

## Analyze the effect of the menstrual cycle on ocular parameters among University health science students.

Saloni<sup>1,5</sup> Dr.Sima Lal Gupta<sup>2,5</sup>, Prof. Monica Chaudhry<sup>3,5</sup>

<sup>1</sup>M.Optom; <sup>2</sup>Associate Professor; <sup>3</sup>Director;

<sup>5</sup>SHS, Sushant University, Gurgaon

---

### Abstract:

#### Aim

The study is aimed at determining the changes in ocular parameters during the menstrual cycle in health science students.

#### Method

A Cohort Study were participants were healthy young females with regular menstrual cycle between the age group 17-30years (n=44) with no ocular and systemic issues were included in this study. The parameters were Symptoms including dryness, headache, fatigue and mood swing on the basis of questionnaire, Visual acuity, Refractive error, Intra ocular pressure (all participants tested at same time), Dry eye, Corneal curvature and Axial length. The subjects were asked to keep records of their menstrual cycle before the study. Measurement was taken during the menstrual cycle of 3<sup>rd</sup>, 6<sup>th</sup> and 15<sup>th</sup>day with follow-up. Day 3 represented the menstrual phase, day 6 represented the proliferative phase and day 14 represented the luteal phase. All measurements will be within same menstrual cycle. All data were measured by gold standard instruments. Data was analysed using SPSS software.

#### Result

In my study the symptoms increased during menstrual phase when compared to proliferative and luteal phase (p=0.01). Symptoms were reduced progressively in luteal phase. Tear breakup time of both eyes was decreased during menstrual phase when compared to proliferative and luteal phase (p=0.01). Mean corneal curvature of menstrual phase of both eyes was increased when compared to other two phases (p=0.01). Mean IOP of menstrual phase of both eyes is mildly changed but statistically not significant (p>0.05). Rest parameters were unchanged. In this study we found the strong correlation between symptoms and tear breakup time in proliferative phase (r<sup>2</sup>=0.204).

#### Conclusion

Menstrual cycle is a normal physiological process. This current study concludes that there is a definite relationship of hormones of the menstrual cycle, tear production and symptoms as the variation occurred in the values was statistically significant. Headache and dryness is more common symptoms during the menstrual cycle. There is a significant role of hormone receptors that is oestrogen and progesterone and symptoms on variation in ocular surface parameters. It is not clear whether oestrogen or progesterone has a direct effect on the eye or acts indirectly.

**Key word:** Symptoms, Visual acuity, Refractive error, IOP, TBUT, Corneal curvature, Axial length.

---

Date of Submission: 16-03-2023

Date of Acceptance: 01-04-2023

---

### I. Introduction

The menstrual cycle is a series of changes in the endometrium of a non-pregnant female. Each month endometrium is prepared to receive an already fertilized ovum that eventually develops into an embryo and then into a foetus until delivery. If no fertilization occurs, the stratum functionalis portion of the endometrium is shed. The ovarian cycle is a monthly series of events associated with the maturation of an ovum. Hormonal control Menstrual cycle, ovarian cycle and other changes associated with puberty in the female are controlled by a regulating factor from the hypothalamus called gonadotropin releasing hormone (GnRH). GnRH stimulates the release of follicle stimulating hormone (FSH) and luteinizing hormone (LH), which stimulates the development of ovarian follicles, brings about ovulation and stimulates the production of estrogens, progesterone, inhibin and relaxin by ovarian cells of the corpus luteum [1]. These hormones play a role in ocular surface parameters variation during menstrual cycle. Tear production, Intra ocular pressure, surface dryness, inflammation were significantly related to hormonal fluctuations in the menstrual cycle due to fluctuation of estrogen and progesterone hormones. These receptors were found in human retina, choroid and human ciliary epithelial cells. Glucocorticoids receptors were found in human eye along with other sex hormone receptors. Topical or systemic application of glucocorticoids were found to decrease aqueous humour outflow [2]. These receptors also identified in human

Cornea, Meibomian glands, Lacrimal glands and Palpebral and bulbar conjunctiva in young female eyes not in male [2][5]. There is reduction in corneal sensitivity a few days before or on the day of ovulation [3]. The central corneal thickness varied during the menstrual cycle. The cornea was the thinnest at the beginning and thicker at ovulation and at the end of the cycle. [7].

### **Estrogens**

The hormones of growth have four functions:

- Development and maintenance of female reproductive structures.
- Fat distribution to the breasts, abdomen, hips, voice pitch, hair pattern etc.
- They help control fluid and electrolyte balance.
- They increase protein anabolism.

### **Progesterone**

The hormone of maturation, works with estrogens to prepare the endometrium for implantation of a fertilized ovum and the mammary glands for milk secretion. High levels of progesterone also inhibit GnRH and prolactin(PRL).

### **Phases of Menstrual cycle:**

- Menstrual Phase
- a.) Primary Follicles b.) Secondary Follicles
- Preovulatory Phase(Proliferative Phase)
- Ovulatory Phase
- Postovulatory Phase(Luteal Phase)

**Menstrual Phase:** Duration of menstrual cycle is 28days. Menstrual phase is periodic discharge of 25-65ml of blood, tissue fluid, mucus and epithelial cell. It is cause by a sudden reduction in oestrogen and progesterone. Its duration is for first 5days in a 28day cycle.

- **Primary Follicles:** During the menstrual phase, ovarian cycle is also in operation. Primary Follicles refers to an ovarian follicle surrounded by a single layer of flattened granulosa cells.
- **Secondary Follicles:** Primary follicles develop secondary follicles.
- 

**Pre-ovulatory Phase (Proliferative Phase):** It is secondary phase of menstrual cycle, is the time between menstruation and ovulation. Its duration is from days 6 to13 in a 28day cycle. FSH and LH stimulate the ovarian follicles to produce more oestrogen.

**Ovulatory Phase:** The rupture of the vesicular ovarian follicle with release of the secondary oocyte into the pelvic cavity, usually occurs on day 14 in a 28day cycle.

**Post-ovulatory Phase (Luteal Phase):** Its duration is from 15 to28 in a 28day cycle. It is the time between ovulation and onset of the next menses. Following ovulation, LH secretion stimulates the development of the corpus luteum. Corpus luteum secretes increasing production of estrogens and progesterone [1].

## **II. Material and Methods**

**Study design:** It is cohort study

### **Inclusion criteria:**

- Female in the age range of 17-30yrs.
- Regular menstrual cycle of 28days.
- Female free of any ocular surgery .

### **Exclusion criteria:**

- Female with history of irregular menstrual cycle.
- Female on any contraceptive pill.
- Female who is suffering from any systemic diseases.
- Contact lens users
- Pregnant women

A cohort study. Participants were healthy young females with regular menstrual cycle between the age group 17-30years (n=44) without any ocular and systemic issues were included in the study. Pilot study was done on 10 subjects. The parameters was Symptoms including dryness, headache, fatigue and mood swing on the basis of questionnaire, Visual acuity, Refractive error, Intra ocular pressure (all participants will be tested at same time), Dry eye, Corneal curvature, Axial length of the female. Measurement were taken during the menstrual cycle of 3<sup>rd</sup>, 6<sup>th</sup> and 15<sup>th</sup>day using follow-up. Day 3 represented the menstrual phase, day 6 represented the proliferative phase and day 14 represented the luteal phase. All measurements will be within same menstrual cycle. All data were measured by gold standard instruments. Visual acuity was measured by Log MAR visual acuity chart, Refraction by Retinoscope, Intra ocular pressure by Goldman Applanation Tonometer, Dry eye evaluation by Tear Break-up Test (TBUT), Axial length by Digital Biometer and Corneal curvature by Manual Keratometer. Data were analysed using SPSS software. TBUT test was done by instilling fluorescein into the patient's tear film and the patient was asked not to blink until the first black spot was observed on the cornea under the slit lamp examination.

### III. Result

Nonparametric data were analysed by Friedman with Wilcoxon signed rank test and Parametric data were analysed by

Repeated Measures ANOVA with post hoc studies using Bonferroni.

Total number of participants enrolled for the study was 50 healthy female volunteers with regular menstrual cycle, but 6 of them dropped out due to some issues. Parameters were obtained from 44 participants and analysed statistically using SPSS software (n=44). The values were obtained both the eyes separately during each phase.

#### Variations in ocular parameters in both eyes during all three phases of menstrual cycle:

<u>Parameters</u>	<u>Menstrual Phase</u> (Mean± SD)	<u>Proliferative Phase</u> (Mean± SD)	<u>Luteal Phase</u> (Mean± SD)	<u>P- value</u>
Axial Length(RE)	23.29±0.78(mm)	23.42±0.66(mm)	23.48±0.68(mm)	0.070
Axial Length(LE)	23.26±0.78(mm)	23.42±0.66(mm)	23.39±0.68(mm)	0.25
Intra Ocular Pressure(RE)	13.534±1.96(mm Hg)	13.54±2.24(mm Hg)	13.7±1.6(mm Hg)	0.839
Intra Ocular Pressure(LE)	14.14±2.24(mm Hg)	13.61±1.99(mm Hg)	14.34±1.75(mm Hg)	0.127
Corneal Curvature(RE)	7.71±0.21(mm)	7.64±0.15(mm)	7.66±0.125(mm)	0.034
Corneal Curvature(LE)	7.74±0.20(mm)	7.66±0.125(mm)	7.70±0.13(mm)	0.020

**Table: 1** Parametric Data)

<u>Parameters</u>	<u>Menstrual Phase</u> (Median± IQR)	<u>Proliferative Phase</u> (Median± IQR)	<u>Luteal Phase</u> (Median± IQR)	<u>P- value</u>
VA(RE)	0.10±0.30	0.10±0.30	0.10±0.30	0.36
VA(LE)	0.10±0.30	0.10±0.40	0.10±0.40	0.26
Symptoms	6±4	4±8	0.0±3	0.01
Spherical Equivalent(RE)	-0.375±1.12(D)	-0.37±1.25(D)	-0.50±1.12(D)	0.85
Spherical Equivalent(LE)	-0.375±1.12(D)	-0.37±0.87(D)	-0.375±1.00(D)	0.77
TBUT(RE)	6±1	7±1	8±1	0.01
TBUT(LE)	6±1	7±1	8±1	0.01

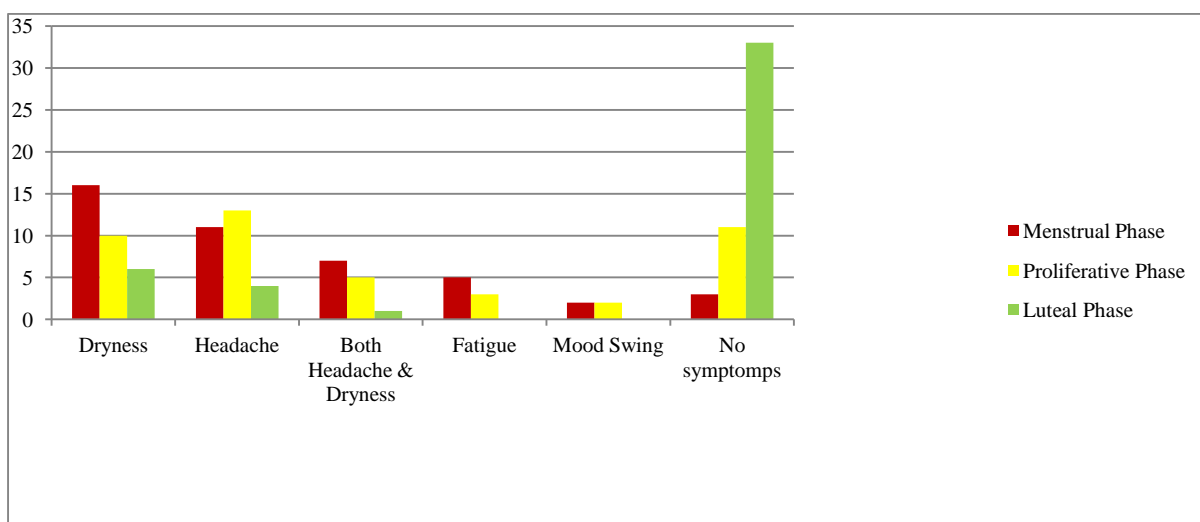
**Table: 2** (Non parametric data)

In my study the median values of symptom were varying within the phases. Values of symptom of luteal phase (0.0±3) is decreased when compared to proliferative and menstrual and increased in proliferative phase (p=0.01). The median value of tear breakup time of menstrual phase (6±1)sec was decreased of both eyes when compared to proliferative and luteal phase by 2steps (p=0.01). Mean corneal curvature of menstrual phase of right

eye ( $7.71 \pm 0.21$ )mm is increased when compared to other two phases ( $p=0.01$ ) and also mean corneal curvature of menstrual phase of right eye ( $7.74 \pm 0.20$ )mm is increased when compared to other two phases ( $p=0.006$ ). Mean IOP of menstrual phase of right eye ( $13.534 \pm 1.96$ )mmHg and left eye ( $14.14 \pm 2.24$ )mmHg is mildly changed but statistically not significant ( $p>0.05$ ). Rest parameters were unchanged.

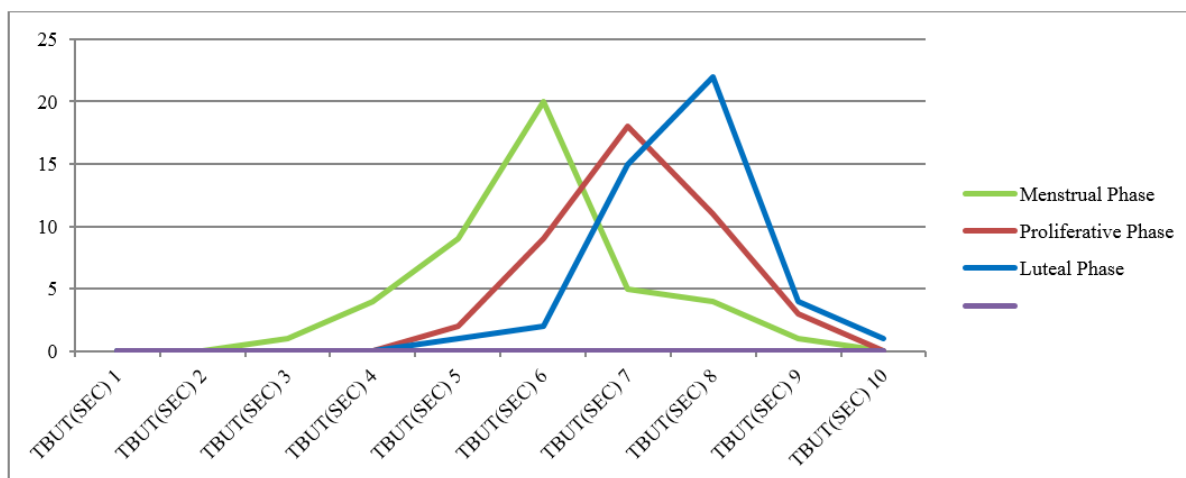
Parameters	Menstrual Phase with Proliferative Phase	Proliferative Phase with Luteal Phase	Luteal Phase with Menstrual Phase
Symptoms	$P \geq 0.335$	$P \leq 0.01$	$P \leq 0.01$
Tear Break-up Time(RE)	$P \leq 0.01$	$P \leq 0.007$	$P \leq 0.01$
Tear Break-up Time(LE)	$P \leq 0.01$	$P \leq 0.007$	$P \leq 0.01$
Corneal Curvature(RE)	$P \geq 0.01$	$P \geq 0.28$	$P \geq 0.13$
Corneal Curvature(LE)	$P \geq 0.006$	$P \geq 0.045$	$P \geq 0.257$

**Table: 3** Comparison of ocular parameters among all three phases where p value is significant at 0.01 level



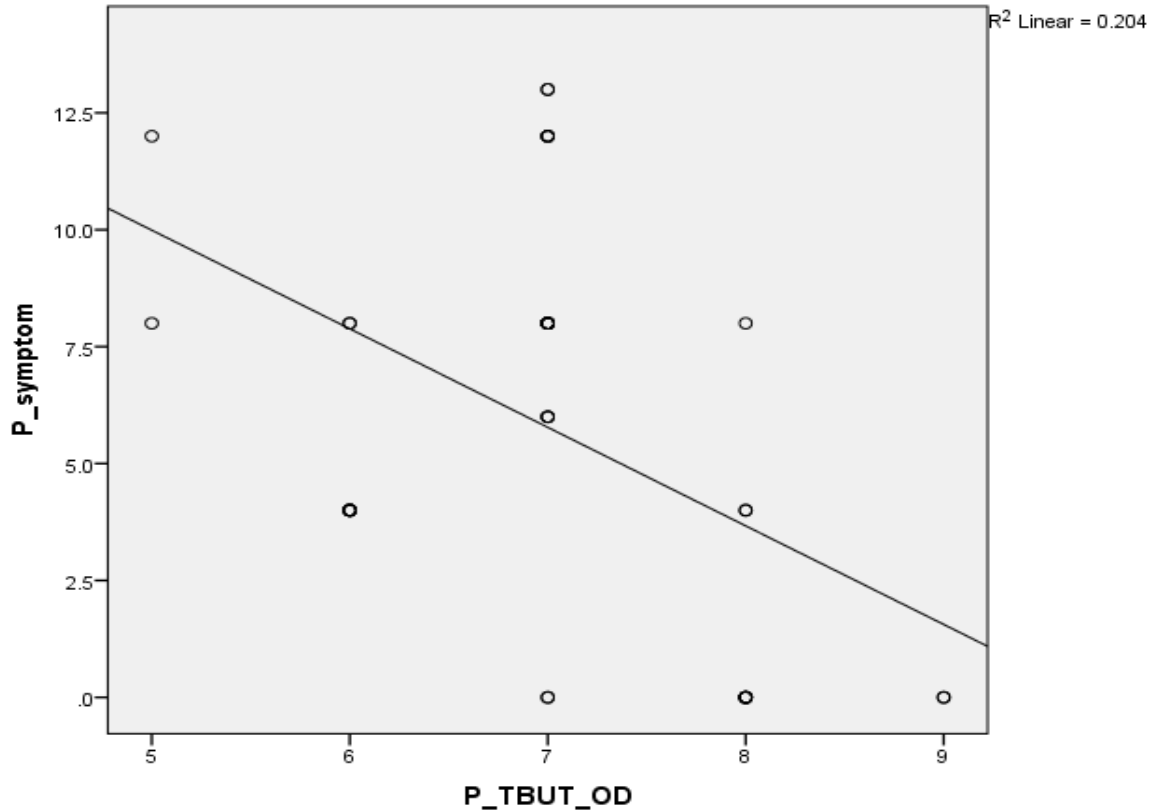
**Fig:1** Variations in symptoms during all three phases of menstrual cycle

This graph shown out of 44 populations the 93% people were symptomatic in menstrual phase and 75% people were symptomatic in proliferative phase but in luteal phase found only 25% were symptomatic and rest were asymptomatic.

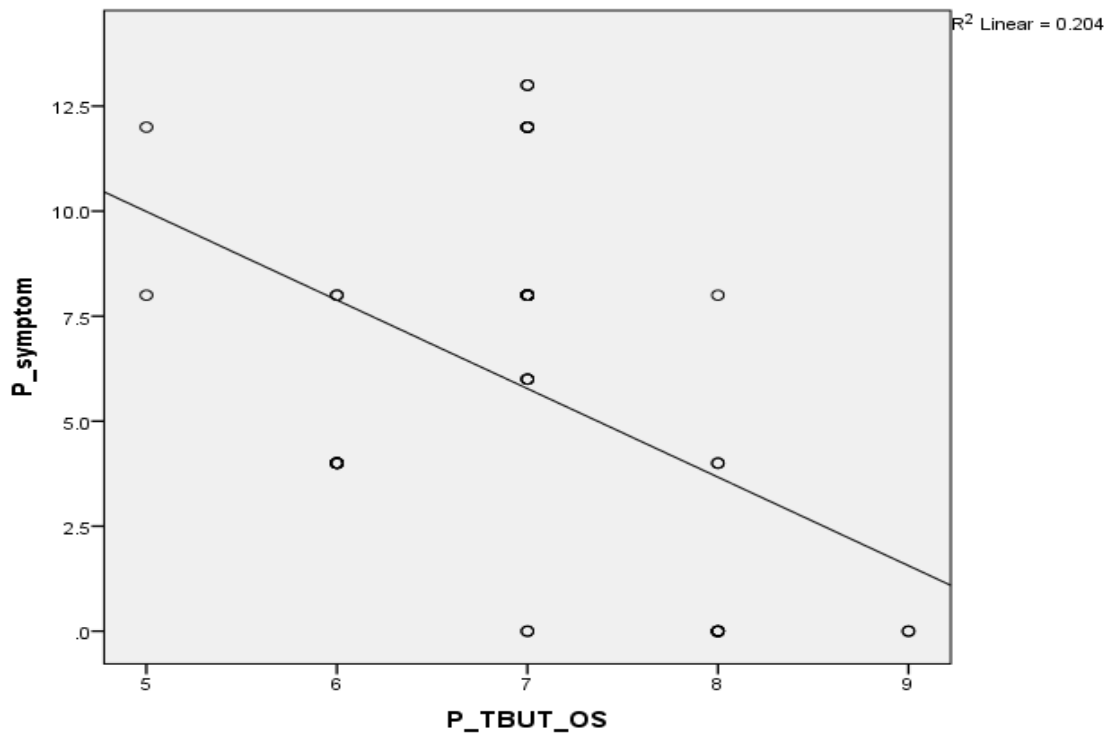


**Fig: 2** Variations in TBUT in both eyes during all three phases of menstrual cycle

In this graph shown the variation of TBUT in all three phases the values of TBUT of both eyes increases from menstrual phase to proliferative phase to luteal phase respectively.



**Fig:3** Correlation of symptoms with TBUT of right eye



**Fig: 4** Correlation of symptoms with TBUT of left eye

In this graph found the strong correlation between symptoms and tear breakup time of both eyes in proliferative phase ( $r^2=0.204$ ) where graph showed symptoms are inversely proportional to TBUT.

#### **IV. Discussion**

During the menstrual cycle female sex hormones fluctuate which is progesterone and Oestrogen. Estrogen and progesterone receptors have been identified in various ocular surface structures like cornea, Meibomian glands, lacrimal glands, and palpebral and bulbar conjunctiva [5]. Fluctuation of hormones was reported to have influence on ocular parameters. The early follicular phase of the menstrual cycle is characterized by low levels of both progesterone and estrogen. Plasma estrogen levels increase just before ovulatory phase. Late luteal phase is characterized by declines in both estrogen and progesterone levels that reach baseline shortly before the onset of menstruation [4]. In my study symptoms increases significantly in early phase and progressively reduces in luteal phase when compare to other phases. This shows that the decrease may be due to fluctuation of both estrogen and progesterone. Hormone receptors which is estrogen, progesterone and androgen have been found in human lacrimal glands and meibomian glands and also found to regulate the secretory functions of the lacrimal gland and meibomian glands. Their main function been to produce tears and prevent evaporation of tear film respectively [5]. Stability of tear film decreases significantly of both eyes during menstrual phase and it increases in late phase when compared to other two phases which may be due to sudden reduction in estrogen and progesterone and it is possible due to this its lead to tear evaporation which can be cause of dryness of the eye. The volume of tear in the eye depends on two factors drainage through the lacrimal passages and evaporation, if tear production decreases or evaporation increases that may cause dryness to the eyes. Visual acuity, Refractive error, Intra ocular pressure and axial length were unchanged among three phases. In my study intra ocular pressure was statistically not significant when compare to three phases. In other study glucocorticoids receptors were found in human eye along with other sex hormone receptors. Topical or systemic application of glucocorticoids were found to decrease aqueous humour outflow and increase IOP [2]. Mild changes in corneal curvature noticed. It reduced in proliferative phase when compare to other two phases which may be due to peak of estrogen. We found a positive correlation between symptoms and tear breakup time in proliferative phase. If symptom increases dryness will more. There was a study that said about the protective role of sex hormones in different aspects during the life time of women. The central corneal thickness varied during the menstrual cycle. The cornea was thinnest at the beginning and thicker at ovulation and at the end of the cycle [7]. Estrogen is found to be a neuroprotector and neuromodulator and diseases associated with retinal ganglion cell death like glaucoma the neuroprotective effect of estrogen is beneficial [4]. Presence of sex steroid hormone receptors has been identified in lens, retina, choroid, cornea and ciliary body. But apart from the hormones blinking and eyes rubbing also increases IOP significantly. Lens wearing women seemed to have increased progesterone level and progesterone has capacity to change the surface properties of cornea [2]. The retinal rim area decreased significantly during the luteal phase. However, the linear cup disc ratio was significantly higher in luteal phase [4]. In a prospective observational study found the associations between modifiable lifestyle factors and menstrual cycle phases on the ocular signs and symptoms of dry eye in young healthy women. The lifestyle frequency scores were obtained by gathering information on the personal lifestyle choices made related to nutritional options, exercise frequency, stress levels, hours of sleep, environmental exposure time and hours of device use. All questions were taken from validated questionnaires. The effect of lifestyle factors appeared to be more pronounced during the ovulation phase compared to the follicular and luteal phases of the menstrual cycle in young healthy women [6].

#### **V. Conclusion**

Menstrual cycle is a normal physiological process. This current study concludes that there is a definite relationship of hormones of the menstrual cycle, tear production and symptoms as the variation occurred in the values was statistically significant. Headache and dryness is more common symptoms during the menstrual cycle. There is a significant role of hormone receptors that is Estrogen and Progesterone and symptoms on variation in ocular surface parameters. It is not clear whether estrogen or progesterone has a direct effect on the eye or acts indirectly.

#### **References**

- [1]. Tortora, G. J., & Derrickson, B. H. (2018). Principles of anatomy and physiology. John Wiley & Sons.
- [2]. Brindha, S., Srihari, R., Prince, J. S., & Shyamala, R. Variations in Intraocular pressure (IOP) during different phases of Menstrual cycle among healthy young population.
- [3]. Riss, B., Binder, S., Riss, P., & Kemeter, P. (1982). Corneal sensitivity during the menstrual cycle. *British Journal of ophthalmology*, 66(2), 123-126.
- [4]. Akar, M. E., Taskin, O., Yucel, I., & Akar, Y. (2004). The effect of the menstrual cycle on optic nerve head analysis in healthy women. *Acta Ophthalmologica Scandinavica*, 82(6), 741-745.
- [5]. Shuaibu A. O., & Agoreyo F. (2016). Tear production in premenopausal women during menstrual cycle.
- [6]. Colorado, L. H., Edwards, K., Dinh, L., Ha, S., Liu, D., Luu, A., & Schmid, K. L. (2020). Associations between the menstrual cycle, lifestyle factors and clinical assessment of the ocular surface: a prospective observational study. *BMC Women's Health*.
- [7]. Yakov Goldich, MD, Yaniv Barkana etal (2011). Variations in corneal biomechanical parameters and central corneal thickness during menstrual cycle. *Journal of Cataract & Refractive Surgery*.