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Tear Production in Premenopausal Women During Menstrual Cycle.

[1]Shuaibu A. O and [2]Agoreyo F.

[1]Department of Optometry, Faculty of Life Sciences, University of Benin, Benin City, Nigeria.

[2]Department of Physiology, School of Basic Medical Sciences, University of Benin, Benin City, Nigeria

Email :ayishetu.garuba@uniben.edu

ABSTRACT

This study examined if menstrual cycle has an effect on tear production in women who are in productive age. Thirty premenopausal females enrolled in this study. After routine ophthalmic examination, the tear production was measured using the Schirmer test. Examinations were carried out on day 3 (follicular phase), day 14 (ovulation phase) and day 26 (luteal phase) for the experimental group. Tear production was not statistically different between right and left eyes at any time ($p > 0.05$).The tear production at day 14 was significantly lower than day 3 ($p=0.03$) and day 26 ($p=0.001$). There was no significant difference between day 3 and day 26 ($p>0.05$). The study showed that menstrual cycle has an effect on tear production. This effect could be attributed to hormonal changes during the menstrual cycle.

Keywords: Tear production, Premenopausal women, Menstrual cycle, Tears, Hormones, Ovulation, Follicular.

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1. INTRODUCTION

Tear film is a complex fluid, which covers the exposed parts of the ocular surface framed by the eyelid margins. The primary function of tears is to protect the cornea and conjunctiva, which together make up the ocular surface. Tears are secreted in response to environmental stressors to protect the ocular surface by providing nourishment to the avascular cornea. The tear film contains proteins and electrolytes synthesized and secreted by the lacrimal gland (Kehinde *et al.,* 2012). If there is any alteration in either amount or composition, it could result in a spectrum of diseases called dry eye syndromes. The secretors of tears (tear film) are the Meibomian glands, lacrimal glands, and conjunctiva goblet cells. Estrogen and progesterone receptors have been identified in various ocular surface structures like cornea, Meibomian glands, lacrimal glands, and palpebral and bulbar conjunctiva (Ogueta *et al.,* 1999).

The menstrual cycle is the monthly series of changes a premenopausal woman's body goes through in preparation for the possibility of pregnancy. 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 (Farage *et al.,* 2009).

According to Ogueta *et al.*(1999*),* a body of epidemiological data points to an involvement of sex hormones, especially

estrogen, in the normal physiology of the human eye. The proposed cellular mechanism by which steroids act is through intracellular receptors, which modulate transcription and protein synthesis on the target cell after becoming activated (Song *et al.,* 2014).

Literature on the subject revealed that because of sex steroid hormone (estrogen, progesterone, and androgen) actions, various physiological conditions, such as age, menstrual cycles, pregnancy, and menopause or andropause (where the hormone milieu changes) affect vision. Ebeigbe *et al.*, (2014) in their study reported that menstrual cycle has an effect on tear secretion and stability. On the other hand, Cavdar *et al*., (2014) in their study reported that menstrual cycle has no significant effect on tear volume and stability. These conflicting results prompted this study which is aimed at assessing if there is an effect of menstrual cycle on tear production.

2. MATERIALS AND METHODS

The study was carried out in the Department of Optometry, University of Benin, Benin City. This study involved selection of 30 healthy females. The consent of each of the subjects was obtained prior to the initiation of the study, following a thorough and comprehensive explanation of the procedures and the level of involvement of the subject. Local ethical approval was also obtained. Those that met the inclusion criteria were selected.

2.1 Inclusion criteria for the experimental group.

Women in the age range of 18-35years, with regular menstrual cycle of 28days, non contact lens users and those free of any ocular pathology or systemic disease.

2.2 Exclusion criteria for the experimental group

Women on any contraceptive pill or hormone therapy, women with current history of irregular menstrual cycle and those with genitourinary infection were excluded.

2.3 Procedure

The nature of the study was described to all subjects who had volunteered to participate in the study. The subjects were asked to keep records of their menstrual cycle before the study. Measurements were taken on the 3rd, 14th and 26th day. Day 3 represented the follicular phase, day 14 represented the ovulatory phase and day 26 represented the luteal phase.

A comprehensive optometric examination was performed; these included a thorough case history (in addition to menstrual history for the female subject), visual acuity measurement, external examination and internal examination. Then the tear production was assessed using the Schirmer's test.

Schirmer's test was done by inserting Schirmer's strip into the lower conjunctiva cul-de-sac at the junction of the mid temporal thirds of the lower lid. The Schirmer's strip was inserted 2minutes after instilling 0.5% tetracaine hydrochloride (topical anesthesic). The moistened exposed portion was measured 5 minutes after insertion.

2.4 Data Analysis

Data collected was analyzed using SPSS-version 21 to compute the two sample t-test.

3. RESULTS

The mean values of the tears production on day 3 (follicular phase) were 25.70 ± 6.803 and 24.30 ± 7.475 millimeters respectively for right and left eyes (mean ± standard deviation). On day 14 (ovulatory phase), the mean tear production were 23.20 ± 7.770 and 21.93 ± 8.416 millimeters respectively for right and left eyes. The mean values on day 26 (luteal phase) were 26.20±7.000 and 25.73 ± 8.085milimeters respectively for right and left eyes.

Tear production was not statistically different between right and left eyes at any time ($p > 0.05$). Statistical analysis revealed a significant difference in tear production on day 3 and day 14 ($p<0.05$). There was also a statistically significant difference comparing means of day 14 and day 26 ($p<0.05$). There was however no significant difference between day 3 and day 26 ($p> 0.05$). Figure 1 and 2 shows a significant reduction in tear production on day 14 as compared to day 3 and day 26 respectively.

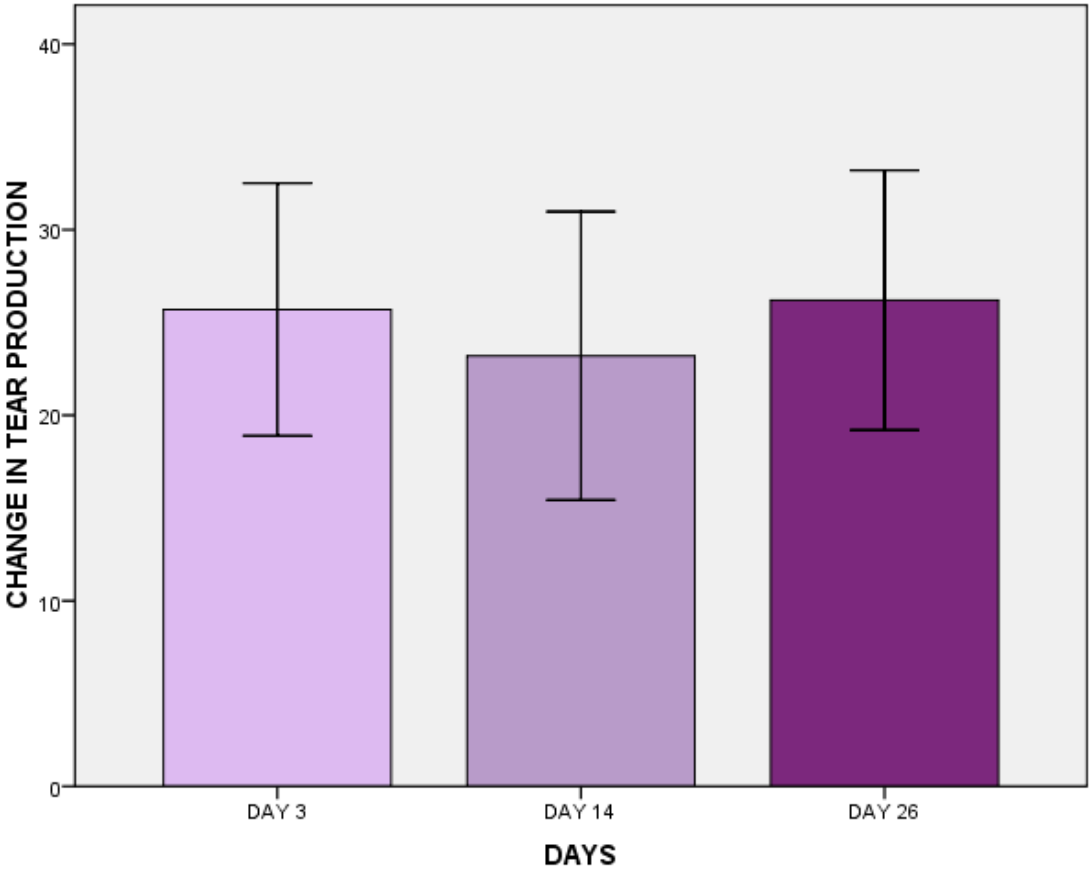

Figure 1. Tear production during menstrual cycle. (Right eye)

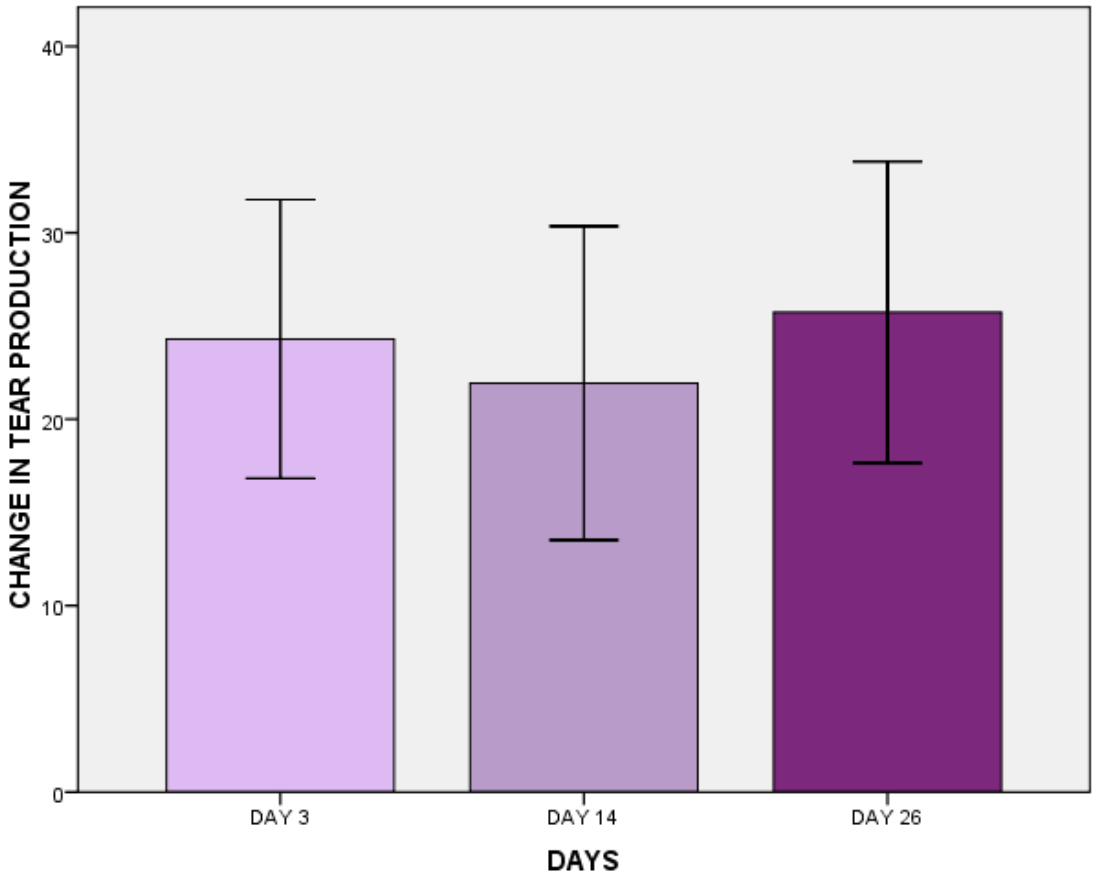

Figure 2. Tear production during menstrual cycle. (Left eye)

4. DISCUSSION

Levels of sex hormones changes occur throughout the menstrual cycle. During the early follicular phase (1^{st} – 5^{th} day) the levels of estrogen and progesterone are low. The estrogen level gets to its peak just before ovulation. Progesterone level rises to its peak in the early luteal phase and then progesterone and estrogen reduces to very low levels in late luteal phase (26^{th} - 28^{th}).

There was a significant decrease in tear production during the 14^{th} day as compared to 3^{rd} day and 26^{th} day. This therefore showed that the menstrual cycle has an effect on tear production. This effect may be as a result of sex hormone changes that occur during the menstrual cycle.

Hormone receptors (Estrogen, Progesterone and Androgen) have been found in human lacrimal glands (Smith *et al*.,1999) and Meibomian glands (Esemae *et al*., 2000) and have been found to regulate the secretory functions of the lacrimal glands and Meibomian glands (Sullivan *et al*., 1996). Their main function been to produce tears and prevent evaporation of tear film respectively. Hormone receptors have also been found associated with dry eye Suzuki *et al*., 2001; Vecsei*et al*, 2000;Wickham *et al*., 2000).The reduction in tear production during the ovulation phase could be as a result of estrogen increase to the highest level just before ovulatory phase. Uncu *et al.*, (2000) in their study on postmenopausal patients revealed that hormone

replacement therapy (HRT) decreased tear production. The decrease was greater in the group that was treated with only estrogen. The decrease in tear production in estrogen-only HRT was worse than a combined estrogen and progesterone therapy. This also suggests that progesterone may be related to a decrease in tear production. This result is in line with the study carried out by Ebeigbe, *et al*., (2014)that reported a significant decrease in tear secretion and stability during the ovulatory phase as compared to the follicular and luteal phases. The study is also in line with Versura *et al*., (2007) who concluded from their study that ocular surface dryness and tear production are closely related to hormonal fluctuations during menstrual cycle. The reduction in tear production could also be as a result of the changes that occur during ovulation.

5. CONCLUSIONS

Menstrual cycle is a normal physiological process and may also affect tear production. A decrease in tear production was observed in the ovulation phase when compared to the follicular phase and luteal phase. The results suggest that hormonal changes in women during the menstrual cycle are associated with alteration in tear production. This therefore extend our knowledge of biological changes in tear production associated with hormonal changes during menstrual cycle. The clinical significance is also implicated in contact lens use as reduction in tear production could cause discomfort to contact lens wearers.

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