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GENDER AND AGE RELATED VARIATION IN CORNEA POWER

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ABSTRACT

***Objective*: To determine the mean cornea power for this population and how it varies with gender and age.**
***Design*: A retrospective study.**
***Setting:* The eye clinic of the Niger Delta University Teaching Hospital.**
***Subjects*: All patients referred to the Optometric unit by the duty optometrist using a Carl Zeiss 599 Auto-refractokeratometer and the findings recorded in a register designed for that purpose. These patients had previously undergone full ocular examination by the referring Ophthalmologist.**
***Statistical Analysis*: Data collected were analysed using the statistical package of social scientist (SPSS) version 16.**
***Results*: Two hundred and one patients (402 eyes) were analysed in this study. They consisted of 100 males and 101 females (M/F = 1:1.01). Their ages ranged from 8 to 84 years with a mean of 42.74 years (SD ± 14.62). The mean cornea power in the entire population was found to be 43.24 D (95% Cl 43.01 – 43.41). The horizontal cornea meridian has a higher diopteric power than the vertical meridian (43.38 D versus 43.13). The mean cornea power in females is greater than the mean cornea power in males (43.62 D versus 42.80 D). Cornea power was found to vary with age (P = 0.003), and the relationship was found to be linear on regression analysis.**
***Conclusion*: The diopteric power of the female cornea is higher than that of their male counterpart. There is evidence that suggests a reduction of the diopteric power of the cornea with aging, but further studies are needed to confirm this observation.**

INTRODUCTION

The cornea is very important for the overall refractive status of the eye. It is responsible for over two-third of the total refractive power of the eye (1). Much of the refractive power of the cornea is lost during infancy as a result of its flattening in the process of emmetropisation in the early phase of life (2).

The gradual decrease in the refractive power of the cornea continue throughout the growth phase of the eye accompanied by axial elongation and associated decrease in the power of the crystalline lens (3-5). However, the contribution of this gradual adjustment in the power of the cornea and the crystalline lens to the process of emmetropisation of the eye has been found to be small when compared with that of the axial length, making the axial length the ultimate determinant of spherical equivalent refractive error in this phase of life (5).

With the stabilisation of growth in later years, the axial length have been found to remain constant or shorten, making the cornea refractive power and crystalline lens changes significant factors in the final refractive status of the eye (6). However, these changes are not exact and refractive error may occur or worsen as in the cases of worsening myopia. In worsening myopia, the refractive cornea power has been found to increase disproportionately relative to the axial length (Axial length / cornea radius of curvature ratio > 3), making the mean cornea power in myopia eyes greater than that of emmetropic eyes (6,7).

While there seemed to be a decline of cornea refractive power with age in children, there appears to be no established relationship between refractive cornea power and age in adults(3,8-11). Some researchers have reported no significant change of cornea refractive power with age while others document some increase or reduction.

Cornea power have been shown to vary with gender in children and adults alike. In both populations, mean refractive cornea power in females is found to be greater than that of their male counterpart (12,13). This gender associated variation in cornea power does not apper to be due to sexual changes in puberty as it was noticed even before the onset of puberty (14).

Worldwide, refractive error is a very important cause of ocular morbidity(15,16). A better understanding of it, is a good step in improving the ocular health of affected populations. In view of the strategic importance of the cornea in the overall refractive status of the eye, a better knowledge of its refractive power as it relates to age and gender may increase our understanding of refractive errors. N o such information is available in the study population to our knowledge. This study was therefore undertaken to provide information on the variation of cornea refractive power with age and sex.

MATERIALS AND METHODS

Location of Study: This study took place at the Eye Clinic of the Niger Delta University Teaching Hospital, Okolobiri, Bayelsa State of Nigeria over a period of seven (7) months. A retrospective study was carried out on Keratometric data routinely obtained from patients attending the eye clinic of the Niger Delta University Teaching Hospital. Keratometry was done on all patients referred to the Optometric unit by the duty optometrist using a Carl Zeiss 599 Autorefractokeratometer and the findings recorded in a register designed for that purpose. These patients had previously undergone full ocular examination by the referring Ophthalmologist. Patients with diagnosed cornea pathology were excluded. The data of two hundred and one patients (402 eyes) was randomly collected from a pool of keratometric readings totalling 2511 and recorded on an appropriate SPSS Window for analysis. The Carl Zeiss 599 Autorefractokeratometer records the Keratometric readings in the principal meridians of astigmatism for that eye which may not be vertical or horizontal in orientation. For the purpose of this study, Oblique meridians of astigmatism were resolved into the vertical or horizontal meridian that they are closest to, accordingly.

Statistical analysis: Data collected were recorded in the appropriate SPSS window(SPSS version 16) for analysis. Mean cornea power were calculated for each gender in the principal meridians and generally in the entire population. The mean cornea power for the various age groups were also estimated and subjected to multivariate analysis (ANO VA). Regressional analysis was done to establish the relationship between age and cornea power. Standard deviation and 95% confidence intervals were estimated for the appropriate means. Null hypothesis was used to test the observed differences between the means and a probability (P) level less than 0.05 were considered statistically significant.

RESULTS

Two hundred and one patients (402 eyes) were analysed in this study. They consisted of 100 males and 101 females (M/F = 1:1.01), Table 1. Their ages ranged from 8 to 84 years with a mean of 42.74years (SD ± 14.62). The mean cornea power in the entire population was found to be 43.24D (95% CI 43.01 – 43.41).The horizontal cornea meridian has a diopteric power of 43.38D (SD ± 1.427) while the vertical had a diopteric power of 43.13D (SD ± 1.426), giving an against the rule astigmatism of 0.25D. The mean cornea power in females (43.62D; SD ± 1.394) is greater than the mean cornea power in males (42.80D; SD ± 1.492) and the observed difference between both genders is statistically significant (P = 0.01786), Table 2.

In both gender, the horizontal meridian was found to have a higher diopteric power compared to the vertical meridian (42.93D versus 42.72D in males and 43.83D versus 43.54D in females. In the vertical meridian,the observed difference in cornea diopteric power between both gender is not statistically significant (P=0.055),however it is statistically significant in the horizontal meridian (P=0.0446). In both meridians, the female cornea have more diopteric power compared to their male counterpart (vertical: 43.54D {female} versus 42.72D {male}; Horizontal : 43.83D {female} versus 42.93D {male}).

The mean cornea power according to the various age categories is shown in Table 3. On multivariate analysis (ANOVA), the variation of cornea power with age was found to be statistically significant (F = 12.374, P = 0.003). Regression and correlation analysis of age and cornea power showed a negative linear relationship (Fig. 1); r = -0.228, P = 0.003.

Table 1
Age and sex distribution of study population

Age (Years)	Sex (n%)		Total (n%)
	Male	Female	
1 – 10	-	3	3
11 – 20	7	10	17
21 – 30	2	13	15
31 – 40	13	28	41

41 – 50	39	37	76
51 – 60	27	9	36
61 – 70	4	1	5
≥ 71	8	-	8
Total	100	101	201

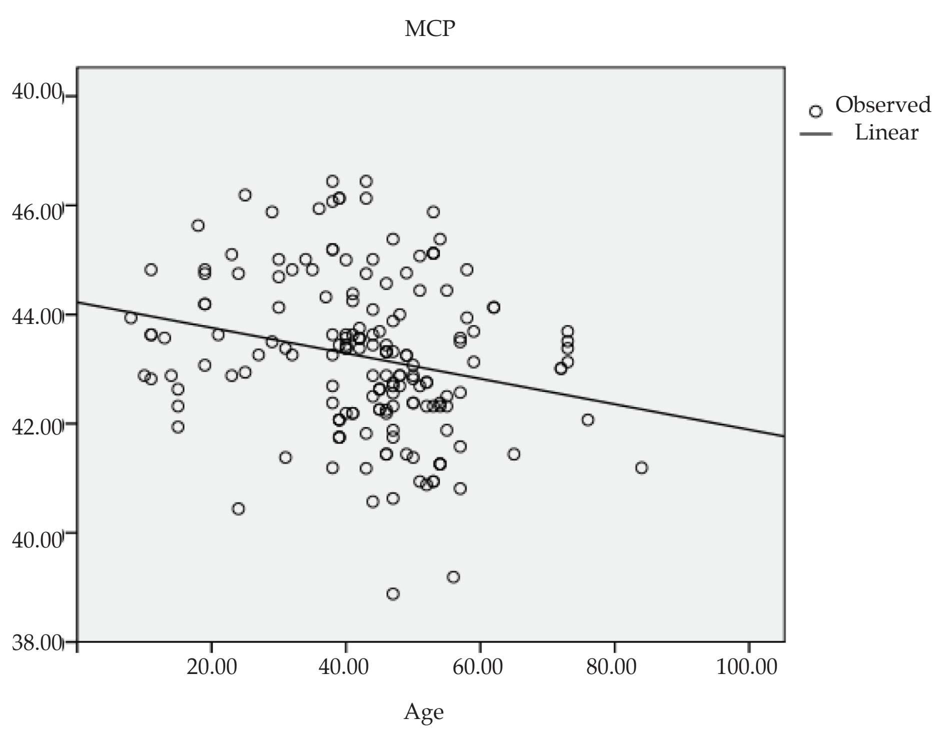
Table 2
Cornea power in relation to gender

Meridian	Sex		P-value
	Male	Female	
Vertical	42.72	43.54	0.0548
Horizontal	42.93	43.83	0.0446
Mean	42.80	43.62	0.01786

Table 3
Mean cornea power according to age group

Age (Years)	Mean Cornea Power (D)
1 – 10	43.48
11 – 20	43.65
21 – 30	44.03
31 – 40	42.34
41 – 50	42.88
51 – 60	42.86
61 – 70	43.23
≥ 71	38.11

Figure 1
Relatioship between Mean cornea Power(MCP)and Age



DISCUSSION

The mean cornea power for this population was found to be 43.24D (95% CI 43.01 – 43.41). This is similar with the findings of Rafai et al(12) (43.53D) and differs from those of Karen *et al* (22) (44.20D), and Adio *et al* (17) (42.43D). The observed differences between various authors may be due to the effect of race as the radius of curvature of the corneas have been observed to exhibit some racial variations (13).

The cornea of females was found to have a higher diopteric power than that of their male counterparts in this study. This observation was earlier made by Donders in 1866 (18) and later by various researchers (12,13,19,20).The higher diopteric power in females was noted in both meridians (vertical and horizontal) in this study. This is consistent with the findings of Zadnik *et al* (20) where both meridians have higher diopteric power in females compared to males. The reason for the higher diopteric power of the cornea of females compared to their male counterpart is not known. However, it is unlikely to be due to hormonal changes as it was observed even before the onset of puberty (14). Further studies are suggested to explain this variation.

In this study, a statistically significant variation was found between cornea power and age, with cornea power exhibiting a reduction with age increase. This is consistent with the findings of Zhang *et al*(3) and that of Friedman *et al* (4).Topuz *et al*(21) also found a statistically significant variation of cornea power with age but reported a reverse trend. However,our findings differ from that of Zadnik *et al* (20) and that of Karen and Harvey (22) where no statistically significant variation of cornea power with age was found. The anterior and posterior cornea radius of curvature are known to vary with age (23), with a tendency of decrease in the curvature of the cornea in old age (24).This observation may explain the reduction of cornea diopteric power with age observed in this population. However, further studies are suggested to confirm this observation. The disparity between the finding of this study and those of previous authors may be due to the effect of race as cornea curvature have been noted to exhibit some racial variation (13).

In conclusion, the diopteric power of the female cornea is higher than that of their male counterpart. There is evidence that suggests a reduction of the diopteric power of the cornea with aging, but further studies are needed to confirm this observation.

REFERENCES

1. D avid Abrams.Duke-Elders Practice of Refraction. 9ed,p23. Churchill Livingstone, Edinburgh 1978.
2. Mutti, D. O., Mitchell, G. L., Jones, L. A., *et al.* Axial Growth and Changes in Lenticular and Cornea Power during Emmetropization in Infants. *Invest. Vis. Sci.* **46**: 3074 – 3080.
3. Zhang, Z., Chu, R., Zang, X., Zhou, X. and Hoffmann, M.Ocular components characteristics of Chinese emmetropic children. *Intern. J. Vis. and Tech* Ed.1: 001 – 006.
4. Friedman, N. E., Mutti, D. and Zadnik, K. Cornea changes in school children. *Optom. & Vis. Sci.* **73**:552-557.
5. Jenny, M., Son, C. H., Annette, K., *et al.* Variation of the contribution from axial length and other oculometric parameters to Refraction by Age and Ethnicity. *Inv/ Ophthalmol & Vis. Sci.* **48**: 4846 – 4853.
6. Grosevenor, T. Role of Cornea in Emmetropia and Myopia. *Optom. & Vis. Sci.* **75**: 132-145.
7. L iu, Z., Chen, J. and Li, S. The difference in cornea shape between myopia and normal eyes. *Zonghua Yan Ke Za Zhi*. **4**: 282 – 284.
8. Ganguli, D., Roy, I. S., Biwas, K. S. and Sengupta, M. Study of cornea power and diameter in simple refractive error. *Indian J. Ophthalmol.* **23**: 6 – 11.
9. W ong, T. Y., Foster, P., Ng TP, Tielsch, J. M., *et al.* Variations in ocular biometry in adult Chinese population in Singapore: The Tanjong Pagar Survey. *Inv. Ophthalmol. Vis. Sci*. **42**: 73 – 80.
10. W arrier, S., Wu, H. M., Newland, H. S., *et al*. Ocular biometry and determinants of refractive error in rural Myanmar; the Meiktian Eye Study. *Br. J. Ophthalmol.* **92**: 1591 – 1594.
11. Fotedar, R., Mitchel, P., Burlutsky, G. and Wang, J. J. Relationship of 10year change in refraction to nuclear cataract and axial length findings in an older population. *Ophthalmol*. **115**: 1273 – 1278.
12. R efai, T. A. Correlation between Keratometric readings, Central Cornea thickness and refractive error among patients seeking refractive surgery. *J. Applied Sci. Research.* **7**: 2073 – 2081.
13. T welker, J. D., Mitchel, G. L., Messer, D. H., *et al.* Children's ocular components and age gender and ethnicity. *Optom. Vis Sci.* **86**: 918-935.
14. Garadiner, P. A. Cornea power in myopic children. *Br. J. Ophthalmol.* **46**: 138.
15. Resnikoff, S., Pascolini, D., Mariotti, S. P. and Pokharel. G. P. Global magnitude of visual impairment caused by uncorrected refractive errors in 2004. *Bull World Health Organisation*. **86**: 63 – 70.
16. A zonobi, I. R. Ocular morbidity in Bayelsa State, Nigeria: A Hospital based study. *Nig. Hospital Practice*. **5**: 103 – 107.
17. Adio, A. O., Onua, D. O. and Arowolo, D. Ocular axial length and keratometric readings of Normal Eyes in Southern Nigeria. *Nig. J. Ophthalmol.* **18**: 12 – 14.
18. D onders, F. C. "Die Anomalien der Refraction and Accommodation des Auges" 1866 Braumiller, Vienna.
19. Goto, T., Klyce, S. D., Zeng, X., *et al.* Gender and age related differences in cornea Topography. *Cornea*. **20**: 270 – 276.
20. Zadnik, K., Manny, R., Yu, J., *et al.* Ocular component data in school children as a function of age and gender. *Optom & Vis Sci.* **80**: 226 – 236.

21. Topuz, H., Ozdemir, M., Cinal, A. and Gumusalan, Y. Age related differences in normal cornea topography. Ophthalmic surg. *Lasers Imaging*. **35**: 298 – 303.
22. Karen, B. R. and Harvey, S. U. Refractive errors in Filipino eyes in a single – centre study population. *Philip. J. Ophthalmol*. **35**: 50-55.
23. Vojnikovic, B., Gabric, N., Dekaris, I. and Juric, B. Curvature Analysis of the cornea front and back surfaces. *Coll. Antropol*. **37**: 93 – 96.
24. Fedelius, H. C. and Stubguard, M. Changes in refraction and cornea curvature during growth and adult life. A cross sectional study. *Acta. ophthalmol.* **64**: 487 – 491.