Is Astigmatism a Common Problem in Urban Population of South India

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Abstract: *Purpose: In urban population of Southern India, the prevalence of astigmatism, the axis of astigmatism and their determinants were evaluated. Materials and Methods: The study was cross-sectional in nature, conducted from March to May 2019. Patients attending the Ophthalmology OPD of Sree Balaji Medical College and Hospital in the study period were investigated in this study. All the examinations including visual acuity, refraction, slit-lamp biomicroscopy, fundoscopy and keratometry were performed in the Ophthalmology OPD. Only phakic eye that could be reliably refracted without any previous surgical history were included. Results: Out of 1317 participants who were screened, 1062 were analyzed for this study, of whom 52% were female.The prevalence of astigmatism was 32% [95% confidence intervals (CI): 30-34]. Astigmatism significantly increased from 14.3% in the under-15 age group to 67.2% in the age group of over-65 years old (P <0.001). The prevalence of With-The-Rule (WTR), Against-The-Rule (ATR) and Oblique Astigmatism was 11.7%, 18.1% and 2.4% respectively. ATR significantly increased with age (P <0.001). The mean corneal astigmatism was 0.73D which linearly increased with age (P <0.001). Conclusion: Attention must be paid to Astigmatism in Urban areas due to the high prevalence. Further studies are suggested to discover the role of the environmental and genetic factors. A high percentage of participants had ATR astigmatism, which was more common at older ages.*

Keywords: Astigmatism, Prevalence, Urban

1. Introduction

Astigmatism is a refractive error. The prevalence of astigmatism, myopia, and hyperopia, has been reported in numerous studies worldwide [1,2,3,4,5]. Astigmatism is the most common refractive error in a few countries. Age, gender, genetics, and even environmental factors have been shown to affect astigmatism in different studies [1, 5, 6, 7, 8, 9, 10, 11, 12, 14, 15,16,17,18]. Astigmatism has various differences when compared to myopia and hyperopia. The prevalence of myopia and hyperopia is presented in amount and percentage, but astigmatism has various types, mainly related to cornea. Thus, the prevalence of the different types of astigmatism need to be reported. Furthermore, the astigmatic axis is an important indicator of this refractive error which in some cases, is more important than the magnitude of astigmatic power[10,17].

Few studies have focused solely on the details of astigmatism.Although the prevalence of astigmatism has been reported in many studies, fewer studies have investigated the astigmatism axis and corneal astigmatism in addition to the prevalence of astigmatism in a normal population[9,15,18,19].

2. Materials and Methods

In this cross-sectional study, participants were selected from patients coming to Ophthalmology OPD in Sree Balaji Medical College and Hospital, from March to May 2019.

2.1 Inclusion and Exclusion Criteria

Inclusion criteria were the person's attending Ophthalmology OPD in SreeBalajiMedical College and Hospital. Onlypatients with phakic eyes were included for this study. Individuals with a surgical history, and the persons whose refraction and keratometry were not measured were excluded from the study.

2.2 Examinations

Optometric examinations
The site for optometric examinations had standard illumination. The first step was auto-refraction and k-reading with the Bausch and Lomb keratometer for each individual.

To verify the accuracy of auto-refraction, refraction with trial lenses was performed. The right eye of each subject was tested first followed by the left eye. All study participants underwent a non-cycloplegic refraction.

2.3 Ophthalmic examinations

These examinations were performed by two ophthalmologists after optometric examinations. All subjects underwent an examination including direct and indirect ophthalmoscopy, slit-lamp biomicroscopy, measurement of intraocular pressure (IOP), and assessment of lens opacities.

3. Definition

Astigmatism is a type of refractive error wherein the refraction varies in the different meridia. Consequently, the rays of light entering in the eye cannot converge to a point focus but form focal lines. Broadly, there are two types of astigmatism: regular and irregular. For assessing the severity of astigmatism, prevalence was reported based on the cylinder power greater than 1, 2 and 3 D. For analyzing the axis of astigmatism, patients with astigmatism >0.5 D were included. The astigmatism axis was classified as With-The-Rule (WTR) if the axis was between 150° and 180° or

between 0° and 30°, against-the-rule (ATR) if the axis was between 60° and 120° and oblique (OBL) if was at any other meridian.

4. Statistical Analysis

Total and corneal astigmatism prevalence was reported as percentage, with 95% confidence intervals (CI). A *P*-value less than 0.05 was considered significant.

5. Results

Out of 1317 participants, after implementing the inclusion and exclusion criteria, the data of 1062 participants were analyzed of whom 52% were female. The mean (± standard deviation) age of the participants was 33.2 (±19.5)-years old (range, 1-80 years).

The prevalence of astigmatism with cylinder power greater than 0.5 D was 35.5% (95% CI: 33.5-37.5). The prevalence of astigmatism was 36.6% and 34.4% in females and males, respectively.

The prevalence of astigmatism increased linearly with age. The prevalence of astigmatism was 16.7% in the participants younger than 15 years of age and showed a significant increase up to 69.8% in the participants over 65-years old; therefore, increase in age by 1 year increased the possibility ofastigmatism by 1.05 times (*P* <0.001).

The prevalence of WTR, ATR, and oblique astigmatism was 12.7% (95% CI: 11.4-14.1), 19.1% (95% CI: 17.5-20.8), and 3.4% (95% CI: 2.7-4.0), respectively.

ATR astigmatism showed the greatest variation. This type of astigmatism increased from 6.3% in participants under the age of 15 years to 49.1% in participants over 65 years of age (*P* < 0.001). The prevalence of WTR, ATR, and oblique astigmatism was 11.9%, 18.9% and 3.3% in males and 13.5%, 19.3% and 3.5% in females. There was no significant difference in astigmatism between males and females

6. Discussion

In this study, the prevalence of astigmatism with the cylinder power greater than 0.5 D was 35.5%. There was considerable difference in astigmatism in different age group, the lowest observed among the participants below 15 years of age and highest over 65 years of age.

The prevalence of astigmatism in the participants who were 5-15 years old was 16.7%. It has been proved by various investigators that genetic and ethnic factors also affect astigmatism. Prevalence of astigmatism was found to be high among middle-aged and elderly participants. The prevalence of astigmatism among the participants over 40 years of age was 53.8% and increased up to 70% in the participants over 65-years old.

In this study, genders in different age groups did not show significant differences in prevalence. However, contradictory results have been reported in the literature[4,7,13]. Krishnaiah *et al*.[21], in India did not find any differences in the prevalence of astigmatism between males and females.

In the present study, most of the changes in astigmatism can be justified by environmental factors in the elderly and the greater exposure to these conditions as compared to children. However, corneal changes related to age, can be another explanation for increase in the prevalence of astigmatism in elderly.

The current study concluded that ATR astigmatism is the most frequent among the participants which significantly increased with age. Previous studies have also shown that ATR astigmatism increases with age[4,9,17].

Variations of astigmatism with age show that newborns have ATR astigmatism which shifts toward WTR astigmatism up to almost 20 years old. Then, it remains almost unchanged up to the 4th decade of life and subsequently changes towards ATR[16]. Weakness of the eye muscles result in reduction of eyelid pressure, which is one of the most important factors that change the type of astigmatism with age.

In the current study, the mean keratometry was 42.78 D. Nevertheless, in age groups, the mean corneal astigmatism considerably increased in such a way that the difference in corneal astigmatism between participants under 15 and over 65-years old was 1 D.

The axis of corneal astigmatism and total astigmatism was similar. The increase in ATR astigmatism and decrease in WTR astigmatism with age were more significant than total astigmatism. This finding shows that major changes in the axis of refractive astigmatism follow the axis of corneal astigmatism. This finding confirms that with age, the effect of eyelid pressure on the cornea decreases.

7. Conclusions

Attention should be paid to astigmatism in urban areas, thanks to the high prevalence. Role of genetics and environment is suggested. A high share of participants had ATR astigmatism, which increased with age. Astigmatism due to corneal factors was almost similar to total astigmatism in all age groups [20].

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