

Gender Differences in Ocular Biometry among Cataract Patients of Western Nepal

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Received April 08, 2015; Revised April 29, 2015; Accepted June 15, 2015

Abstract Cataract blindness presents an enormous problem in terms of public health burden, economic loss and social burden. A hospital based retrospective study reviewed the medical data of 520 patients (mean age 68.42 ± 11.77 years) to detect gender based comparison of axial length, corneal curvature and power of intraocular lens that was implanted in patients undergoing cataract surgery in Western Nepal. A significant inter-gender differences was seen in age, axial length, keratometric values and intraocular lens power between the two groups ($p < 0.05$). Females had shorter axial length (22.85 ± 0.86 mm) and steeper corneal curvature (K1: 43.79 ± 1.51 D, K2: 44.46 ± 1.54 D) compared to males (23.04 ± 1.01 mm, K1: 43.51 ± 1.40 D, K2: 44.16 ± 1.40 D). The axial length had a decreasing trend with increasing age in both the sexes. The average power of the intraocular lens was 21.28 ± 1.91 D. In conclusion, the axial length of Nepalese population was comparable to Indian and Pakistani population. However, it was slightly shorter than Whites, Middle-Eastern and some Asian population. The keratometric value ranges from 38.75-50.00 D. Maximum number of patients required intraocular lens of power between 20.00-22.99 D

Keywords: Axial Length, Corneal Curvature, Intraocular Lens Power, Cataract, Sex

Cite This Article: Shristi Shrestha, Khem Raj Kaini, and Binamra Basnet, "Gender Differences in Ocular Biometry among Cataract Patients of Western Nepal." *American Journal of Public Health Research*, vol. 3, no. 4A (2015): 31-34. doi: 10.12691/ajphr-3-4A-6.

1. Introduction

According to the World Health Organization's estimation in 2010, proclaimed in Vision 2020, "Global Initiative for the Elimination of Avoidable blindness 2020", there were 285 million visually impaired persons in the world out of them 39 million are blind. Cataract is the major cause of blindness (51%) and is responsible for one third of visual impairment (33%) [1]. Cataract blindness presents an enormous problem in terms of public health burden, economic loss and social burden.

At present rapid visual rehabilitation is the main objective of the cataract surgery with optimum uncorrected visual acuity and with minimum postoperative astigmatism [2]. The final postoperative visual acuity is dependent on the pre-existing corneal astigmatism, accurate biometry, intraocular lens (IOL) power calculation and surgically induced astigmatism. The main determining factor to achieve the desired refractive outcome after cataract surgery is the accurate measurement of axial length (AL). The preoperative and the postoperative ultrasound biometry demonstrated that 54% of the error in predicted refraction after implantation of an IOL is attributed to axial length measurement errors, 8% to corneal power measurement errors, and 38% to errors in the estimation of the postoperative anterior chamber depth [3]. An error of 100 μ m in axial length

measurements lead to about 0.28 diopter (D) of postoperative refractive error [4].

A significant amount of the clinical research consider women and men in a sex neutral form as patients, implicating thereby that the population is considered as homogenous and that the results have validity for both sexes. Even when calculating the power of the intraocular lens to be implanted during cataract surgery, different formulae are used in a unisex manner, the same for women and men [5]. Richards et al. found that using the same surgical procedure and the same calculation of the power of the implanted lens, the results for women were worse than for men. He recommended that special care be taken when implanting an intraocular lens in a female patient, especially in the accuracy of measurement of the axial length [6].

Since the biometric indices can be influenced by gender, race and genetics, their differences across different population would help to determine the distribution of these parameters in different area. This study was undertaken focusing on axial length, corneal curvature and power of the intraocular lens in elderly Nepalese patients and particularly on possible differences between women and men.

2. Materials and Methods

A hospital-based retrospective study was carried out in the Department of Ophthalmology, Manipal Teaching Hospital, Pokhara from June 2010 to December 2013. We reviewed medical data on patients admitted for routine cataract surgery from 520 patients. Routine cataracts were defined as cataracts occurring with no associated pathology which could possibly affect the measurements or distort the anatomy of the eye. Patients with corneal disease, extensive pterygium, previous ocular surgeries, high myopia with posterior staphyloma, glaucoma and previous ocular trauma were excluded from the study. All the patients had undergone complete ophthalmologic examination including visual acuity, refraction, slit-lamp examination, tonometry, keratometry, ultrasound A-scan and B-scan if required. Axial length was measured using A-scan (Palmscan AP200). Keratometric data were collected using Bausch and Lomb keratometer (AppaSamy). The Sanders-Retzlaff-Kraff (SRK/II) linear regression formula was used for IOL power calculation in all cases and 'A' constant of 118.5 was used. Preceding the study, ethical approval from the institutional research ethical committee was taken. Data were collected and analyzed using statistical software SPSS version 16. The student t-test was applied to determine the difference between two independent means. A 'p' value less than 0.05 was considered statistically significant.

3. Results

Out of 520 patients, 228 were female and 292 were male. Table 1 lists the overall demographic characteristics of the patients. The mean age of the female subjects undergoing cataract surgery was 69.54 ± 10.83 years whereas it was 66.97 ± 12.76 years in males. Majority (62.3%) of the patients reported at the age between 60-79 years. Overall, the mean axial length was 22.96 ± 0.95 mm and ranged from 18-29.5 mm.

Table 1. Descriptive statistics of Age, Axial Length, Keratometric values and IOL Power

	Mean \pm SD	Range
Age (years)	68.42 \pm 11.77	24-94
AL (mm)	22.96 \pm 0.95	18-29.5
K1 (diopter)	43.64 \pm 1.45	38.75-49
K2 (diopter)	44.29 \pm 1.47	40.5-50
IOL Power (diopter)	21.28 \pm 1.91	5-29

*K1-flat keratometry, K2-steep keratometry

Gender based comparison revealed significant difference in age, axial length, keratometric values and IOL power ($p < 0.05$, Table 2). Females had significantly shorter axial length compared to males (22.85 mm versus 23.04 mm, $p = 0.023$). Women had significantly steeper cornea than men ($p = 0.02$, Table 2).

Table 2. Comparison of Age, Axial length, Keratometric values and IOL Power between Males and Females

Mean	Female	Male	p-value
Age (years)	69.54 \pm 10.83	66.97 \pm 12.76	0.013
AL (mm)	22.85 \pm 0.86	23.04 \pm 1.01	0.023
K1 (diopter)	43.79 \pm 1.51	43.51 \pm 1.40	0.028
K2 (diopter)	44.46 \pm 1.54	44.16 \pm 1.40	0.02
IOL Power (diopter)	21.75 \pm 1.82	20.9 \pm 1.91	0.00

Table 3 shows the age-wise distribution of the overall axial length. The axial length had a decreasing trend with increasing age in both the sexes (Figure 1).

Table 3. Age-wise Distribution of Axial Length

Age (years)	N	Axial length (Mean \pm SD)
≤ 49	34	23.74 \pm 0.95
50-59	63	23.21 \pm 0.84
60-69	156	23.06 \pm 0.96
70-79	168	22.97 \pm 0.76
80-89	94	22.40 \pm 1.00
≥ 90	5	21.32 \pm 0.30

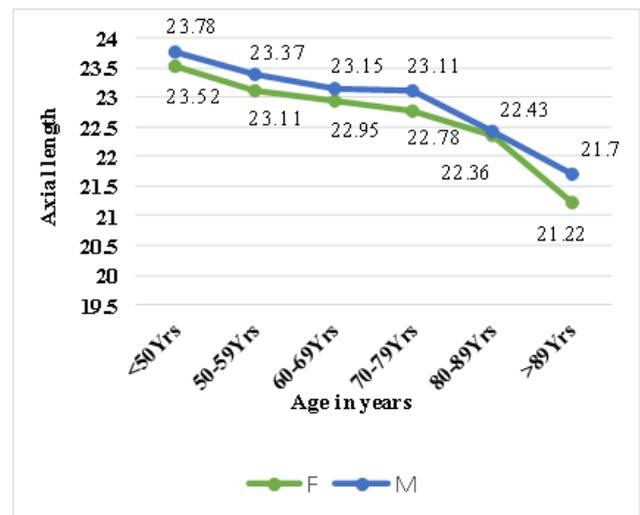


Figure 1. Gender-wise distribution of axial length

Overall, 86.2% of the subjects had an axial length between 21-23.99 mm (91.7% in females, 81.8% in males, Table 4).

Table 4. Distribution of Axial Length

Axial length (mm)	Female	Male	Total
<20.99	1	2	3
21-23.99	209	239	448
24-26.99	18	49	67
>27.00	0	2	2

The average power of the intraocular lens was 21.28 ± 1.91 D, ranging from 5-29 D. Maximum number of the patients (59.4%) required an IOL power between 20-22.99 D (Table 5).

Table 5. Distribution of IOL Power

IOL Power (D)	Female	Male	Total
<17.0	6	5	11
17.0- <20.0	31	99	130
20.0- <23.0	146	163	309
23.0- <26.0	44	25	69
≥ 26.0	1	0	1

4. Discussion

The results of this study confirm some important differences between women and men regarding various ocular parameters. The mean age of the patients in our study was 68.42 ± 11.77 years. Men were slightly younger than women (66.97 ± 12.76 years versus 69.54 ± 10.83 years). A similar observation was seen in Taiwanese population where the mean age was 67.2 ± 2.1 years and men were younger (66.1 ± 1.30 years in men versus 68.2 ± 1.10 years in women) [7]. But in other studies from Pakistan [8,9] and Kashmir [10], patients underwent cataract surgery at a relatively younger age (55.08 ± 14.52 years, 58.71 ± 18.23 years and 60.5 years). This difference in the mean age could merely imply a difference in the timing of presentation as men are more socially active or

the selection criteria for the cataract surgery at a particular hospital. On the other hand, the mean age in Norwegian population was 76.2 ± 10.1 years (F: 76.6 ± 9.7 years, M: 75.3 ± 10.7 years) which may be due to the higher life expectancy in Norway [11].

Ethnicity and racial factors have been known to influence the axial length of the eye. Overall, the mean axial length in the present study was 22.96 ± 0.95 mm which was consistent with other reports from Pakistan (22.96 ± 1.04 mm) [8], (22.52 ± 1.3 mm) [9], Kashmir (22.66 mm) [10] and Central India (22.6 mm) [12]. The mean axial length of Nepalese eye was slightly shorter than those previously reported for normal white population (23.11 mm, 23.44 mm, 23.15 mm, 23.69 mm) [11,13,14,15], Middle Eastern population (23.14 mm) [16] some other Asian population (24.43 mm, 23.23 mm) [17,18]. Our observation of shorter axial length in female population is consistent with previous findings [8,10,11,13,15-20]. Shorter axial length in females could possibly be due to shorter stature and underlying genetic differences. With age, there was tendency towards smaller eyes in both the sexes [10,11,14,16,17,18,20]. An age dependent decrease of the axial length of the adult eye has been suggested to serve as an emmetropizing mechanism occurring concurrently with a decrease in the anterior chamber depth together with an increase in the refractive power of the cornea and lens [11]. On the other hand, one study concluded no relation between axial length and age [19].

The mean corneal curvature in Nepalese population (43.96 D) was steeper than Norwegian population (43.36 D) [11] but was slightly flatter than Filipino population (44.05 D) [17]. There has been variability in the mean keratometric value among Pakistani population (K1- 44.00 D, K2- 44.78 D and K1- 42.65 D, K2- 42.48 D) [8,9]. Gender based comparison of keratometric values (F: K1- 43.79 D, K2- 44.46 D, M: K1- 43.51 D, K2- 44.16 D) revealed that women had steeper cornea than men which was congruent with other reports [8,11,17,18,21,22].

The mean intraocular lens power that was implanted in the present study was 21.28 D which was less as compared to 23.17 D in Pakistan [9] and 21.72 D in Norway [11]. However, the Taiwanese required a lesser intraocular lens power (20.0) [7]. Also, the intraocular lens power required for women was higher as compared to men in this study which is identical to other studies [7,8,11]. Since the axial length was shorter in women, it is quite obvious to observe a larger power in the women. Behndig et al. suggested the use of Haigis' formula to a higher extent, in eyes with steep corneas and short axial lengths as mostly seen in women to reduce the biometry prediction errors after cataract surgery [22].

5. Limitations

In a developing country like Nepal, access to modern equipment like IOL master is not readily available. The use of ultrasound probe in our study, may cause corneal indentation when in contact with the corneal surface, thereby shortening the eye, leading to an underestimation of the true axial length. Measurement using the IOL master would have given a higher resolution measures of axial length compared with ultrasound methods (± 0.01

mm versus ± 0.15 mm) [23]. The axial length of the eye also depends on the height of the individual [12,15,24], which was not taken into account. The most significant drawback of this study is that it was hospital based and not population based. Also, most of the patients in our study were in the age group of 60-80 years.

6. Recommendations and Conclusion

Axial length has different applications in ophthalmology. Describing the normal range of this index helps to determine the refractive status of the eye and may provide an insight into the measures to reduce the errors while calculating the IOL power. The results of our study show the average axial length in our population to be comparable with the Indian and Pakistani population whereas it was shorter than whites and Middle-Eastern population. Women had significantly shorter axial length as compared to men and the axial length in both the genders showed a decreasing trend with increase in the age.

Data of the range of intraocular lens power inserted during the cataract surgery will serve as a guide in the procurement of the intraocular lens power in the hospital. Also, the data regarding the axial length and intraocular lens power will be useful as reference values in case the surgery is to be done at high volumes in surgical camps in rural areas where biometry equipment may not be available.

A population based participant source and inclusion of younger population in addition to hospital based study should be considered in future research.

Declaration of Conflicting Interests

The authors declare that there is no potential conflicts of interest with respect to the research, authorship and /or publication of this article

Funding

The authors received no financial support for the research, authorship and/or publication of this article

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