williams & Wilkins; 2008: 672-81.

5. Ismaili E, Walsh S, Michael P *et al*. Fourth consensus of the International Society for Premenstrual Disorders (ISPMD): auditable standards for diagnosis and management of premenstrual disorder. *Arch Womens Ment Health* 2016; 19: 953-8.

6. William K. Gynecologic History, Examination and Diagnostic Procedures. Danforth`s Obstetrics and Gynecology.10th ed. Philadelphia: Lippincott Williams & Wilkins; 2008: 698-743.

7. Steiner M. Premenstrual syndrome and premenstrual dysphoric disorder: guidelines for management. *J Psych Neurosci* 2000; 25: 459–68.

8. Welford AT, Introduction: An Historical Background Sketch: Reaction Times. Academic Press London. 1980: 3-7.

9. Steiner M, Macdougall M, Brown E. The premenstrual symptoms screening tool (PSST) for clinicians. *Arch Womens Ment Health* 2003; 6: 203-9.

10. Jadhav S, Bansod N, Diwanji S. Study of auditory reaction time in premenstrual phase and postmenstrual phase. *J Med Sci Clin Res* 2014; 2: 968-72.

11. Pollack AE. Exploring the complexities of experimental design: Using an online reaction time program as a teaching tool for diverse student population. *J Undergrad Neurosci Edu* 2010; 9: 47-50.

12. Raval CM, Panchal BN, Tiwari S *et al*. Prevalence of premenstrual syndrome and premenstrual dysphoric disorder among college student of Bhavnagar, Gujarat. *Indian J Psych* 2016; 58: 164-70.

13. Chumpalova P, Lakimiva R, Popova MS *et al.* Prevalence of clinical picture of premenstrual syndrome in females from Bulgaria. *Ann Gen Psych* 2020; 19: 3.

14. Das S, Gandhi A, Mondal S. Effect of premenstrual stress on audiovisual reaction time and audiogram. *Indian J Physiol Pharmacol* 1997; 41: 67-70.

15. Kumar S, Mufti M, Kisan R. Variation of reaction time in different phases of menstrual cycle. *J Clin Diagn Res* 2013; 7: 1604-05.

16. Pawar BL, Kulkarni MA, Syeda A *et al.* Effect of premenstrual stress on cardiovascular system and central nervous system. *J Obstet Gynecol India* 2006; 56: 156-8.

17. Barrett KE, Barman SM, Boitano S Brooks HL. Ganong's Review of Medical Physiology. 23rd ed. Mc graw Hill. 2010; 418.

18. Ciucurel MM. The relation between anxiety, reaction time and performance before and after sport competitions. *Proc Social Behav Sci* 2012; 33: 885-9.

19. Smith S, Waterhouse BD, Chapin JK. Progesterone alters GABA and Glutamate responsiveness: A possible mechanism for its anxiolytic action. *Brain Res* 1987; 400: 353- 59.

20. Smith MJ, Keel JC, Adams LF, Schmidt PJ. Menstrual cycle effects on cortical excitability. *Neurology* 1999; 53: 2069.

21. Kaur S, Manchanda KC, Gharg A *et al.* Effect of sex hormones on central auditory conductivity in young rural females of Bathinda District of Punjab. *Nat'l J Physiol Pharm Pharmacol* 2013; 2: 124-8.

22. Callachan H, Cottrell GA, Hather NY, Lambert JJ. Modulation of GABAA receptor by progesterone metabolites. *Biol Sci* 1987; 231: 359-69.

23. Maggi A, Perez J. Estrogen induced up regulation of gamma-amino butyric acid receptors in the CNS of rodents. *J Neurochem* 1986; 47: 1793.