

Original Article

Physiological Ocular Changes in Various Trimesters of Pregnancy

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Abstract

Introduction: A large number of hormonal, metabolic, immunologic and haematological changes occur in all organ system of female body during pregnancy. Human eye and its function are no exception to these changes. **Purpose:** To evaluate physiological ocular changes in various trimesters of pregnancy and to compare them amongst the three trimesters. **Patients and Methods:** A hospital based cross sectional study, using judgmental convenient sampling method, was done in both eyes of 120 pregnant females (40 in each trimester), with known last menstrual period, attending antenatal clinic of BPKIHS, Dharan. Women with known systemic or ocular diseases like conjunctivitis, keratitis, iridocyclitis, glaucoma, refractive error, were excluded. Demographic details of all patients were recorded and detailed ocular examination, including best corrected visual acuity, slit lamp examination, vertical and horizontal keratometry, central corneal thickness and intraocular pressure were performed and recorded. A comparison of these parameters was made amongst three trimesters. **Results:** Visual acuity of all the subjects was 0 logMAR. Corneal curvature, both vertical and horizontal, significantly increased towards third trimester. Central corneal thickness progressively increased from first to third trimester ($p=0.019$ Right eye, 0.016 Left eye). In contrary to this, intraocular pressure significantly decreased during successive stages of pregnancy ($P=0.000$ both eye). **Conclusion:** Significant increase in corneal curvature and central corneal thickness along with, decrease in intraocular pressure occur during successive trimesters of pregnancy. All pregnant women should have routine ocular examination; changes noted, if any, should receive attention and period of gestation should be considered prior to making a diagnosis.

Key words: pregnancy, corneal curvature, central corneal thickness, intraocular pressure

Introduction

Pregnancy is a physiological state during which a female carries a developing embryo within

her body (Shiel WC, 2008). A large number of changes occur in all organ system of the body including hormonal, metabolic, immunologic and haematologic changes (Sunness JS,1998; Thornburg KL,2000). Daniel and Joan (2008) believed that functioning of the pregnant women's eyes is affected by changes in metabolism, hormonal parameters and haemodynamics that occur temporarily during pregnancy.

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It has been suggested that pregnant women's corneal sensitivity decreases and conversely corneal thickness and curvature increases physiologically during pregnancy. It has also been suggested that intraocular pressure (IOP) decreases physiologically. These can result in temporary refractive changes, ocular surface changes and intolerance to contact lens wear (Schultz KL et al, 2005; Sharma S et al, 2006; Afekhide EO, 2008).

This study was conducted to observe these changes in ocular biometry and IOP during various trimesters of pregnancy and to compare them amongst the three trimesters.

Patients and methods

A hospital based cross sectional study was conducted at Ophthalmology department of BP Koirala Institute of Health Sciences for a year. Ethical clearance was obtained from Institutional Ethical Review Board prospectively. Written informed consent was obtained from all the women involved in the study.

A total of 120 pregnant females (40 from each trimester) within 15-35 years of age group, without significant ophthalmic pathology, with known last menstrual period visiting Antenatal Clinic of Department of Obstetrics and Gynaecology, irrespective of the period of gestation, were selected by judgemental convenient sampling and were included. Women with pre-existing systemic disease (diabetes, hypertension) or any ophthalmic pathology like corneal opacity, corneal ulcer, acute conjunctivitis, iridocyclitis, glaucoma and refractive error were all excluded from the study.

Demographic details of all the participants were recorded and all of them underwent a detailed ocular examination including visual acuity in log MAR, vertical keratometry (KV) and horizontal keratometry (KH) by Bausch and

Lomb keratometer, Central corneal thickness (CCT) by ultrasound pachymetry, intraocular pressure examination (IOP) by Goldman applanation tonometry of both right eye (RE) and left eye (LE).

DATA ANALYSIS: All collected data were entered in Microsoft XP EXCEL spread sheet and converted into SPSS Version 17. For descriptive analysis: mean, standard deviation, percentage were calculated. For inferential statistics, parametric and non parametric tests were carried out to find significant differences among the pregnant females of three trimesters at 95% confidence where p value ≤ 0.05 was considered statistically significant. 95% confidence interval was calculated using standard error of mean.

Results

A total of 120 females, forty in each of the three trimesters (01-12 weeks: first; 13-28 weeks: second; 29-40 weeks: third), were enrolled in the study. Visual acuity of all the women was 0 log MAR. The mean \pm standard deviation (95% confidence interval) of the study parameters have been tabulated in table 1. These parameters are compared amongst the three trimesters in table 2.

The corneal curvature was found to be significantly increasing as pregnancy advances, i.e., KV and KH of third trimester was steeper in comparison to that of second and first trimester (Figure1). Similarly, central corneal thickness was also found to be significantly increasing from 1st trimester to 3rd trimester ($p=0.005$ RE, 0.008 LE) (Figure 2). On measurement of intraocular pressure, it was found to be significantly decreasing from 1st trimester to 2nd trimester and from 1st trimester to 3rd trimester ($p=0.000$ both RE, LE). It further decreased towards the end of 3rd trimester in comparison to 2nd trimester. However, this difference wasn't statistically significant ($p=0.09$ RE, 0.06 LE) (Figure 3).

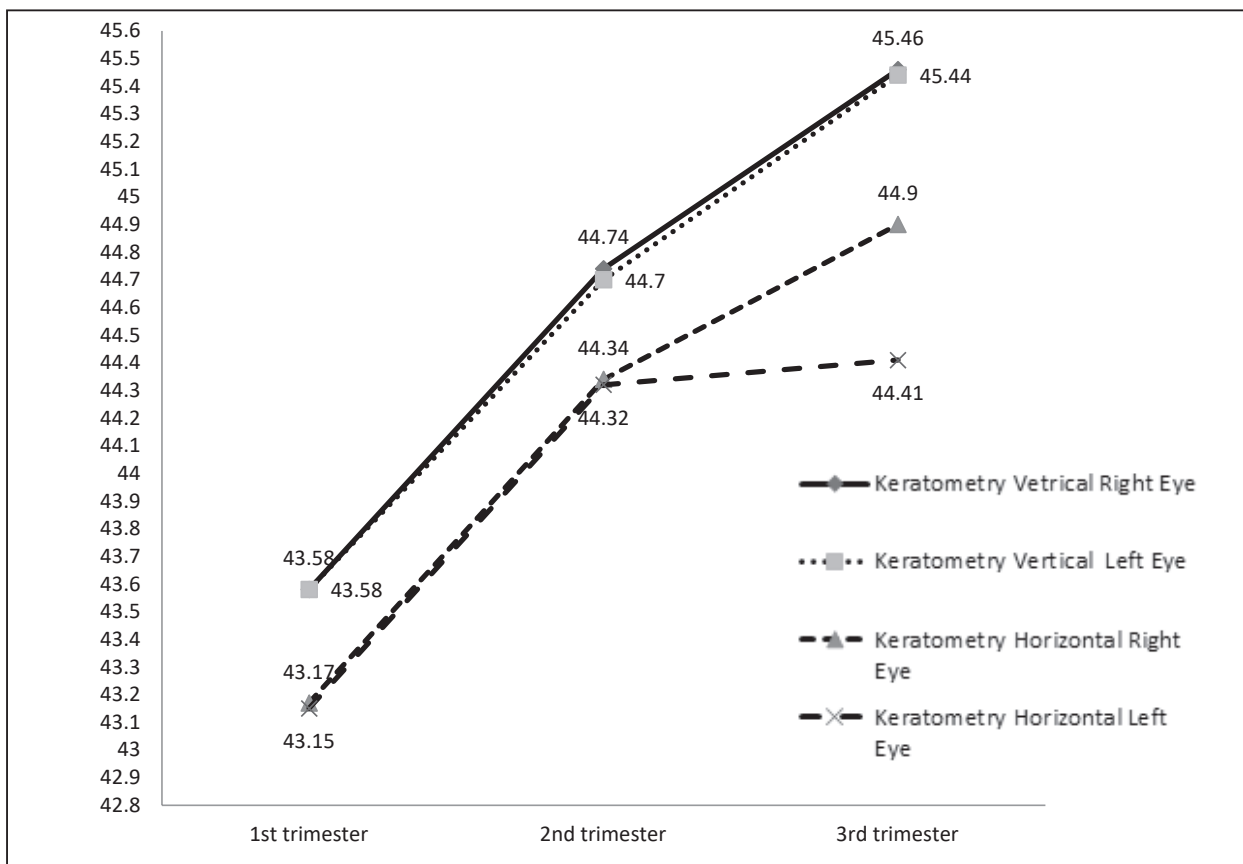


Figure 1: Mean vertical and horizontal corneal curvature (D) in various trimesters of pregnancy

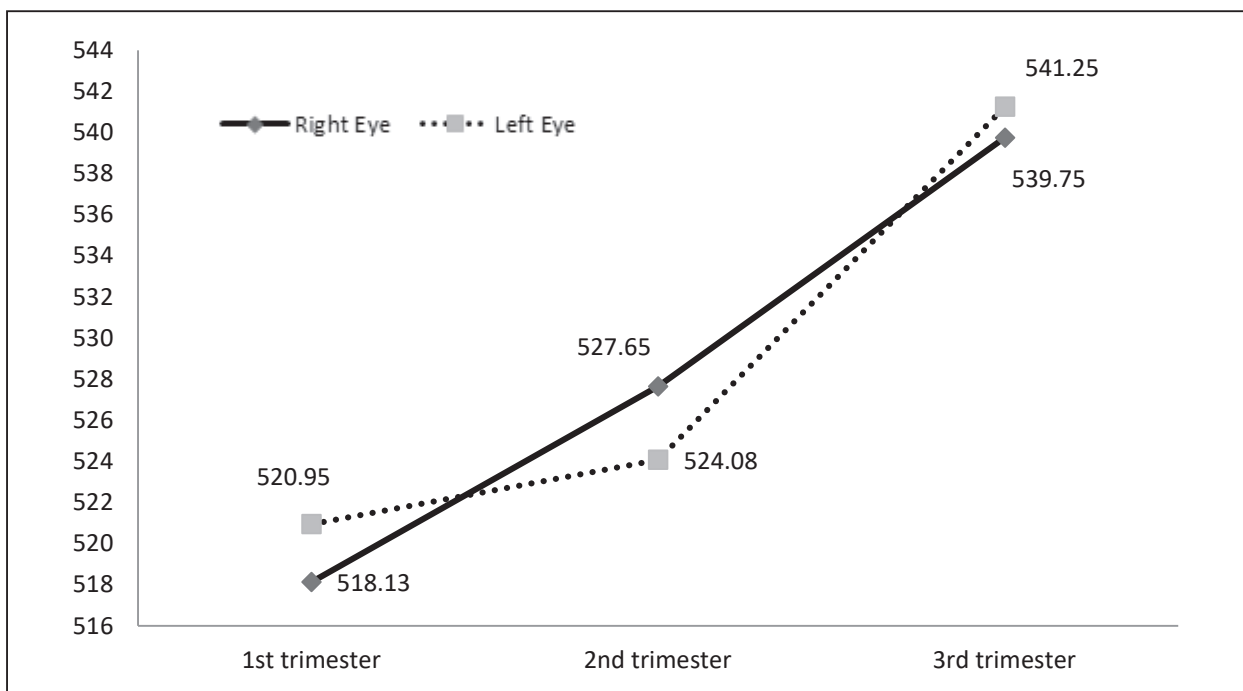


Figure 2: Mean central corneal thickness (µm) in various trimesters of pregnancy.

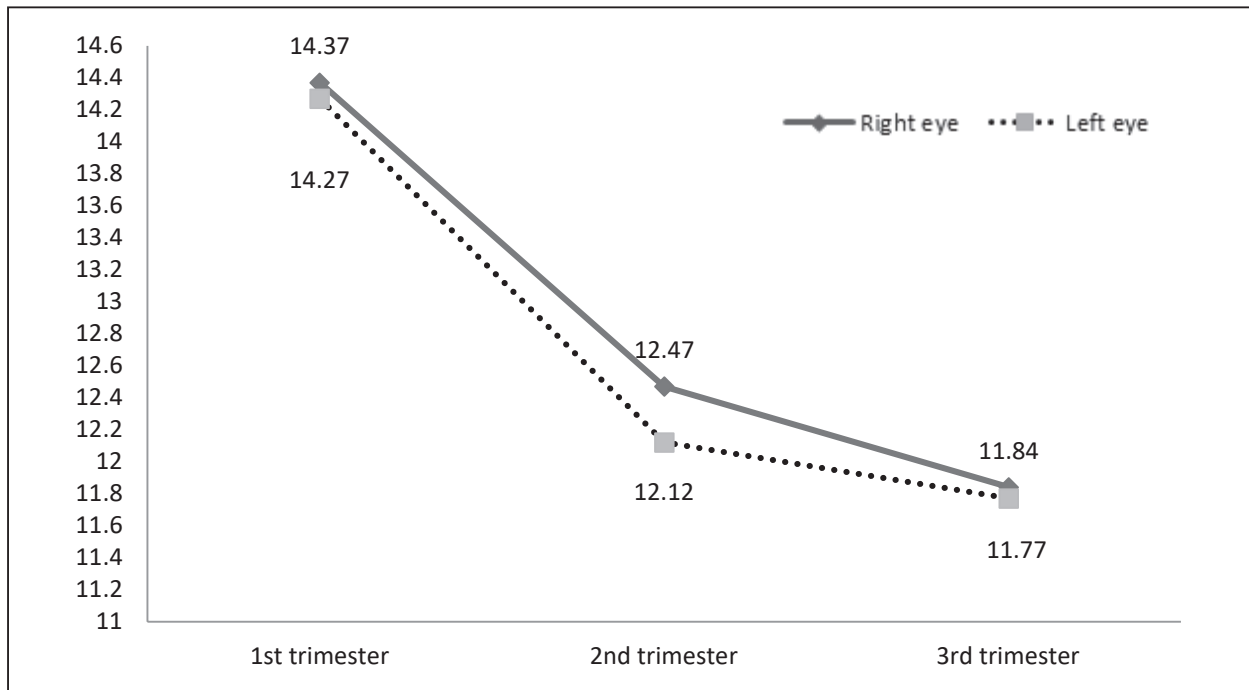


Figure 3: Mean intraocular pressure (mmHg) in various trimesters of pregnancy.

Table 1: Various biometric parameters in subjects of the three trimesters (n=120)

Characteristic	Trimester			Total	p value
	1 st (n=40)	2 nd (n=40)	3 rd (n=40)		
Kv R: MEAN± (SD) (95% CI)	43.58(0.75) (43.34-43.82)	44.74 (0.65) (44.53 - 44.94)	45.46 (0.60) (45.27 - 45.65)	44.59 (1.02) (44.4 - 44.78)	<0.001
Kv L: MEAN± (SD) (95% CI)	43.58 (0.76) (43.34 - 43.83)	44.70 (0.74) (44.45 - 44.93)	45.44 (0.61) (45.24 - 45.63)	44.57 (1.04) (44.38 - 44.76)	<0.001
Kh R: MEAN± (SD) (95% CI)	43.15 (0.82) (42.88 - 43.41)	44.34 (0.67) (44.12 - 44.55)	44.41 (3.18) (43.40 - 45.43)	43.96 (2.006) (43.6 - 44.33)	0.006
Kh L: MEAN± (SD) (95% CI)	43.17 (0.86) (42.9 - 43.44)	44.32 (0.72) (44.08 - 44.55)	44.90 (0.69) (44.68 - 45.12)	44.13 (1.04) (43.94 - 44.32)	<0.001
CCTR: MEAN±(SD) (95% CI)	518.13 (28.39) (509.05 - 527.20)	527.65 (42.24) (514.14 - 541.16)	539.75 (28.78) (530.55 - 548.95)	528.51 (34.63) (522.25 - 534.77)	0.019
CCT L: MEAN± (SD) (95% CI)	520.95 (28.73) (511.76 - 530.14)	524.08 (42.24) (510.57 - 537.58)	541.25 (27.29) (532.52 - 549.98)	528.76 (34.34) (522.55 - 534.97)	0.016
IOP R: MEAN± (SD) (95% CI)	14.37 (1.87) (13.78 - 14.97)	12.47 (1.48) (12.0 - 12.95)	11.84 (1.63) (11.31 - 12.36)	12.90 (1.98) (12.54 - 13.25)	<0.001
IOP L: MEAN± (SD) 95% CI	14.27 (1.91) (13.67 - 14.89)	12.12 (1.76) (11.56 - 12.69)	11.77 (1.35) (11.34 - 12.21)	12.73 (2.01) (12.36 - 13.09)	<0.001

Right (R) and left (L) eye. Kv- vertical keratometry, Kh- horizontal keratometry, CCT- central corneal thickness, IOP- intraocular pressure, p<0.05 statistically significant, SD- standard deviation and CI- confidence interval.

Table 2: Comparison of various parameters amongst subjects of 1st, 2nd and 3rd trimesters

Character	Pog in Weeks		Mean Difference	p value
KV R	1st trimester	2nd trimester	-1.16	<0.001
		3rd trimester	-1.88	<0.001
	2nd trimester	3rd trimester	-0.73	<0.001
KV L	1st trimester	2nd trimester	-1.11	<0.001
		3rd trimester	-1.85	<0.001
	2nd trimester	3rd trimester	-0.75	<0.001
KH R	1st trimester	2nd trimester	-1.19	0.007
		3rd trimester	-1.27	0.004
	2nd trimester	3rd trimester	-0.08	0.085
KH L	1st trimester	2nd trimester	-1.15	<0.001
		3rd trimester	-1.73	<0.001
	2nd trimester	3rd trimester	-0.58	<0.001
CCT R	1st trimester	2nd trimester	-9.52	0.209
		3rd trimester	-21.63	0.005
	2nd trimester	3rd trimester	-12.10	0.112
CCT L	1st trimester	2nd trimester	-3.13	0.677
		3rd trimester	-20.30	0.008
	2nd trimester	3rd trimester	-17.17	0.023
IOP R	1st trimester	2nd trimester	1.90	<0.001
		3rd trimester	2.54	<0.001
	2nd trimester	3rd trimester	0.64	0.09
IOP L	1st trimester	2nd trimester	2.15	<0.001
		3rd trimester	2.50	<0.001
	2nd trimester	3rd trimester	0.35	0.06

Right (R) and left (L) eye. Kv- vertical keratometry, Kh- horizontal keratometry, CCT- central corneal thickness, IOP- intraocular pressure, p<0.05 statistically significant.

Discussion

Various ocular changes occur during pregnancy. Various authors have attempted to investigate these changes over time in various parts of the world. To the best of our knowledge, no similar study has been conducted in Nepal so far.

Both vertical and horizontal corneal curvature was found to be progressively steepened from first to third trimester in our cases. A similar study was conducted by Park et al (1992) in 24 women who were prospectively followed till postpartum period. They also noted that in the second and third trimester, corneal curvature increases.

Central corneal thickness (CCT) was found to be significantly increasing towards third trimester of pregnancy in our study. In a study by Weinreb et al (1988), CCT increased by 3% during pregnancy in comparison to non pregnant and postpartum females. Maximum CCT was noted in the third trimester in the same study by Weinreb and colleagues (1988). But they did not report any progressive changes in corneal thickness. Riss (1981) and Sunness (1998) suggested that the hormonal changes that occur in pregnancy induce water retention in the cornea alike in other parts of the body which is responsible for corneal edema and change in curvature of eye.

A decreasing trend in IOP was noticed towards later trimesters of pregnancy in our study. Similar result was reported by Qureshi et al (1996). They reported that when compared with non-pregnant control group, the mean IOP was lower in second and third trimester subjects. Another study by same author, conducted a year later (Qureshi, 1997) showed that at 12th week of gestation IOP was significantly lower in comparison to the non-pregnant females. Also, a significant difference was found between first and second, first and third trimester in the females in our study.

Pilas et al (2004) reported a significant decrease (19.8%) in IOP during successive stages of pregnancy. Similarly, Pita et al (2011) also reported similar findings in second and third trimester in their study in 2011. Percentage decrease could not be calculated in our study as the same subject was not followed progressively, though decrease in IOP was noted as pregnancy advanced.

Various mechanisms have been postulated which may explain this observation. First mechanism suggested is increase in aqueous outflow. Increased progesterone and the beta human chorionic gonadotrophin levels (Ziai et al, 1994) leads to decrease in systemic vascular resistance, episcleral venous pressure and hence, increased aqueous outflow. Second mechanism responsible for this change is generalised increased tissue elasticity resulting in decreased scleral rigidity (Afekhide et al, 2008). Third mechanism suggested is generalized acidosis during pregnancy which may also be responsible for such changes.

Conclusion

Significant increase in corneal curvature, central corneal thickness and decrease in intraocular pressure occurs during successive trimesters of pregnancy. Hence, it is concluded that, as all organ systems of the body are affected by pregnancy, including the eyes. All

pregnant women should have routine ocular examination; changes noted, if any, should receive attention and period of gestation should be considered prior to making a diagnosis.

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References

- Afekhide EO, Joseph MWE, Valentina WO (2008). A review of the changes in the ophthalmic and visual system in pregnancy. *African journal of reproductive health*; 12(3): 185-96.
- Daniel MA, Joan WM (2008). In Jakobiec's Disease of the eye. 3rd edition. Philadelphia: Saunders Elsevier; Chapter 336, Pregnancy and the eye; Volume 4; p 4587-95.
- Park SB, Lindahl KJ, Temnycky GO, Aquavella JV (1992). The Effect of Pregnancy on Corneal Curvature. *The CLAO journal*; 18(4): 256-59.
- Pilas PM, Luczak M, Czajkowski J, Wozniak P, Oszukowski P (2004). Changes in intraocular pressure during pregnancy. *Klin Oczna*; 106(1-2 Suppl): 238-9.
- Pita P, Lakshmi ANR, Surekha D (2011). Physiological Changes of Intraocular Pressure in the second and third trimesters of Normal Pregnancy. *Journal of Clinical and Diagnostic Research*; 5 (5):000-000.
- Qureshi IA (1997). Measurements of intraocular pressure throughout the pregnancy in Pakistani women. *Chin Med Sci J*; 12 (1): 53-6
- Qureshi IA, Xi XR, Wu XD (1996). Intraocular pressure trends in pregnancy and in the third trimester hypertensive patients. *Acta Obstet Gynecol Scand*; 75: 816-19.



Riss B (1981). Corneal sensitivity in pregnancy. *Ophthalmologica*;183: 57-62.

Schultz KL, Bimbaum AD, Goldstein DA (2005). Ocular disease in pregnancy. *Curr Opin Ophthalmol*; 16(5): 308-14.

Sharma S, Wuntakal R, Anand A, Sharma TK (2006), Downey G. Pregnancy and the eye. *The Obstetrician and Gynaecologist*; 8: 141-46.

Shiel WC, Stoppler MC (2008). In Webster's New Word Medical Dictionary. 3rd ed. New York: Wiley Publishing Inc.

Sunness JS (1988). The pregnant woman's eyes. *Survey Ophthalmology*; 32: 219-38.

Thornburg KL, Jacobson SL, Giraud GD, Mortan MJ (2000). Haemodynamic changes in pregnancy. *Semin Perinatol*; 24: 11-14.

Weinreb RN, Lu A, Beeson C (1988). Maternal corneal thickness during pregnancy. *Am J Ophthalmol*; 105(3): 258-60.

Ziai N, Steven JO, Khan AR, Brubaker RF (1994). Beta-Human Chorionic Gonadotrophin, Progesterone, and Aqueous Dynamics During Pregnancy. *Arch Ophthalmol*; 112: 801-6.