Anterior and posterior ocular measurements in healthy South Indian eyes

Dear Editor

Normative data is data that characterizes what is usual in a defined population at a specific point or period and can be of enormous importance to physicians in all spheres of medical sciences. Such data seek to describe rather than explain phenomena. There is a paucity of normative data related to ocular parameters originating from different regions of India. In any case, most of the studies describing normative data that are available in the literature are either in the Caucasian population\textsuperscript{[4-6]} or describe exclusively either anterior segment\textsuperscript{[9]} or posterior segment findings.\textsuperscript{[6-8]} Yet others have reported biometry in conditions such as cataract\textsuperscript{[9]} and keratoconus\textsuperscript{[10]} within the remit of their study design, comparing one or several parameters in diseased conditions. We collected decade-wise normative data prospectively from 156 eyes of healthy subjects of South-Indian origin between the age group of 10–60 years, encompassing both anterior and posterior segments, using the latest available technology. The central corneal thickness (CCT) and anterior and posterior corneal curvatures (ACC and PCC) were measured using WaveLight OcuLyzer II (Alcon, Tx, USA), axial length (AL). Lens thickness (LT) and anterior chamber depth (ACD) were measured using Lenstar LS 900 (Haag Streit, Bern, Switzerland), and the retinal nerve fiber layer thickness (RNFLT), macular thickness (MT), and peripapillary and subfoveal choroidal thickness (CT) were measured using swept-source OCT (SS-OCT) by using Triton Dri OCT Plus (Topcon Inc, NJ, USA). The mean ACC and PCC were 7.66 ± 0.26 mm and 6.37 ± 0.27 mm, respectively. CCT, ACD, LT, and AL were 536.05 ± 29.95 μm, 3.37 ± 0.36 mm, 3.81 ± 0.38 mm, and 23.16 ± 0.90 mm, respectively. LT correlated positively with age (P < 0.001); ACD and AL correlated negatively with age (P < 0.001 and 0.05, respectively) [Fig. 1-top and center]. We obtained an annual increase in LT by 0.023 mm and ACD decreased by 0.014 mm. An age-related increase in LT further shallows the AC, which decreases with age. Recognizing a shallow AC is important as such individuals are not only at risk of developing angle-closure glaucoma but may also present challenges during cataract surgery.\textsuperscript{[11-13]} particularly in pseudoexfoliation eyes.\textsuperscript{[10]}

Average peripapillary and subfoveal CT were 325.76 ± 146.82 μm and 352.90 ± 118.25 μm, respectively. Average RNFLT and MT were 106.25 ± 34.1 μm and 272.51 ± 13.17 μm, respectively. Though we established RNFL thinning by 0.11 μm per year, the average RNFLT did not correlate significantly with age. MT decreased by 0.37 μm per year and correlated negatively with age (P < 0.001) [Fig. 1, bottom].
Table 1 shows the decade-wise measurements obtained from the anterior-to-posterior segment in mean ± SD. Table 2 shows the quadrant-wise and decade-wise distribution of RNFL thickness in microns; the difference is not statistically significant, except for the inferior and temporal thickness when the second decade is compared to the sixth.

OCT technology has progressed at a rapid pace; values obtained from these generational OCTs differ for CT\textsuperscript{[14]} as well as RNFLT.\textsuperscript{[15]} However, Mansoori et al.\textsuperscript{[8]} obtained RNFLT in Indian eyes with spectral-domain OCT (SD-OCT) and the results were somewhat similar to ours. In contrast, Appukuttan et al.\textsuperscript{[7]} reported normative values for Indians for RNFLT (and MT) by the Spectralis SD-OCT and the superior and inferior RNFL appears to be thinner when compared to SS-OCT measurements. The foveal macular thickness was reported as 260.1 ± 18.19 µm, and it appeared
### Table 1: Mean values of ocular parameters in each decade and the average of all decades

| Parameter                        | 10-19 (n=30) | 20-29 (n=32) | 30-39 (n=34) | 40-49 (n=34) | 50-60 (n=30) | 60-69 (n=156) |
|----------------------------------|--------------|--------------|--------------|--------------|--------------|---------------|
| Age (years)                      | 15.33±3.0    | 21.81±2.0    | 34±3.15      | 43.41±2.23   | 52.73±2.18   | 33.56±13.84   |
| Anterior Corneal Curvature (mm)  | 7.69±0.21    | 7.65±0.27    | 7.72±0.17    | 7.66±0.29    | 7.58±0.30    | 7.66±0.26     |
| Posterior Corneal Curvature (mm) | 6.46±0.32    | 6.27±0.27    | 6.43±0.21    | 6.36±0.24    | 6.31±0.26    | 6.37±0.27     |
| Central Corneal Thickness (µm)   | 532.7±33.6   | 583.40±34.01 | 537.5±19.91  | 536.79±25.99 | 543.3±35.20  | 536.05±29.95  |
| Anterior Chamber depth (mm)      | 3.68±0.3     | 3.48±0.28    | 3.44±0.28    | 3.10±0.37    | 3.17±0.36    | 3.37±0.38     |
| Lens Thickness (mm)              | 3.37±0.19    | 3.56±0.19    | 3.79±0.22    | 4.07±0.23    | 4.21±0.27    | 3.81±0.38     |
| Axial Length (mm)                | 23.57±0.92   | 23.32±1.03   | 23.27±0.55   | 22.89±0.80   | 22.78±0.92   | 23.16±0.90    |
| Average peripapillary choroidal thickness (µm) | 331.05±108.01 | 353.71±80.88 | 338.48±127.42 | 270.05±89.46 | 340.66±116.45 | 325.76±146.82 |
| Sub-Foveal Choroidal Thickness (µm) | 355.93±81.33 | 373.78±80.88 | 372.83±76.79 | 304.97±80.65 | 362±69.98    | 352.90±118.25 |
| Average RNFL Thickness (µm)      | 106.84±34.65 | 106.95±34.95 | 108.04±35.65 | 106.3±32.58  | 106.05±33.06 | 106.25±34.1   |
| Macular Thickness (µm)           | 275.43±14.57 | 280.06±8.72  | 271.49±12.46 | 270.35±10.26 | 265.04±14.93 | 272.51±13.17  |

Table 2: Quadrant-wise and decade-wise thickness of retinal nerve fibre layer in microns

|                   | 10-19 years (A) | 20-29 years (B) | 30-39 years (C) | 40-49 years (D) | 50-60 years (E) | P A vs. B | P A vs. C | P A vs. D | P A vs. E |
|-------------------|-----------------|-----------------|-----------------|-----------------|-----------------|----------|----------|----------|----------|
| Inferior Mean±SD  |                 |                 |                 |                 |                 |          |          |          |          |
| Superior Mean±SD  |                 |                 |                 |                 |                 |          |          |          |          |
| Nasal Mean±SD     |                 |                 |                 |                 |                 |          |          |          |          |
| Temporal Mean±SD  |                 |                 |                 |                 |                 |          |          |          |          |
| Total Mean±SD     |                 |                 |                 |                 |                 |          |          |          |          |

To summarize, we established normative values of anterior and posterior ocular biometric parameters over five decades by using cutting-edge technology in an exclusive cohort of Indians of South India. An age-related change was seen in some of these ocular parameters.

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Conflicts of interest
There are no conflicts of interest.

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References
1. Hoffmann PC, Hutz WW. Analysis of biomeetry and prevalence data for corneal astigmatism in 23,239 eyes. J Cataract Refract Surg 2010;36:1479-85.
2. Foteder R, Wang JJ, Burlutsky G, Morgan IG, Rose K, Wong TY, et al. Distribution of axial length and ocular biometry measured using partial coherence laser interferometry (IOL Mater) in an older white population. Ophthalmol 2010;117:417-23.
3. Shufelt C, Fraser-Bell S, Ying-Lai M, Torres M, Varma R. Los Angeles Latino Eye Study Group. Refractive error, ocular biometry, and lens opalescence in an adult population: The Los Angeles Latino eye study. Invest Ophthalmol Vis Sci 2005;46:4450-60.
4. Ferreira TG, Hoffer JK, Ribeiro F, Ribeiro P, O’Neill JG. Ocular biometric measurements in cataract surgery candidates in Portugal. PLoS One 2017;10:1-12.
5. Nangia V, Jonas JB, Sinha A, Matin A, Kulkarni M, Panda-Jonas S. Ocular axial length and its associations in an adult population of central rural India: The Central India eye and medical study. Ophthalmol 2010;117:1360-6.
6. Agarwal P, Saini VK, Gupta S, Sharma A. Evaluation of central macular thickness and retinal nerve fiber layer thickness using spectral domain optical coherence tomography in a tertiary care hospital. J Curr Glaucoma Pract 2014;8:75-81.
7. Appukuttan B, Giridhar A, Gopalakrishnan M, Sivaprasad S. Normative spectral domain optical coherence tomography data on macular and retinal nerve fiber layer thickness in Indians. Indian J Ophthalmol 2014;62:316-21.
8. Mansoori T, Viswanath K, Balakrishna N. Quantification of retinal nerve fiber layer thickness using spectral domain optical coherence tomography in normal Indian population. Indian J Ophthalmol 2012;60:555-8.
9. Natung T, Shullai W, Nongrum B, Thangkhiew L, Baruah P, Phimphu ML. Ocular biomeetry characteristics and corneal astigmatisms in cataract surgery candidates at a tertiary care center in North-East India. Indian J Ophthalmol 2019;67:1415-23.
10. Shetty R, Arora V, Jayadev C, Nuijts RM, Kumar M, Puttaiah NK, et al. Repeatability and agreement of three Scheimpflug-based imaging systems for measuring anterior segment parameters in keratoconus. Invest Ophthalmol Vis Sci 2014;55:5263-8.
11. Pathak-Ray V, Ramesh S,B, Rathi V. Slitlamp measurement of anterior chamber depth and its agreement with anterior...
segment optical coherence tomography and Lenstar LS 900 in pseudoexfoliation and normal eyes. Indian J Ophthalmol. 2021;69:2469-74.

12. Aung T, Nolan WP, Machin D, Seah SK, Baasanhu J, Khaw PT, et al. Anterior chamber depth and the risk of primary angle closure in 2 East Asian populations. Archives Ophthalmol 2005;123:527-32.

13. Küchle M, Viestenz A, Martus P, Händel A, Jünemann A, Naumann GO. Anterior chamber depth and complications during cataract surgery in eyes with pseudoexfoliation syndrome. Am J Ophthalmol 2000;129:281-5.

14. Matsuo Y, Sakamoto T, Yamashita T, Tomita M, Shirasawa M, Terasaki H. Comparisons of choroidal thickness of normal eyes obtained by two different spectral-domain OCT instruments and one swept-source OCT instrument. Invest Ophthalmol Vis Sci 2013;54:7630-6.

15. Seibold LK, Mandava N, Kahook MY. Comparison of retinal nerve fiber layer thickness in normal eyes using time-domain and spectral-domain optical coherence tomography. Am J Ophthalmol 2010;150:807-14.