Brief communication

**Ocular biometric indices in Vietnamese 46 to 65 years of age**

Índices biométricos oculares en vietnamitas de 46 a 65 años de edad

Hien Thi Thu Nguyen1\* <https://orcid.org/0000-0002-6658-7962>

Khoa Xuan Ngo2 <https://orcid.org/0000-0003-1718-7644>

Luan Thanh Nguyen3 <https://orcid.org/0000-0002-0858-4106>

Luong Van Hoang4 <https://orcid.org/0000-0002-2657-4411>

1Vietnam National Institute of Ophthalmology. Hanoi, Vietnam.

2Hanoi Medical University. Hanoi, Vietnam.

3Haiduong Medical Technology University. Haiduong, Vietnam.

4Vietnam Military Medical University. Hanoi, Vietnam.

\*Author for correspondence. Email: thuhienvnio@gmail.com

**ABSTRACT**

**Introduction:** Ocular axial length, anterior chamber depth and central corneal thickness are three important ocular biometric indices. These measurements are useful to show changes in the Vietnamese population with presbyopia.

**Objectives:** To determine the ocular biometric indices, ocular axial length, anterior chamber depth and central corneal thickness, in Vietnamese population and evaluate the correlation between these indices.

**Methods:** A cross-sectional study was carried out in a Vietnamese population, aged 46 to 65 years. Data on ocular axial length, anterior chamber depth and central corneal thickness were collected. The Student's t test and ANOVA were used to compare the means of the indices, grouped by age and sex. The relationship between the ocular biometric indices was tested using Pearson's correlation, with a significance level of p <0.05.

**Results:** 390 eyes of 195 people were analyzed. The mean length of the ocular axis was 23.13 ± 0.66 mm, the depth of the anterior chamber, 3.15 ± 0.36 mm, and the central corneal thickness, 529.15 ± 30.57 µm. The three biometric indices decreased with age and were higher in men (p <0.05). The length of the ocular axis had a positive relationship with the depth of the anterior chamber (r = 0.411 and p <0.001) and the central corneal thickness (r = 0.141 and p <0.001). There was no relationship between anterior chamber depth and central corneal thickness (r = 0.039 and p = 0.44).

**Conclusion:** Three ocular biometric indices decreased with age and were higher in men. The length of the ocular axis was related to the depth of the anterior chamber and the thickness of the central cornea.

**Keywords:** ocular axial length; anterior chamber depth; central corneal thickness.

**RESUMEN**

**Introducción:** La longitud axial ocular, la profundidad de la cámara anterior y el grosor corneal central, son tres índices biométricos oculares importantes. Estas medidas son útiles para mostrar los cambios en la población vietnamita con presbicia.

**Objetivos:** Determinar los índices biométricos oculares, longitud axial ocular, profundidad de la cámara anterior y espesor corneal central, en población vietnamita y evaluar la correlación entre ellos y con la edad y el sexo.

**Métodos:** Se realizó un estudio transversal en población vietnamita, con edad de 46 a 65 años. Se recogieron los datos de longitud axial ocular, profundidad de la cámara anterior y grosor corneal central. Se utilizaron la prueba t de Student y ANOVA para comparar las medias de los índices, agrupados por edad y sexo. La relación entre los índices biométricos oculares fue probada mediante la correlación de Pearson, con un nivel de significación de p < 0,05.

**Resultados:** Se analizaron 390 ojos de 195 personas. La longitud media del eje ocular fue 23,13 ± 0,66 mm, la profundidad de la cámara anterior, 3,15 ± 0,36 mm, el grosor corneal central, 529,15 ± 30,57 µm. Los tres índices biométricos disminuyeron con la edad y fueron mayores en los hombres (p < 0,05). La longitud del eje ocular tuvo relación positiva con la profundidad de la cámara anterior (r = 0,411 y p < 0,001) y el espesor corneal central (r = 0,141 y p < 0,001). No hubo relación entre la profundidad de la cámara anterior y el grosor corneal central (r = 0,039 y p = 0,44).

**Conclusión:** Los tres índices biométricos oculares disminuyeron con la edad y fueron mayores en los hombres. La longitud del eje ocular se relacionó con la profundidad de la cámara anterior y el grosor de la córnea central.

**Palabras clave:** longitud axial ocular; profundidad cámara anterior; grosor corneal central.

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**INTRODUCTION**

Ocular axial length (AL), anterior chamber depth (ACD), and central corneal thickness (CCT) are the 3 main ocular biometric indices. The determination of these indices provides important ophthalmological information in the diagnosis and treatment of eye diseases. According to *Young*,(1) the main alteration in myopia and hyperopia is the alteration of the AL. Many investigations have shown, in myopic eyes, that the higher the ACD, the higher the AL. In contrast, hyperopia tends to have small ACD and AL, and a higher risk of glaucoma than normal and myopic eyes. Eyes with a ACD smaller than 2.8 mm have a 42.5-fold higher risk of angle-closure glaucoma than a ACD of 3.0 mm. In the surgical treatment of myopia, CCT plays an important role in choosing excimer laser refractive surgery or intraocular refractive surgery.(1) In cataract eyes with indication for surgery, AL is an important index to calculate the power of artificial lens.(2)

Studies on the distribution of ophthalmological indices have been published in several countries, such as China, the United States, and Australia.(3,4) The results of these studies have established a reference database for diagnosis and treatment. These indices can be affected by race or heredity; therefore, it is impossible for the same standard to apply for all countries. Therefore, it is necessary to carry out studies in different countries, to obtain a base of data appropriate to different morphological characteristics. With the improvement of technology, the IOL Master machine can measure biometric indices accurately and safely because it does not directly contact the corneal surface.(5)

Clinical ophthalmologists have used foreign indices to compare cases with some disorders, however, there have been many ocular measurements that show differences between ethnic groups. In the epidemiology of eye diseases in Vietnam, there are those in which prevention and diagnosis are related to AL, ACD and CCT, such as cataracts, refractive errors and glaucoma. In addition, the cataract, refractive or glaucoma surgery can change the AL, ACD and CCT.(6,7) The absence of a database of ocular biometric indices gives rise to difficulties in diagnosis. Therefore, more studies are needed to complete a database of measurements of normal ocular biometric indices at different ages, which could be used to compare pathological cases.

This study was carried out in order to determine, in the Vietnamese population, the ocular biometric indices, AL, ACD and CCT, and to evaluate the correlation between them and with age and sex.

**METHODS**

A cross-sectional study was carried out at the National Ophthalmology Institute of Vietnam, during the period of one year, starting in September 2017. 390 eyes were included, of 195 participants, Vietnamese (living in Vietnam), aged 46 to 65 years, who voluntarily agreed to participate in the study.

People with eye injuries, previous eye surgery, corneal scar, severe cataracts, acute eye diseases, myopia above 6 diopters or hyperopia above 5 diopters were excluded.

Each patient underwent an eye examination. Self-refraction (with a Nidek autorefractor), slit lamp examination, and fundus examination were measured; to rule out any eye disease or high refractive error. The examination was performed by specialists in ophthalmology. The Carl Zeiss Meditec IOL Master 700 equipment was used to evaluate AL, ACD and CCT.

The sample size was calculated using the formula:



Where:

n: sample size.

s: standard deviation (s = 0.368) (s = SEx√n) = 0.005 x √4869 = 0.348, SE is the standard error of the mean and this n is the sample size of *Hashemi's* research.(8)

α: level of significance (α = 0.05)

$Z\_{1-α/2}^{2}$= 1,962

ε: expected error (ε = 0.02)

X: mean value (2.62 in *Hashemi's* research(8))

With these values, the calculated size was 171.4. Finally 195 subjects were included.

To compare the means of AL, ACD and CCT, the t test was used for independent samples, between gender groups. The ANOVA test was used to compare the difference in means of AL, ACD and CCT between age groups. Pearson's correlation was applied to analyze the correlation between AL, ACD and CCT, with a significance level of p <0.05. The data were analyzed using SPSS v. 20.0.

This study strictly obeys the tenets of Declaration of Helsinki and was approved by Hanoi Medical University Ethics Committee. Informed consents were collected from participants for their anonymous information, to be reported in the study.

**RESULTS**

Of the participants, 101 were women (51.8%) and 94 men (48.2%). The mean age was 56.43 ± 5.74.

The Al, ACD and CCT averages were 23.13 ± 0.66 mm, 3.15 ± 0.36 mm and 529.15 ± 30.57 µm, respectively. The AL decreased with age, this difference was statistically significant (ANOVA test, p <0.05). The AL was higher in men; this difference was statistically significant (t test, p <0.001). The ACD decreased with age, this difference was statistically significant (ANOVA test, p <0.001). The ACD was higher in men; this difference was statistically significant (t test, p <0.001). The CCT decreased with age; the difference was statistically significant (ANOVA test, p <0.05). The CCT was higher in men; this difference was statistically significant (t test, p <0.001) (table 1 and table 2).

**Table 1 -** Average AL, ACD, CCT and relation with age



**Table 2 –** Average AL, ACD, CCT and relation with gender



Regarding the correlation between AL and ACD (Fig. 1), it was significant (r = 0.411; p <0.001). The higher the AL, the higher the ACD.



**Fig. 1 -** Correlation between AL and ACD.

Regarding the correlation between AL and CCT (Fig. 2), r = 0.141, p <0.001. The higher the AL, the higher the CCT.



**Fig. 2 -** Correlation between AL and CCT.

There was no correlation between ACD and CCT (r = 0.039; p = 0.44) (Fig. 3).



**Fig. 3 –** Correlation between ACD and CCT.

**DISCUSSION**

In recent medical literature, changes in AL, ACD, and CCT are related to age and sex.(8,9,10,11,12) After age 40, the eye begins to degenerate and presents presbyopia. AL, ACD and CCT decrease with age, in people over 40 years. The direct relationship between these indices and age was proven by studies by *Lee*,(13) and *Wu*,(14) in addition, the AL, ACD and CCT are higher in people with greater height and weight.

In this study, all three biometric indices (AL, ACD, and CCT) decreased with age. The decrease in AL leads to imbalance and hyperopia. The results showed a negative correlation between age and AL; therefore, older people are at higher risk for hyperopia. ACD decreased with age, especially in those older than 50 years, who increase the risk of angle-closure glaucoma. *Praveen*(15) hypothesized that the main cause of the decrease in ACD was the thickening of the lens, due to degeneration because of age. The same results were reported by *Shufelt*,(4) *Hashemi*(8) (50 - 54 years: AL - 23.16 mm; ACD - 2.66 mm; 55 - 59 years: AL 23.07 mm, ACD - 2, 60 mm; 60 - 64 years: AL - 23.04 mm, ACD 2.52 mm), *Kadhim*(16) (age 40 - 49: CCT 538.67 µm; age 50-59: CCT - 537.39 µm; age> 60: CCT - 528.75 µm ). *Gudmundsdottir*(17) showed that AL decreases with age, in a 5-year cohort study, in 846 people over 50 years of age, in Iceland. This increase in age may be due to degeneration, which decreases ACD, *Praveen* reports.(15) *Hahn* et al(18) assume that decreased keratocytes, along with age, cause a decrease in CCT.

The AL, ACD, and CCT in this study were higher in men. Some authors hypothesized that the corneal curvature in men is greater than in women, leading to a greater distance from the central cornea to the posterior foramen.(3,4,10) Published studies also show higher levels of AL, ACD and CCT in men: *Warrier*(10) (male: AL - 23.12 mm, ACD - 2.86 mm; female: AL - 22.54 mm, ACD - 2.79 mm), *Shufelt*(4) (male: AL - 23.65mm, ACD - 3.48 mm; Female: AO - 23.18 mm, ACD -3.36 mm), *He*(3) (Male: AL - 23.38 mm, ACD - 3.15 mm; female: AL - 22.83 mm, ACD - 3.08 mm), *Hashemi*(8) (male: AL - 23.41 mm, ACD - 2.87 mm; female: AL - 22.95 mm, ACD - 2.77 mm), *Chen*(19) (male: CCT - 534.1 µm; female: 528.3 µm), *Kadhim*,(16) (male: CCT - 545.7 µm; female: 541.9 µm ). The AL, ACD and CCT, had a positive correlation with height and weight.(13,14) The height and mean weight of women are lower than that of men of the same age; that could be the reason for the difference between men and women. In this study, the anterior chamber in women was shallower compared to men, which may increase the risk of angle-closure glaucoma in women. The results were consistent with the research by *Do Thi Thai Ha*,(20) whose result showed that in Vietnam, the prevalence of glaucoma in women is higher than in men.

These results showed a positive relationship between AL and ACD (r = 0.411; p <0.001). Many studies have been done on this correlation. *Chen*(19) reported a positive correlation between AL and ACD (r = 0.651; p <0.001). It is recognized that ACD is higher with higher AL. *Aprioku*(21) noted that for every millimeter increase in AL, there was a 0.07mm rise in ACD (r = 0.253, p = 0.000) and the value are higher in males. *Sedaghat*(22) found that men have an average longer AL (23.7±2.4mm vs. 22.9±2.1mm; p<0.001) and deeper ACD compared to women (2.93±0.45mm vs. 2.82±0.42mm, p=0.002).

In this study, there was a weak positive correlation between AL and CCT (r = 0.141; p <0.005). *Hwang's*(23) study about Koreans over 40 years of age show the same results. However, studies by *Chen*(19) in Taiwanese people over 40 years of age, show no correlations. No correlation was found between ACD and CCT (p = 0.44; r = 0.039). *Chen*(19) shows the same result (p> 0.05).

The 3 ocular biometric indices studied decreased with age and were higher in men. The length of the ocular axis was related to the depth of the anterior chamber and the thickness of the central cornea.

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**Conflict of interest**

Los autores plantean que no tienen conflictos de interés

**Authorship contribution**

Conceptualization: *Hien Thi Thu Nguyen, Khoa Xuan Ngo, Luan Thanh Nguyen, Luong Van Hoang.*

Data curation: *Hien Thi Thu Nguyen, Khoa Xuan Ngo, Luan Thanh Nguyen, Luong Van Hoang.*

Formal analysis: *Hien Thi Thu Nguyen, Khoa Xuan Ngo, Luan Thanh Nguyen, Luong Van Hoang.*

Acquisition of funds: *Hien Thi Thu Nguyen, Khoa Xuan Ngo, Luan Thanh Nguyen, Luong Van Hoang.*

Research: *Hien Thi Thu Nguyen, Khoa Xuan Ngo, Luan Thanh Nguyen, Luong Van Hoang.*

Methodology: *Hien Thi Thu Nguyen, Khoa Xuan Ngo, Luan Thanh Nguyen, Luong Van Hoang.*

Project administration: *Hien Thi Thu Nguyen, Khoa Xuan Ngo, Luan Thanh Nguyen, Luong Van Hoang.*

Resources: *Hien Thi Thu Nguyen, Khoa Xuan Ngo, Luan Thanh Nguyen, Luong Van Hoang.*

Supervision: *Hien Thi Thu Nguyen, Khoa Xuan Ngo, Luan Thanh Nguyen, Luong Van Hoang.*

Validation: *Hien Thi Thu Nguyen, Khoa Xuan Ngo, Luan Thanh Nguyen, Luong Van Hoang.*

Display: *Hien Thi Thu Nguyen, Khoa Xuan Ngo, Luan Thanh Nguyen, Luong Van Hoang.*

Drafting - original draft: *Hien Thi Thu Nguyen, Khoa Xuan Ngo, Luan Thanh Nguyen, Luong Van Hoang.*

Drafting - revision and editing: *Hien Thi Thu Nguyen, Khoa Xuan Ngo, Luan Thanh Nguyen, Luong Van Hoang.*