

Changes in Visual Parameters during Paramenstruum in a Rural Population of Eastern India: A Pilot Study

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Abstract:-

➤ Aim

This study aims to analyze a set of symptoms of visual difficulties due to accommodative changes before and during the period of menstruation.

➤ Methods

This cross-sectional study includes 60 females of the rural population having an accommodative facility of 14 cycles/min with $\pm 2.00D$ flippers. All subjects have undergone a comprehensive ocular examination which also includes investigation of different parameters of accommodation and convergence before and during menstruation. This Statistical analysis was done with the help of paired T test and the result was shown as significant if $P < 0.05$.

➤ Results

Pre-menstruation no accommodative changes were found. During menstruation, all the subjects were found with a significant change in NPA (OD, OS), AA (OD, OS), NRA, PRA, PFV (Break-Near) and AF (OU) during menstruation. 66.7% of subjects were found with symptoms of headache, backache, difficulty in reading and blurring of vision during menstruation. After prolong near work 16.7% of subjects were found with the blurring of near vision 16.7% were found with the blurring of distance vision.

➤ Conclusion

Accommodative insufficiency along with its associated symptoms may induce during the menstruation cycle. The clinician should consider accommodative changes during eye examination of an adult female.

Keywords:- Near Point of Accommodation, Negative Relative Accommodation, Positive Relative Accommodation, Accommodative Facility, Visual Function, Menstruation.

I. INTRODUCTION

Studies have reported that, while menstruation due to action of sex hormone (estrogen, androgen and progesterone) and pathophysiological changes in the body as well as ocular surface several changes happen (e.g., changes in vision & IOP, induce eye strain, suffer from dry eye symptoms and contact lens intolerance etc).^(1,2) Some other studies demonstrate that visual sensitivity can vary across the menstrual cycle⁽³⁾ and corneal sensitivity reduced markedly during the first 4 days of the menstruation cycle (paramenstruum)⁽⁴⁾.

In a few studies, change of body weight and increased intraocular pressure (IOP) was reported^(5,6,7). Leach NE⁽⁷⁾ et al reported that tear film osmolarity changes indirectly by hormonal variation and leads to corneal hydration. Like in the Green K et al and Katharina Dalton et al, both of these studies found that if pharmacologically administered progesterone or oestrogen influence intraocular pressure probably mediated through aqueous outflow pathways and even in normal individual women a raised IOP (average 2-3 mm of Hg) found during paramenstruum. Variation of these hormonal levels also leads to loss of visual field sensitivity,^(8,9) decreased in choroidal thickness⁽¹⁰⁾ and corneal sensitivity.⁽¹¹⁾ Corneal thickness variation and corneal hydration were found in some studies in menstruating women. Thickening of the cornea in the ovulation time followed by slight thinning and on 21st day slight thickening was noted in different studies. Out of these three stages, the thickest cornea was found during ovulation and these all three changes were correlated with the variation level of estrogen and pregnanediol. Corneal thickness increases when the hormonal level is increased.⁽¹²⁻¹⁵⁾

Tatlipinar S et al reported tear ferning patterns to remain unchanged during the different menstrual cycle⁽¹⁶⁾. C Sanghvi et al found a correlation between acute anterior uveitis and level of oestrogen or progesterone or both⁽¹⁷⁾. Kaneda Y et al and Azarmina M et al, reported changes in Flash visual evoked potential (VEP) and electroencephalogram (EEG) changes depending on progesterone level. An increased level of progesterone leads to maximum bleeding and prolonged VEP during the cycle and also affects optic nerve conduction velocity⁽¹⁸⁻²⁰⁾. Giuseppe Giufree et. al, they have reported that colour discrimination was better at ovulation than the beginning and end of the menstrual cycle. This test was performed with the Farnsworth- Munsell 100 hue arrangement test.⁽²¹⁾ Due to change in the refraction in the eye, vision differs during and premenstrual stage. Vision reduced in the premenstrual stage compares to the late menstrual stage.⁽²³⁾

It is expected that hormones can influence changes in mood, skin, and weight, different parts of the body and ocular surface, experts say female hormones have an impact on vision too. During the first week of menstruation the typical elevated level of estrogen, androgen and progesterone can cause blurred vision, trouble focusing, and watery eyes. This study is to evaluate whether there is any variation in the binocular vision parameters especially accommodation and convergence before and during the time of the menstrual cycle.

II. SUBJECTS AND METHODS

In this cross-sectional study 60 females, within the age group of 18-30 years, with no ocular or systemic disease were included. All the subjects underwent a complete detailed dilated examination followed by a non-strabismic binocular vision assessment.

Visual acuity was measured for distant and near with the help of Snellen chart. Stereopsis of the females was measured using TNO and red and green spectacles. Broad H test was performed to check the ocular motility. Cover test, cover

uncover test, and the alternate cover test was performed. Monocular Estimation Method (MEM) was done with the help of retinoscope to understand the status of lead and lag of accommodation. Near Point of Accommodation (NPA) and Near Point of Convergence (NPC) are measured using RAF rulers. Negative Relative Accommodation (NRA) and Positive Relative Accommodation (PRA) are measured using plus lenses, minus lenses respectively by giving a near vision target. Negative Fusional Vergence (NFV) and Positive Fusional Vergence (PFV) are measured using horizontal prism bars. The accommodative facility of each subject was measured using a $\pm 2.00D$ accommodative flipper. Subjects with Refractive error, Strabismus, Cataract surgery, Amblyopia and Systemic Diseases such as diabetes, hypertension, thyroid etc. were excluded from the study. Data's are analyzed using the paired-t test.

III. RESULTS

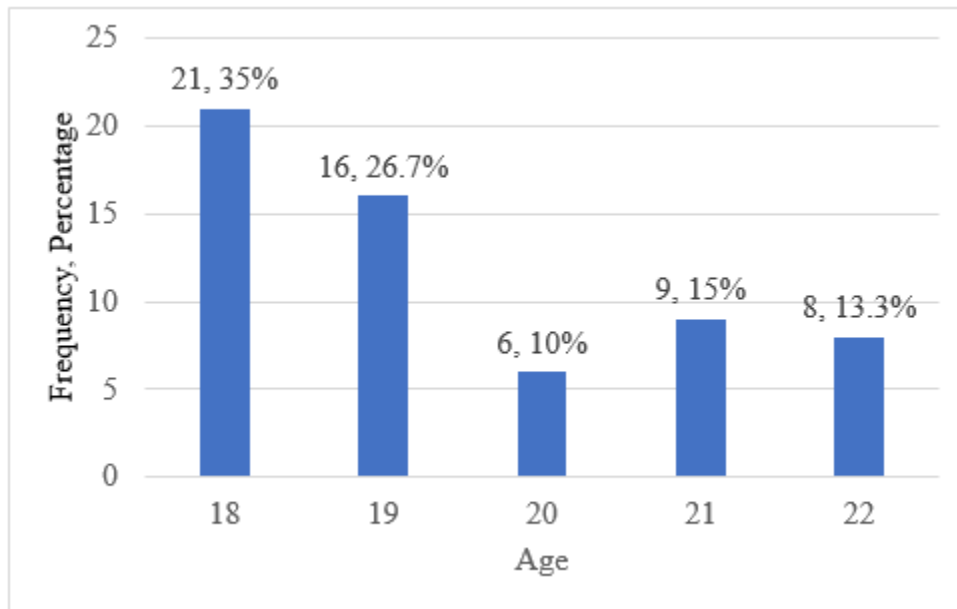
Pre- menstruation data showed a significant change in different visual parameters in all selected 60 females, aged between 18-24 years. Result shows that NPA (OD, OS), AA (OD, OS), NRA, PRA, PFV (Break-Near) and AF (OU) has a significant change during menstruation. This Statistical analysis was done with the help of paired T test and the result was shown as significant if $P < 0.05$.

During the time of menstruation, headache, difficulty in reading and blurring of vision was found among 40 females (66.7%). Blurring of near and distance vision after prolonged near work was found among 10 females (16.7%). None of these females were facing these symptoms before menstruation.

IV. ORGANIZATION OF FINDINGS

➤ Section I

This section shows the analysis and interpretation of the data of the sample with age are given. The data has been analyzed and presented in terms of frequency and percentage.



Graph 1: Frequency and Percentage Distribution of the Samples.

Graph 1: shows that most of the samples are in the age group of 18 years (35.0%) and 19 years (26.7%), the least number of samples are in the rest age group between 22-24.

➤ *Section II*

This section shows the analysis and interpretation of the symptoms and visual parameters changes of the sample before and during the menstruation. The data has been analyzed and presented in terms of frequency, percentage and mean with P & T value.

Table 1: Description of the Presence of Different Symptoms before and During Menstruation.

Parameters		Before Menstruation	During menstruation	Statistical measurement (p value)
Blur vision after prolong near work	Count (n)	0	10	0.001
	Percentage (%)	0	16%	
headache, poor concentration, difficulty in reading, and Blurring of vision	Count	0	40	0.000
	Percentage (%)	0	66.7%	

Table 1: shows that before menstruation the subjects are not facing any symptoms. During the time of the menstrual cycle, some subjects suffer from several ocular symptoms (ex; Blurred vision after prolonged near-focusing headache, poor concentration, and difficulty in reading). During menstruation, there is a significant change This statistical analysis was done by using Kendall's tau-b test.

Table 2: Description of Clinical Signs before and During Menstruation.

Parameters	Before Menstruation (Mean ± SD)	During menstruation (Mean ± SD)	P Value
Phoria (Distance)	-1.48±2.04	-1.55±2.26	0.86
Phoria (Near)	1.11±2.42	1.16±2.72	0.91
NPA (OD)	9.83±0.88	10.43±1.00	0
NPA (OS)	10.08±0.98	10.51±1.02	0.02
NPA (OU)	9.52±0.65	11.35±1.79	2.45
NPC (Break)	5.47±1.05	5.47±0.77	1.78

NPC (Recovery)	8.92±0.69	8.78±0.77	0.33
AC/A Ratio	4.69±1.40	4.32±1.40	0.15
MEM (OD)	0.44±0.2	1.06±0.52	4.38
MEM (OS)	0.40±0.18	1.02±0.51	1.68
NRA	2.14±0.19	2.45±0.65	0
PRA	-2.15±0.6	-2.53±1.53	0.08
NFV (Break)- Distance	9.67±0.9	9.7±0.71	0.82
NFV (Recovery)-Distance	5.23±1.71	5.00±1.87	0.48
NFV (Break)-Near	15.73±2.79	16.20±2.51	0.3
NFV (Recovery)-Near	10.33±2.56	10.06±2.15	0.54
PFV (Break)- Distance	14.77±2.48	14.97±2.56	0.66
PFV (Recovery)-Distance	8.93±2.05	8.47±1.53	0.16
PFV (Break)-Near	14.77±2.39	15.98±2.71	0.01
PFV (Recovery)-Near	9.70±2.22	10.27±2.37	0.18
AF (OD)	8.58±1.64	5.68±2.7	1.32
AF (OS)	8.48±1.48	5.82±2.62	4.22
AF (OU)	8.5±1.61	6.36±5.91	0.008

Table 2: Shows that NPA (OD, OS), AA (OD, OS), NRA, PRA, PFV (Break-Near) and AF (OU) has a significant change before and during menstruation. This Statistical analysis was done with the help of paired T test and the result was shown as significant if $P < 0.05$.

V. DISCUSSION

Accommodation is the eye's ability to change in power in order to focus on objects at different distances. The purpose of accommodation is to neutralize negative vergence from a near object. Present study has shown that before menstruation all the 60 subjects with the age group ranges from 18-24 years were normal, nobody had any particular accommodative disorders before menstruation but during menstruation a group of subjects (8.3%) experienced low Amplitude of Accommodation (AA) and nobody experienced High AA during menstruation. 23.3% subjects were with abnormal NRA-PRA during menstruation. Also, the result of the current study shows that NPA (OD, OS), AA (OD, OS), NRA, PRA, PFV (Break-Near) and AF (OU) have a significant change during menstruation. Most of the subjects (66.7%) experienced Headache, poor concentration, irritability, difficulty in reading and blurring of vision during menstruation followed by blurring of vision after prolonged near work in 16.7% of subjects and blurring of distance vision after prolonged near focusing and blurring of near vision after prolonged distance focusing were experienced in 16.7% subjects however these symptoms were not experienced by the subjects before menstruation.

Several studies have shown similar results, like Piera ⁽¹⁾. Versua et al, in their study on 29 fertile age women found that during the period of menstruation cycle, 14 subjects suffered from dry eye symptoms. Tear production and stability, subjective symptoms, surface dryness and inflammation were significantly correlated with the level of sex hormone variation. The severity level of dryness of the eye depends on the level of estrogen in the body. Peter A Howarth et, ⁽²²⁾ in a study on 12 female participants assessed visual acuity, near the point of accommodation before and after intensive visual work for 30 minutes to find out induced visual discomfort during the menstruation cycle and they reported that although visual discomfort was generated due to increased accommodative demand while doing intensive visual task, during menstrual cycle visual discomfort does not vary significantly. Negar Amiri et al reported ⁽²³⁾ that in adult females with different levels of Serum estradiol, spherical and cylindrical lens power vary significantly during the menstruation cycle. Visual clarity differs from the premenstrual stage to the late menstrual stage. It decreased in the premenstrual stage and comparatively increased in the late menstrual stage. Luo C et al, found that during the menstruation cycle, the vision fluctuated with Serum estradiol levels. They also reported that each diopter of eye power decreased is negatively correlated with the increase of estrogen level during the menstruation cycle ⁽²⁴⁾. The female hormone estrogen is generated in the placenta and ovaries and starts secreting from the puberty stage of life, helping in the development and formation of menses. Epidemiologic studies reported that estrogen participated in the homeostasis of the eye

⁽²⁵⁾. All these studies show that there are many changes induced in different ocular structures during menstruation and previous studies support our present study that an adult female subject suffers from induced accommodative changes and its symptoms during the menstruation cycle.

VI. CONCLUSION

Fluctuation of the level of sex hormone and its action have an impact on accommodation. During the menstruation cycle, accommodative insufficiency is the most common problem among all other dysfunctions of accommodation. A large group of women of reproductive age are suffering from headaches, poor concentration, irritability, difficulty in reading, and blurring of vision during menstruation. Eye care practitioners should consider these changes of accommodative variation and its related symptoms during the examination of an adult female subject.

The authors declare that this study has not received any funding.

The authors also declare that this study does not have any conflict of interest.

REFERENCES

- [1]. Versura P, Fresina M, Campos EC. Ocular surface changes over the menstrual cycle in women with and without dry eyes. *Gynecol Endocrinol*. 2007;23(7):385-90.
- [2]. Guttridge NM. Changes in ocular and visual variables during the menstrual cycle. *Ophthal Physl Opt*. 1994;14(1):38-48.
- [3]. Eisner A, Burke SN, Toomey MD. Visual sensitivity across the menstrual cycle. *Neurological sciences institute, Oregon health & science university, OR97006, USA. Vis Neurosci*. 2004;21(4) 513-31.
- [4]. Millodot MI, Lamont AN. Influence of menstruation on corneal sensitivity. *Br J Ophthalmol*. 1974;58(8):752.
- [5]. Green K, Cullen PM, Philips CL. Aqueous humour turnover and IOP during menstruation. *Br J Ophthalmol*. 1984;68(10):736-40.
- [6]. Dalton K. Influence of menstruation on glaucoma. *Br J Ophthalmol*. 1967;51(10):692.
- [7]. Leach NE, Wallis NE, Lothringer LL. Changes in corneal hydration and curvature occur during the normal menstrual cycle over an extended period. *J Reprod Med*. 1971;6(5):201-4.
- [8]. Akar Y, Yucel I, Akar ME, Taskin O, Ozer HO. Menstrual cycle-dependent changes in visual field analysis of healthy women. *Ophthalmologica*. 2005;219(1):30-5.
- [9]. Akar Y, Zulauf M, Yucel I, Akar ME, Erdem U, Trak B. Menstrual Cycle-Dependent Differences Between Right and Left Visual Hemifields in Perimetry. *Curr Eye Res*. 2005;30(9):723-7.
- [10]. Ulas F, Dogan U, Duran B, Keles A, Agca S, Celebi S. Effects of the menstrual cycle on the choroidal thickness of healthy women of reproductive age using spectral-domain optical coherence tomography. *Department of Ophthalmology and Curr Eye Res*. 2013;38(11):1172-81.
- [11]. Riss B, Binder S, Riss P, Kemeter P. Corneal sensitivity during the menstrual cycle. *Br J Ophthalmol*. 1982;66(2):123-6.
- [12]. Kiely PM, Carney LG, Smith G. Menstrual cycle variations of corneal topography and thickness. *Am J OptomPhysiol Opt*. 1983;60(10):822-9.
- [13]. Ghahfarokhi NA, Vaseghi A, Ghahfarokhi NA, Ghoreishi M, Peyman A, Dehghani A. Evaluation of corneal thickness alterations during menstrual cycle in productive age women. *Indian J Ophthalmol*. 2015;63(1):30.
- [14]. Lodato Giuffre G, Di Rosa L, Fiofino F, Bubella DM, Changes in the central corneal thickness during various phases of the menstrual cycle *University Eye Clinic, Department of Neurology, Ophthalmology and Psychiatry, University of Palermo, Palermo, Italy. J Optom Arch Am Acad Optom*. 1973;50(11):863-71
- [15]. Ghahfarokhi NA, Vaseghi A, Ghahfarokhi NA, Ghoreishi M, Peyman A, Dehghani A. Evaluation of corneal thickness alterations during menstrual cycle in productive age women. *Indian J Ophthalmol*. 2015;63(1):30.
- [16]. Tatlipinar S, Gedik S, Irkec M, Orhan M, Erdener U. Ocular ferning during the menstrual cycle in healthy women. *Eur J Ophthalmol*. 200;11(1):15-8.
- [17]. Sanghvi C, Aziz K, Jones NP. Uveitis and the menstrual cycle. *Eye*. 2004;18(5):451-4.
- [18]. Kaneda Y, Ikuta T, Nakayama H, Kagawa K, Furuta N. Visual evoked potential and electroencephalogram of healthy females during the menstrual cycle. *J Med Investigation*. 1997; 44: 41-6.
- [19]. Brulé J, Lavoie MP, Casanova C, Lachapelle P, Hébert M. Evidence of a possible impact of the menstrual cycle on the reproducibility of scotopic ERGs in women. *Doc Ophthalmol*. 2007;114(3):125-34.
- [20]. Azarmina M, Soheilian M, Azarmina H. Increased latency of visual evoked potentials in healthy women during menstruation. *J Ophthalmic Vis Res*. 2016;6(3):183.
- [21]. Giuffrè G, Di Rosa L, Fiorino F. Changes in colour discrimination during the menstrual cycle. *Ophthalmologica*. 2007;221(1):47-50.
- [22]. Howarth PA, Clemes SA. Susceptibility to induced visual discomfort during the menstrual cycle while viewing a visual display unit. *Optom Vis Sci*. 2006;83(3):190-4.

- [23]. Gong JF, Xie HL, Mao XJ, Zhu XB, Xie ZK, Yang HH, et al. Relevant factors of estrogen changes of myopia in adolescent females. *Chin Med J.* 2015;128(5):659.
- [24]. Xie H, Mao X, Yang H, Xie Z, Pan Y, Gao Y. Analysis on the relationship between adolescent myopia and serum sex hormone. *Chin Med J.* 2014;94(17):1294-7.
- [25]. Gong JF, Xie HL, Mao XJ, Zhu XB, Xie ZK, Yang HH, et al. Relevant factors of estrogen changes of myopia in adolescent females. *Chin Med J.* 2015;128(5):659.