

# The Influence of Premenstrual Stress on Auditory and Visual Reaction Time in I Year MBBS Students

Rekha KN<sup>1</sup>, Gopi Kumar MS<sup>2</sup>, Jamuna BL<sup>3</sup>, Ranganath MD<sup>4</sup>

<sup>1</sup>Assistant Professor, Dept. of Physiology, Rajarajeswari Medical College & Hospital, Bengaluru, <sup>2</sup>Assistant Professor, Dept. of Physiology, Xavier University School of Medicine, Aruba, <sup>3</sup>Professor, Dept. of Physiology, <sup>4</sup>Retired Professor, Dept. of Physiology, Rajarajeswari Medical College & Hospital, Bengaluru

## Abstract

**Introduction:** Premenstrual syndrome (PMS) is characterized by a cluster of psychological and somatic symptoms in the late luteal phase of the menstrual cycle which subsides with the onset of menses. The prevalence of premenstrual tension is 2 to 10 % for disabling symptoms where as minor symptoms are seen in 85% of women. Thus the performance of individual will be reduced during premenstrual phase. Reaction Time is a simple, non invasive performance task test which assesses the processing capabilities of CNS. In the present study, simple auditory reaction time (ART) and visual reaction time (VRT) were determined in 60 healthy female subjects between the age group 17 to 20 years during pre and postmenstrual phases.

**Objectives:** To compare the auditory and visual reaction time in premenstrual and postmenstrual phases of menstrual cycle.

**Methodology:** 60 normal healthy female students in the age group 17-20 years, having regular menstrual cycles were selected from I year MBBS students, RRMCH. PC 1000 Hz Reaction timer was used to measure auditory and visual reaction time.

**Results and discussion:** The mean ART in premenstrual and postmenstrual phase were 167+ 21 ms and 144+23 ms respectively. The mean VRT in premenstrual and post menstrual phase were 200+22 ms and 176+16 ms respectively. The P value for both ART and VRT was <0.0001 and results were considered extremely significant. This is attributed to delay in axonal conduction which occurs because of salt and water retention in premenstrual phase.

**Keywords:** Premenstrual stress, ART, VRT.

## Introduction

Premenstrual syndrome (PMS) is characterized by a cluster of psychological and somatic symptoms in the late luteal phase of the menstrual cycle which subsides with the onset of menses. Pre menstrual tension syndrome as per American Congress of obstetricians

and gynecologists criteria is 30% increase in intensity of symptoms of premenstrual syndrome from cycle day 5 to 6 as compared with the six day interval before the onset of menses for at least 2 consecutive cycles.

The prevalence of premenstrual tension is 2 to 10 percent for disabling symptoms, whereas minor symptoms are seen in 85 percent of woman. The commonly occurring symptoms are anxiety, irritability, depression, mood swings, difficult in concentration, insomnia, headache and fatigue. <sup>1</sup> These symptoms can reduce the performance of individuals during the premenstrual phase. Changes in the autonomic functions may be responsible for some of the symptoms produced through endorphins and have been held responsible for behavioral changes. <sup>2</sup>

---

### Corresponding Author:

**Gopi Kumar M.S.**

Assistant Professor, Department of Physiology, Xavier University school of Medicine, Aruba

Ph: +2977411611

e-mail: drrekhamanu. physio@gmail.com

Reaction time is a simple non invasive performance task test <sup>3</sup> and simpler to devise and administer than most other cognitive measures or psychometric tests. <sup>4</sup>

Reaction time is the elapsed time between the presentation of a stimulus and the subsequent behavioral response. Reaction time is often used in experimental psychology to measure the duration of mental operations in area of research known as mental chronometry.<sup>5</sup>

The processing efficiency of CNS can also be assessed by reaction time which includes stimulus processing, decision making and response programming.<sup>5</sup>

Hence, this study was undertaken to observe the effect of premenstrual stress on simple auditory and visual reaction time in first year MBBS students of RRMCH.

## Material and Method

The present study was conducted in the department of physiology, Rajarajeswari medical college and Hospital, Kambipura, Bangalore. The study was started after taking clearance from the institutional ethical committee. 60 healthy female students from 1<sup>st</sup> MBBS having regular menstrual cycles aged 17-20 years were selected based on inclusion and exclusion criteria for the study. The selected subjects were briefed about the nature of the study and a written informed consent was obtained.

### Inclusion criteria:

1. Healthy female 1<sup>st</sup> MBBS students of RRMCH.
2. Aged 17-20 years.
3. Having regular menstrual cycle of 28-30 days for at least last 6 months.

### Exclusion criteria:

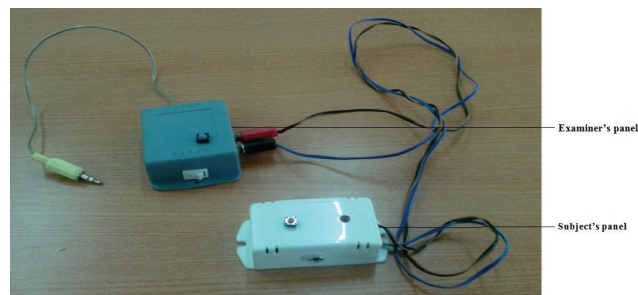
1. Subjects with irregular cycles.
2. Subjects with premenstrual tension syndrome.
3. On oral contraceptive or any other hormones, psychotropic drugs, antihistaminics, antiepileptics.
4. Subjects having visual or auditory symptoms.
5. Any subjects not willing to give consent for the study.
6. Subjects with any history of drug abuse (nicotine, alcohol, opium) or sleep disorders.

**Method of collection of data:** Before recording the reaction time the subjects were asked to fill a questionnaire. Anthropometric measurements were taken from the subjects and filled in the subject questionnaire form. Premenstrual and post menstrual phases were calculated as follows.

**Premenstrual phase:** 1 to 7 days prior to onset of next menstruation.

**Postmenstrual phase:** 5<sup>th</sup> to 10<sup>th</sup> day of cycle.

ART and VRT was measured by using an in house built add on device called PC1000 Reaction timer. <sup>5</sup> PC1000 Reaction timer is 1000 hertz square wave oscillator which has two components connected to each other. First component has a soft start button to give stimulus which is handled by the examiner only. Second component has stop button and a small red LED and it is handled by the subject alone. Red light is preferred as it persists in the retina for long time. <sup>6</sup> Red LED receives the visual stimulus. Headphone which receives the auditory stimuli is also connected to the second component. If headphone is connected to the second component, then only ART can be measured. First component which is handled by the examiner will be connected to a computer having a audacity software. Audacity software records the reaction time in wave format and measured in milliseconds.



**Figure 1: PC 1000 Reaction timer**

**ART and VRT measurement protocol:** Both the recordings were done between 9am and 11am. All the subjects were instructed to have adequate sleep at night and not to have coffee for at least 2 hours before coming for the study.

Headphone is connected to the second component. Examiner gives the auditory stimuli by pressing the soft start button which will be out of the view of the subject. Subject is asked to respond immediately on hearing the sound by pressing the soft button on second component. ART is recorded in millisecond in computer

using audacity software. Similarly VRT is measured by instructing the subject to press stop button in second component as soon as she sees the red light. Five readings of each stimulus were recorded and the lowest was considered as the reaction time. Stimulus was given at random intervals.

These recordings were taken both during pre and post menstrual phases of the cycle.

**Statistical Analysis:** All results were expressed as mean+ SD. Student's paired "t" test was used to analyze the data using SPSS software. P value of less than 0.05 was considered as statistically significant.

**Findings:** Our study comprised of 60 healthy females, aged between 17-20 years. Table 1 shows anthropometry parameters of the subjects.

The mean ART in premenstrual and postmenstrual phase were 167+ 21 ms and 144+23 ms respectively as shown in table 2. ART is significantly prolonged in premenstrual period (p value <0.0001).

The mean VRT in premenstrual and post menstrual phase were 200+22 ms and 176+16 ms respectively (table 2). VRT value is also significantly higher in premenstrual period (p value <0.0001).

**Table 1: Anthropometric Parameters**

Variables	Mean ±SD
Height (Mt)	154.83±4.7
Weight (Kgs)	54.45±6.3
BMI (Kg/Mt <sup>2</sup> )	22.69±2.2

**Table 2: Recordings of ART & VRT in pre & post menstrual phases.**

Parameters	Premenstrual phase (20 <sup>th</sup> -27 <sup>th</sup> day) Mean ±SD	Postmenstrual phase (5 <sup>th</sup> -10 <sup>th</sup> day) Mean ±SD	P value
ART (millisec)	167±21	144±23	<0.0001
VRT (millisec)	200±22	176±16	<0.0001

## Discussion

In present study, statistically significant increase in mean ART value was observed in premenstrual phase compared to post menstrual phase. Increase in ART value observed in our study is in accordance with work done by Das et al in 1996<sup>7</sup>, Asmita SN and Pushpa AP in 2010<sup>8</sup> and Pawar Babyminakshi L in 2006.<sup>9</sup>

Visual reaction time value was increased in premenstrual phase compared to postmenstrual phase in our work which is statistically significant. Similar findings were observed in a study by Das et al in 1996<sup>7</sup>, Pawar Babyminakshi L et al in 2006<sup>9</sup> and Afroz Afshan et al in 2012.<sup>10</sup>

A menstrual cycle includes cyclic changes in sex hormone levels. Low levels of oestradiol and progesterone are present during the menstrual phase. The follicular phase is characterized by a gradual increase in oestradiol levels, which culminates in the preovulatory period. The central point of a menstrual cycle is ovulation, which occurs between days 10 and 14. It is controlled by the pituitary gland, which increasingly secretes the follicle-stimulating hormone (FSH) and luteinizing hormone (LH), followed by a higher amount of oestradiol from the follicles. During this period, basal body temperature values increase. After ovulation, oestradiol levels are lower, but progesterone levels start to increase. The luteal phase is characterized by high levels of oestradiol and progesterone.<sup>11</sup>

Many Neurophysiologic studies have shown that the brain regions involved in affective state and cognition are diffusely affected by ovarian hormones.<sup>12</sup>

Most of the behavioural & emotional patterns observed during the premenstrual phase is mainly attributed to the increased activity of sympathetic division of autonomic nervous system. Sympathetic activity is more during premenstrual phase because of estrogen.<sup>13</sup>

Progesterone acts at the level of plasma membrane of selected cells by a nongenomic mechanism to inhibit the activation of adenylycyclase. Progesterone through some metabolites acts in the brain as an anesthetic / anxiolytic agent by binding to gamma aminobutyric acid A (GABA) receptor. GABA is an inhibitory

Neurotransmitter. These metabolites are formed in women during premenstrual phase when progesterone excretion is high. These metabolites inhibits neural transmission through GABA A receptors, hyperpolarising the neuronal cells. This neural transmission inhibition affects sensorimotor association and processing capability of central nervous system.<sup>14</sup>

The reaction time is the time interval between the onset of the stimulus and the initiation of the response. The reaction time provides an indirect index of the

processing capability of the CNS and a simple means of determining the sensorimotor performance.<sup>5</sup>

Bruce and Russel have indicated that varying level of sex steroids during different phases of menstrual cycle have sodium and water retaining effect associated with weight gain in females. This retention of salt and water could modify the axonal conduction and alter the rate of impulse transmission. Further, it is also suggested to alter the availability of the neurotransmitter at the synaptic level. They have concluded that the increased synaptic delay coupled with the reduced velocity of nerve impulse due to the effect of female sex hormones affects the sensorimotor co-ordination and the processing speed of the Central Nervous System.<sup>15, 16</sup>

Possible neuroendocrine causes of premenstrual edema are estrogen, progesterone, and renin-angiotensin-aldosterone axis. Estrogen increases the level of plasma renin substrate through enhanced hepatic synthesis, which leads to elevation of plasma angiotensin. This results in an elevated secretion and excretion of aldosterone. It shows that sodium retaining effect of estrogen is independent of its ability to augment aldosterone production. Progesterone is a partial agonist of aldosterone and blocks the effect of aldosterone at renal tubules. During the luteal phase of menstrual cycle, there is no change in level of plasma renin substrate but there is rise in renin concentration leading to an increase in plasma renin activity with an increase in plasma aldosterone level and excretion.<sup>17</sup>

A study by Mahesh B et al in 2013, have demonstrated that exercise improves reaction time by improving cerebral blood flow.<sup>18</sup>

### Conclusion

This fact of prolonged reaction time during premenstrual period can be considered in neurological and behavioural assessment of women. In the modern era, women are equally involved in all fields like men. Because of this premenstrual syndrome of psychological or physical nature, it may limit their functional capacity affecting quality of life & if severe may lead to sickness absentism.

Women with premenstrual symptoms should modify their life style by doing exercises regularly and reducing intake of water and salt during premenstrual period which helps in improving their quality of life.

**Conflict of Interest:** None

**Source of Funding:** Personal funds.

**Ethical Clearance:** Permission was taken from institutional research and ethical committee

### References

1. Joshi JV, Pandey SN, Galvankar N, Gogate JA. Prevalence of premenstrual symptoms: Preliminary and brief review of management strategies. *Journal of Midlife Health*. Jan–Jun 2010; 1 (1): 30-34.
2. Mehta V, Chalranartu AS. Autonomic functions during different phases of menstrual cycle. *Ind J Physiol Pharmacol*. 1993; 37: 56-8.
3. Becker D, Creutzfeldt OD, Schwibbe M, Wuttke W. Electrophysiological and psychological changes induced by steroid hormones in men and women. *Acta Psychiatr Belg*. 1980 Sep–Oct; 80 (5): 674-97.
4. Geoff Der, Glasgow Ian J. Deary Age and Sex Differences in Reaction Time in Adulthood: Results From the United Kingdom Health and Lifestyle Survey University of University of Edinburgh, *Psychology and Aging*. 2006; 21 (1): 62-73.
5. Niruba, Maruthy. Glycosylated Hemoglobin verses Reaction time in Diabetics—A cross sectional study. *National Journal of Basic Medical Science*. 2011 April-June; 4 (1): 198-201.
6. Hema S, Konrad P. Critical flicker fusion test of potential vision. *Journal of Cataract and refractive surgery*. 2007 February; 33: 232-9.
7. Das S, Gandhi A, Mondal S. Effect of premenstrual stress on audiovisual reaction time and audiogram. *Indian J Physio Pharmacol*. 1997; 41 (1): 67-70.
8. Asmita SN, Pushpa AP. A Study of auditory reaction time in different phases of the normal menstrual cycle. *Indian J Physio Pharmacol*. 2010; 54 (4): 386-390.
9. Babyminakshi PL, Mangala KA, Afroz S, Nanda SD, Sudhir CP. Effect of premenstrual stress on cardiovascular system and central nervous system. *J Obstet Gynecol India*. 2006 April; 56 (2): 156-158.
10. Afroz A, Ashutosh B, Swati IA. The influence of different phases of normal menstrual cycle on simple visual reaction time. *International Journal of Bioassays*. 2013; 02 (04): 716-718.
11. Simin N, and Ravlic A. changes in body temperature and reaction times during menstrual cycle. *Arh Hig Rada Toksikol*. 2013; 64: 99-106.

12. McEwen B. Estrogen action throughout brain. *Recent Prog Hormon Res.* 2002; 57: 357-384.
13. Ashwini NN, Vaishali VP, Samir K, Mangala V. Autonomic function tests during pre and post menstrual phases in young women. *Pravara medical review.* 2011; 3 (2): 24-30.
14. Garry F, Gant C, MacDonald PC et al (eds). *Williams obstetrics 20<sup>th</sup> (edn).* Connecticut. Appleton and Lange. 1997: 84-6.
15. Bruce J, Russell GF. Premenstrual tension: a study of weight changes and balances of sodium, water and potassium. *Lancet.* 1962; 11: 267-271.
16. Lalita HN, Jayshree VG. Effect of age, gender and body mass index on visual and auditory reaction times in Indian population. *Indian J Physiol Pharmacol.* 2012; 56 (1): 94-99.
17. Reid RL, Yen SSC. Premenstrual syndrome. *Am J ObstetGynecol.* 1981; 139: 85-104.
18. Mahesh B, Kalpesh V, Gitesh D. Maulik P, Hitesh J, Varsha J. A comparative study of visual reaction time in badminton players and healthy controls. *Indian Journal of Applied Basic Medical Sciences.* 2013 Jan; 15 (20): 76-81.