

## ORIGINAL ARTICLE

# VISUAL FUNCTION CHANGES DURING MENSTRUAL CYCLE IN YOUNG FEMALES

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## ABSTRACT:

**Background:** Changes in visual functions such as visual acuity, contrast sensitivity, and color vision have been reported by many women with normal menstrual cycle, which may be due to sensory and perceptual processes. The objective of this study was to observe the changes in visual acuity (VA), contrast sensitivity (CS) and color vision (CV) during one complete menstrual cycle (MC) among young females.

**Materials & Methods:** This cross sectional observational study was conducted from 1<sup>st</sup> October to 30<sup>th</sup> December 2021 on healthy, young unmarried females in Department of Ophthalmology, Hayatabad Medical Complex, Hayatabad, Peshawar, KP, Pakistan. Each subject was examined five times during the whole MC: Menstrual phase (MP), follicular phase (FP), ovulatory phase (OP), post ovulatory phase, and luteal phase (LP). In each phase, VA, CS, and CV were recorded on the Logarithm of the Minimum Angle of Resolution (Log MAR) chart, the Pelli-Robson CS chart and PV-16 respectively. The mean and standard deviation of VA and CS and differences in their scores at the five points of the MC were analyzed through a sample t-test and a paired t-test, respectively. Descriptive statistics were used for CV abnormalities.

**Results:** There were total 35 participants in the study. Their mean age was  $21.89 \pm 1.102$  years. The duration of the MC ranged from 21 to 35 days. A significant difference in the mean score of VA and CS was observed only between the LP and MP, in both eyes. Mild confusion in tritan was observed in LP among three participants. In the FP, two participants reported mild confusion and one participant noticed severe confusion in tritan. All other participants did not show any changes in the CV.

**Conclusion:** Significant change in VA and CS was observed only in the LP and MP. Mild confusion in tritan was noted in some of the females while most of them did not show any change in CV.

**KEY WORDS:** Color vision; contrast sensitivity; menstrual cycle; visual acuity.

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## INTRODUCTION

Menstrual cycle (MC) is a natural and a regularly occurring monthly process that occurs in the uterus and ovaries, of young and healthy females. It begins in the young female at the age of twelve to fifteen years and ends in 45 to 50 years' age. The length of the MC cycle varies from female to female and regular cycles can be longer or shorter but normally it has a length ranging from 21 to 35 days. It is characterized by ovarian and uterine or menstrual

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cycles that are regulated by the hypothalamic-pituitary-ovary system.<sup>1,2</sup> This cycle is characterized by many phases, such as menstrual phase (MP), follicular (FP), ovulatory (OP), post-ovulatory and luteal phase (LP). The levels of various hormones distinguish these phases.<sup>3</sup>

The MC shows cyclical variations in the levels of various sex hormones such as oestrogen, progesterone and luteinizing hormone (LH). These hormones are associated with physical changes. They not only affect reproductive system, but also other body systems, such as nervous system, psychological state of mind, changes in voice, speech, and hearing, and effects on the visual system, specifically visual functions such as vision, contrast and color.<sup>3-5</sup>

These changes occur throughout life, beginning with puberty, fluctuating systemically with the MC during the reproductive years, and changing again with the decline of hormonal activity at menopause.<sup>6,7</sup>

Changes in visual functions such as visual acuity (VA), contrast sensitivity (CS), and color vision (CV) have been reported by many women with normal MC, which may be due to sensory and perceptual processes.<sup>8,9</sup> Women's performance levels may be affected by such changes, throughout their cycle.<sup>1,8</sup> Changes in VA, CS, CV and possible changes in comfort may be clinically significant.<sup>10</sup> Therefore, knowledge of any such fluctuations, linked with the MC, would be useful for clinicians, in deciding whether any change, detected in VA, CS and CV is within normal limits. The fluctuations in VA, CS and CV in young women with normal MC have been investigated in this research. The objective of this study was to observe the changes in visual acuity (VA), contrast sensitivity (CS) and color vision (CV) during one complete menstrual cycle (MC) among young females.

## MATERIAL AND METHODS

This was a cross sectional observational study which was conducted from 1st October to 30th December 2021, Department of Ophthalmology, Hayatabad Medical Complex, Hayatabad, Peshawar, KP, Pakistan. It was performed according to the Declaration of Helsinki, and the protocol was approved by the ethical committee of the institute. Informed consent was attained from all the participants after explaining the procedure to them. In this study, total thirty-five unmarried, healthy female students with normal and regular MC were enrolled. The female enrolled in this study were from age 18 to 25 years, emmetropic, normotensive, non-diabetic and no any anterior or posterior segments pathology. Those females whose vision was 20/20 with glasses or contact lenses were excluded from the study. Moreover, those females, who had irregular cycle that is either shorter or longer, or who had known hormonal diseases, or use of any contraceptive medications were also excluded from the study.

All examinations were scheduled in the morning in the low vision clinic in the department of ophthalmology. Each subject was examined five times during the whole cycle, that is during menstrual phase (MP) or menstruation (1 to 7days), Follicular phase (FP) or after menstruation (days 7 to 14), ovulatory phase (OP) or mid menstrual phase (days 14 to 16), post-ovulatory phase (days 16 to 18) and luteal phase (LP) or pre-menstrual phase (28 to 35 days). The LH peak in the urine, which occurs 24-36 hours prior to ovulation, was used to determine the exact day of ovulation. All of the participants were given an ovulatory strip kit to test for the presence of LH in their urine. They tested themselves at home every day during the per-ovulatory period, until the LH peak took place. If the LH peak did not occur within the first five days of testing, a second kit was provided to them. When the test resulted in a positive result,

the subjects were instructed to notify the investigator immediately.

Each participant was examined through a slit lamp in all five phases of the MC. Both the anterior and posterior segments were examined to rule out any pathology. After that, visual functions were assessed in each participant as follows: During each phase of the MC, first, VA was assessed in the right eye while occluding the left eye with an occluder. Similarly, then, the right eye was occluded and the VA of the left eye was recorded. VA was recorded in Log MAR on a pre-designed proforma. Then both subjective and objective refraction were performed to assess refractive error in all the participants. After the VA assessment, the participant underwent a contrast sensitivity assessment. CS was assessed using the Pelli-Robson Contrast sensitivity chart at one-meter distance. First, the CS was measured for the right eye while occluding the left eye. The participants were asked to read the line till they could see. The value against that line was recorded. CS of the left eye was taken in a similar way. The values were recorded in the log units. After VA and CS, color vision was assessed binocularly through PV-16 in each phase of the MC. The color vision pattern was drawn on the proforma and the data was recorded. After assessment of VA, CS, and color vision in one phase, the participants were instructed to report to the low vision clinic for the next phases of MC. The same visual functions were recorded in all the phases with the same methods described above.

The data was analyzed using the Statistical Package for the Social Sciences (SPSS) software. Age, education, number of days with active bleeding and cycle length were analyzed through descriptive statistics. The mean and standard deviation in VA and CS for both the right and left eye were analyzed through a sample *t*-test. Differences in the scores of VA and CS at the five points of the MC were evaluated with a paired *t*-test. Changes in color vision in all the participants were analyzed through descriptive statistics.<sup>7</sup>

## RESULTS

There were 35 participants in this study, and their mean age was  $21.89 \pm 1.102$  years. Most of them were undergraduate students. Table: 01 shows the details of menstrual duration and other demographic profiles.

Mean values of VA and CS of the right and left eye in different phases of the MC are shown in table :02. In the FP, the CS of both the right and left eye was the same.

Changes in the VA of the right eye between the LP and MP show a mean difference of  $0.045 \pm 0.089$  ( $p < 0.005$ ), which shows that changes in VA are more significant between the LP and MP. Similar results are found for the left eye, with a difference in scores of VA as  $0.062 \pm 0.143$  ( $p = 0.014$ ). Table 03 shows

**Table: 01. Demographic profile of the study participants (N=35)**

Profile of the participants		Frequency	Percentage (%)
Age range	18 to 21 years	15	42.9
	22 to 25 years	20	57.1
Education	Undergraduate	33	94.3
	Post graduate	02	5.7
Days of active bleeding	3 to 4 days	05	14.3
	4 to 5 days	03	8.6
	5 to 6 days	07	20
	6 to 7 days	20	57.1
Cycle length	21 to 28 days	19	54.28
	29 to 35 days	16	45.71

**Table: 02. Mean and standard deviation in visual acuity and contrast sensitivity in different phases of the menstrual cycle (one sample t- test) N=35**

Laterality	Menstrual cycle	Visual acuity Mean $\pm$ standard deviation	Contrast sensitivity Mean $\pm$ standard deviation
Right eye	Menstrual phase	-0.082 $\pm$ 0.075	1.911 $\pm$ 0.074
	Follicular phase	-0.078 $\pm$ 0.069	1.938 $\pm$ 0.053
	Ovulatory phase	-0.098 $\pm$ 0.787	1.950 $\pm$ 0.00
	Post ovulatory phase	-0.082 $\pm$ 0.083	1.950 $\pm$ 0.00
	Luteal phase	-0.054 $\pm$ 0.095	1.844 $\pm$ 0.108
Left eye	Menstrual phase	-0.074 $\pm$ 0.124	1.881 $\pm$ 0.108
	Follicular phase	-0.094 $\pm$ 0.060	1.938 $\pm$ 0.053
	Ovulatory phase	-0.101 $\pm$ 0.099	1.941 $\pm$ 0.051
	Post ovulatory phase	-0.080 $\pm$ 0.084	1.941 $\pm$ 0.051
	Luteal phase	-0.012 $\pm$ 0.093	1.837 $\pm$ 0.108

**Table 03. Difference between the scores in visual acuity and contrast sensitivity in different phases of the menstrual cycle**

Laterality	Phases of MC	Difference in scores of VA		Difference in scores of CS	
		Mean $\pm$ standard deviation	p-value	Mean $\pm$ standard deviation	p-value
Right eye	Menstrual phase – Follicular phase	-0.015 $\pm$ 0.090	0.319	-0.028 $\pm$ 0.096	0.086
	Ovulatory – Post ovulatory phase	-0.017 $\pm$ 0.081	0.218	1.95 $\pm$ 0	-
	Luteal phase – Menstrual phase	0.045 $\pm$ 0.089	0.005*	-0.066 $\pm$ 0.128	0.005*
Left eye	Menstrual phase – Follicular phase	0.020 $\pm$ 0.111	0.294	-0.028 $\pm$ 0.096	0.029
	Ovulatory phase – Post ovulatory phase	-0.021 $\pm$ 0.062	0.053	1.95 $\pm$ 0	-
	Luteal phase – Menstrual phase	0.062 $\pm$ 0.143	0.014*	-0.066 $\pm$ 0.128	0.048*

MC=Menstrual cycle, VA= Visual acuity, CS= Contrast sensitivity, \* Statistically significant p- value < 0.05

**Table: 04. Changes in color vision in different phases of menstrual cycle**

Color vision (PV 16)		Phases of menstrual cycle				
		Follicular phase N (%)	Ovulatory phase N (%)	Post ovulatory phase N (%)	Luteal phase N (%)	
Menstrual phase N (%)						
Trichromatic		34 (97.1)	32 (91.4)	34 (97.1)	34 (97.1)	32 (91.4)
Tritanomoly	Mild confusion	01 (02.90)	02 (05.70)	01 (02.90)	01 (02.90)	03 (08.60)
	Moderate confusion	0	0	0	0	0
	Severe confusion	0	01 (2.90)	0	0	0
Protonomoly	Mild confusion	0	0	0	0	0
	Moderate confusion	0	0	0	0	0
	Severe confusion	0	0	0	0	0
Deuteranom- aly	Mild confusion	0	0	0	0	0
	Moderate confusion	0	0	0	0	0
	Severe confusion	0	0	0	0	0

the difference between the scores in VA and CS in different phases of MC.

Most of the participants were trichromatic and showed no change in colour vision throughout the MC. However, mild confusion in tritan was observed in the LP among three (8.60%) participants, while two (5.7%) participants reported mild confusion in tritan in the FP. One of the participants (2.9%) noticed severe confusion in tritan in color vision in the FP (Table: 04).

## DISCUSSION

The research on variations in visual functions during MC in women is limited and contradictory. This has raised concern about various effects of female hormonal levels on visual functions such as visual VA, CS and CV. In this study, we measured the VA, CS and CV of young women at five points in the MC. The results of this study show changes in VA, CS and CV during the MC, while the most significant variation in these visual functions occurs in the LP of MC.

In this study, changes in VA was observed among all of the stages of MC but the most significant changes were observed in the LP and MP ( $p < 0.05$ ), which may be attributed to higher hormonal changes in this stage of MC. Similar findings are reported by other studies too.<sup>11</sup> However, a study conducted on Caucasian women in Italy, found no changes in VA during MC. But, they assessed women at three different points during the menstrual cycle.<sup>12</sup>

There has been little study on the changes in CS across the MC. In this study, a significant change in CS was observed in the LP and MP of the MC. Variations in CS may be due to hormonal shifts across the MC or changes in ocular parameters,

for example pupil size or lens shape.<sup>8, 10</sup> Some other studies reported no significant change in CS though their sample size is smaller.<sup>13</sup>

In normal and healthy humans, usually variation in color discrimination has not been observed by women during MC. However, it is possible that during MC, color discrimination may also exhibit due to cyclical changes, even if not readily appreciated. In this study, variations in color vision were also reported. Although no significant changes were found in the color vision but subtle changes in tritan were noted during the cycle, from mild confusion to severe confusion in tritan (Table 4). Contrary, research conducted on color vision demonstrated better color discrimination at ovulation compared at the beginning and end of the cycle.<sup>11, 14</sup>

In summary, in this study, a significant change in the VA and CS was observed in the LP of the MC, while there was no significant change in either of these parameters in other phases of the cycle. Mild confusion in tritan was observed in some of the females, while most of them did not show any change in color vision.

These findings are intended to be considered as normal physiological fluctuations without any adverse consequences. Because the MC is relatively long in duration and the hormones fluctuate cyclically. Therefore, clinicians must consider cyclical variation in these parameters, specifically, in the luteal and menstrual phases while assessing young females if any significant changes are observed.

## CONCLUSION

Significant change in visual acuity and contrast sensitivity was observed only in the LP and MP. Mild

confusion in tritan was noted in some of the females while most of them did not show any change in color vision.

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### CONFLICT OF INTEREST

Authors declare no conflict of interest.  
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### AUTHORS' CONTRIBUTION

The following authors have made substantial contributions to the manuscript as under:

Conception or Design:	YT, SAK
Acquisition, Analysis or Interpretation of Data:	YT, SAK, MS, SN, MTK
Manuscript Writing & Approval:	YT, SAK, MS, SN, MTK

All the authors agree to be accountable for all aspects of the work in ensuring that questions related to the accuracy or integrity of any part of the work are appropriately investigated and resolved.



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