

Original Article

Biometric Indices and Their Relation with Age, Sex and Ethnicity

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Abstract

Objective: The aim of the present study was to evaluate the association of biometric indices with age, gender and ethnicity.

Patients and Methods: Three hundred and seventy patients entered the study from Basir Eye Clinic refractive assessment clinic. Socio-demographic data was gathered. Ocular parameters for both eyes and corneal curvature were measured by immersion technique and manual keratometry, respectively.

Results: Axial length was significantly higher among male patients ($P < 0.01$) and vitreous chamber depth was significantly higher in females ($P = 0.02$). Axial length and vitreous chamber depth parameters were significantly higher among Arab patients ($P < 0.01$) compared to Persian patients and there was no other significant differences between these two groups. A significant increase in lens thickness and mean K ($P < 0.001$, coefficient = 0.15 and 0.023 respectively) and a significant reduction in axial length, anterior chamber depth and vitreous chamber depth ($P < 0.001$, coefficient = - 0.31, - 0.10 and - 0.37 respectively) were observed in correlation with the age of participants.

Conclusion: There was correlation between axial length, depth of the anterior chamber, vitreous chamber depth, lens thickness and mean k with age of the participants. Male subjects and specific Arab patients tend to have higher axial length values.

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Introduction

The restoration of near, intermediate and distant visual acuity in patients after cataract surgery is important. Clinical inspection might be sufficient to diagnose a wide range of pathological features. WHO's initiation is to prevent avoidable loss of vision by the year 2020^{1,2}. Biometry provides more accurate information than other common methods such as the use of intraocular lens master about the refractive outcomes among patients after cataract surgery³.

Several studies have reported the variation of refractory parameters in adults presenting a growing trend after the age of 40 years and higher prevalence of hyperopia among elders, which will decrease after the age of 70 - 80 years with ambiguous etiology⁴. The mentioned variations in the refractory parameters of young adults might be due to reported differences between axial length measurements in previous studies. Likewise, uncorrected refractive errors are a common ocular condition and a prominent cause of visual impairment in children worldwide⁵.

Axial dimensions are major indicators of uncorrected refractive errors⁶. Previous surveys have found a number of ocular dimensions including axial ocular length, anterior chamber depth, lens thickness, and vitreous chamber depth to be associated with hypermetropia and myopia⁷. On the other hand, refractive errors depend on various factors like age, gender and race. Previous reports have concluded that Asians have higher prevalence of myopia compared to Caucasians. Excessive studies in Caucasian population have reported the dimensions of ocular components in their population; however, the average of these values in Middle East region is not yet assessed accurately^{8,9}.

A number of population-based surveys support

the association between refractive errors and axial ocular dimensions with demographic data such as age, gender, education, cigarette smoking and diabetes. For example Wong et al.,¹⁰ showed that posterior subcapsular cataract is associated with thinner lenses, longer vitreous chamber and deeper anterior chamber. The present study was carried out in order to examine the average values of ocular dimensions among adult patients in Basir Eye Clinic, Tehran, Iran and its association with age, gender and ethnicity.

Patients and Methods

Participants

Our survey was a cross-sectional observational study. Three hundred and seventy patients from Basir Eye Center refractive assessment clinic entered the study. Inclusion criteria were the presence of cataract without any other pathological conditions which could influence compared indices. Exclusion criteria were: corneal pathology, retinal pathologies such as macular degeneration and diabetic retinopathy, previous anterior or posterior segment surgery, choroidal neovascularization and vitreous hazing. Sociodemographic information like age, gender, ethnicity and country of birth were collected from all enrolled participants. Ocular parameters including Axial Length (AL), Anterior Chamber Depth (ACD), Lens Thickness (LT), Vitreous Chamber Depth (VCD), were measured using immersion technique and corneal curvature was measured by manual keratometry in both eyes. Axial length in both eyes was measured using IOL master. The study was performed in agreement with declaration of Helsinki and all participants gave informed consent before entering the study. This study was approved by the local ethics committee.

Immersion Technique

In this technique, patients lay supine in

examination bed. Topical anesthesia, Tetracaine 0.5 % was used while pupils were not dilated. Normal saline for coupling fluid and Prager scleral immersion shell for probe support was also used. The chamber was filled using a syringe connected to silicone tube and in order to minimize the leakage methylcellulose was applied to the rim of the shell. After asking the patient to focus on a target light, an automated sequence of 10 measurements was taken. Ultrasound velocities of 1550 millisecond were used for the anterior chamber and vitreous and 1641 milliseconds for the lens measurements.

Manual keratometry

Corneal curvature was measured by Manual Keratometer Javal-Schiotz (Haag-Streit Street, Bern, Switzerland) and using a 1.3375 refractive index and all measurement were compared with an Automated Keratometer (RKT-7700; Nidek Co, Ltd, Archi, Japan). Patients with less than 0.5 diopter of mean difference between automated and manual keratometry were recruited in our study. All subjects were asked to blink before measurement in order to have an optically smooth tear film over the cornea. All metric data were obtained by the same individual in order to prevent observer's bias.

Statistical Analysis

After collecting all data, the variables were summarized by descriptive statistics. We used SPSS version 22 (Armonk, NY: IBM Corp) to analyze the data. Independent sample T-test was employed to test for significant difference in categorical variables between groups. Analysis of variance with one-way ANOVA was used for detecting the differences of variables between ethnicity groups. Paired sample ANOVA showed the mean intra patient differences. A linear regression analysis with age as repressor factor for biometric parameters was performed. P values under 0.05 were considered statistically significant.

Results

Three hundred and seventy patients (201 female and 169 male) with a mean age of 54.6 ± 12 years were enrolled in our study. Table 1 represents the mean of biometric indices. The analysis of biometric variables based on different gender subgroups detected that AL parameter was significantly higher among male patients ($P < 0.01$) and VCD was significantly higher in females ($P = 0.02$). Other parameters were not significantly different between genders.

It was found that AL and VCD parameters were

Table 1: Descriptive statistics of biometric indices

	Minimum	Maximum	Mean	Std. Deviation
AL with Immersion	18.61	31.55	23.4835	2.01001
ACD with Immersion	2.05	4.97	3.2765	.42536
LT with Immersion	2.26	5.41	4.2754	.47622
VCD with Immersion	11.17	23.16	15.9147	1.89435
Mean K with Manual	39.13	49.00	44.3625	1.81946

significantly higher in Arab patients among 5 different ethnicities (Fars, Lor, Arab, Turks and Kurds) ($P < 0.01$) and there was no other significant difference between these groups (Figure 1). A significant increase in LT and mean K

($P < 0.001$, coefficient = 0.15 and 0.023 respectively) and a significant decrease in AL, ACD, VCD ($P < 0.001$, coefficient = - 0.31, - 0.10 and - 0.37 respectively) were observed in our patients in correlation with their age (Figure 2, 3).

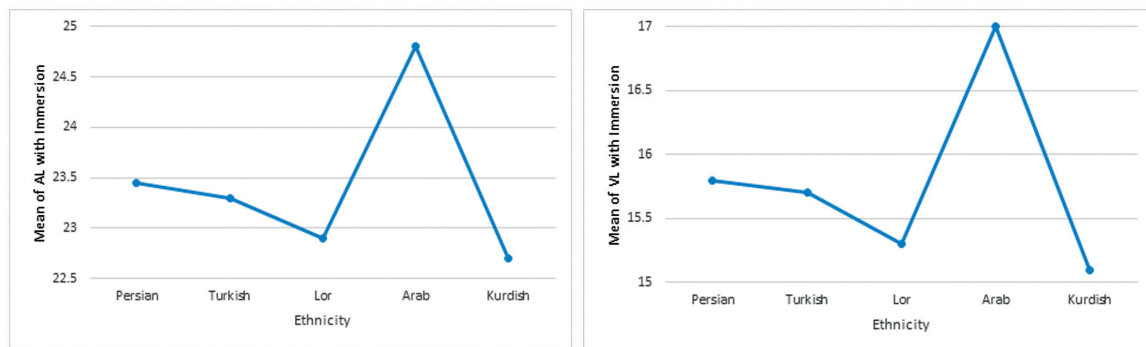


Figure 1: AL and VCD means were significantly higher among Arab patients compared to other ethnicities

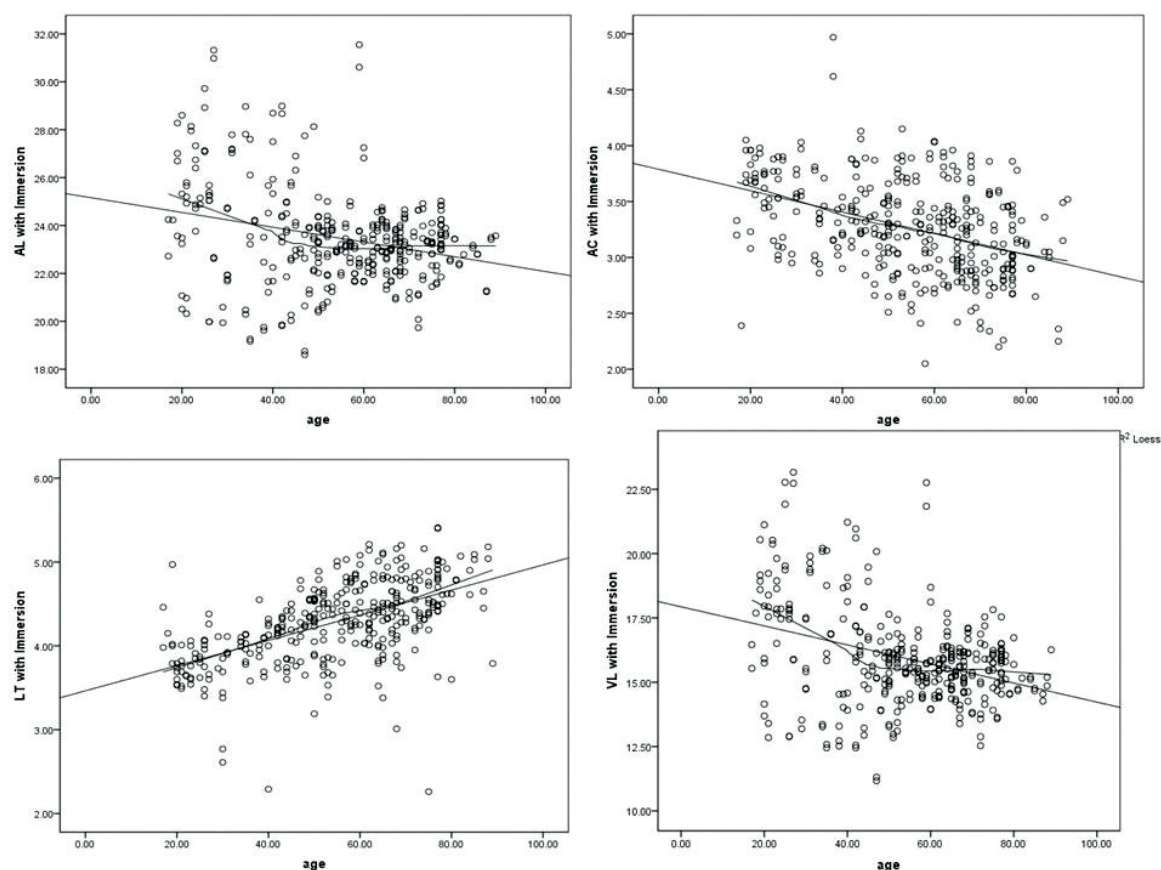


Figure 2: Scatterplot of age against AL, AC, LT and VL

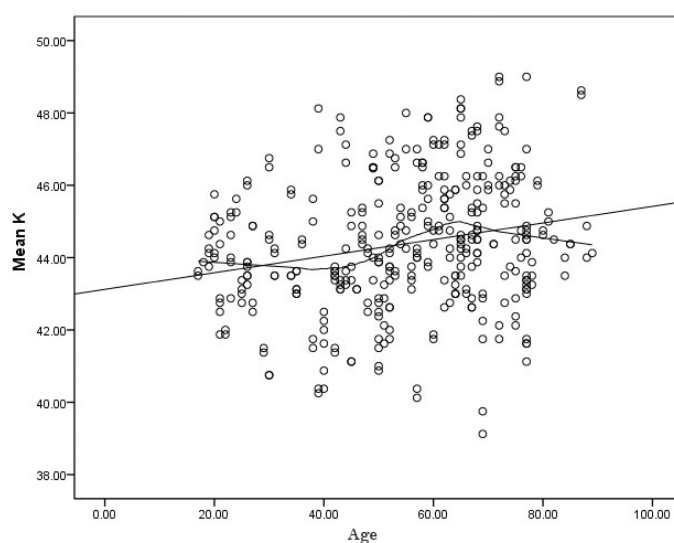


Figure 3: Scatterplot of age against mean K

Discussion

Biometric indices are important due to their major role of giving insight into the pathophysiology of well-known ocular abnormalities such as glaucoma or cataract. There is a notable shortcoming in availability of biometric data from eyeballs of Iranian patients with various ocular diseases. We found AL to be higher in males than females. Also, we discovered that Iraqi patients have higher AL values; but the mean K was significantly higher among Iranian patients.

Biometric parameters discussed in our study have been surveyed in children, young adults, adults or a specified group of participants such as medical doctors, etc.^{11, 12}.

Axial length is an essential marker for accurate measurement of intraocular lens' power and has been recognized as a great predictor of visual acuity outcome in patients after cataract surgery or vitrectomy for diffuse macular edema secondary to diabetic retinopathy^{13, 14}. Some studies have indicated that gender has a small effect on axial length. A Singaporean study reported shorter eyes in women¹⁵, which is consistent

with our finding indicating higher AL values among male patients. We found AL to be notably decreased in correlation with the age. Grosvenor et al.,¹⁶ also proposed the reduction of AL in adults to be an emmetropizing action, which happened in association with the elevation of refracting power of the eye.

Previous studies have shown that VCD is a predominant component in maintaining the tendency to emmetropia in children aged 6 to 16 years¹⁷ and illustrated VCD to be a potential indicator of the effects of lid fusion. In the present study, Arab patients had greater AL and VCD in comparison with other ethnicities. Previous studies showed higher prevalence of myopia in eastern Asians, and it seems that Chinese have greater AL compared with non-Chinese patients¹⁸. Also Eskimos have shorter AL and VCD in comparison with other Caucasians¹⁹.

It is proved that the thickness of human lens increases as age advances. After the stabilization of globe length in the second decade of life, an elevating pattern will be seen as 0.15 - 0.20 mm per decade²⁰. We found that aging is associated

with higher measurements in LT and mean K, and smaller AL, ACD and VCD. Our results were consistent with Tanjong et al., survey which found that older people had shorter AL, ACD and VCD but greater LT²¹. Current biometric data is mainly based on children data^{12,22}, with a great lack of comparable information in adult's population.

Several studies have shown that shorter AL might be caused by poor nutrition and general health in older people as well as some physiologic changes²³. Although these mechanisms are still unclear but several factors could be worthy to note, such as reduced need of accommodation in the myopic eye, which may cause lens stress from ciliary processes and peripheral lens fibers^{24,25}. Another possible mechanism is increased oxidation

of unsaturated lipids, which will reduce oxidation defense systems of the lens^{26,27}.

In this study we did not include a number of variables such as smoking and alcohol consumption in the analysis; but there is some evidence indicating that these variables are not cofounders, and have no association with axial length or other biometric indices²⁸.

Conclusion

There was correlation between axial length, depth of the anterior chamber, vitreous chamber depth, lens thickness and mean k with age of the participants. Male subjects and Arab patients tend to have higher axial length values.

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Footnotes and Financial Disclosures

Conflict of Interest:

The authors declare no conflict of interest with the subject matter of the present manuscript.