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Ocular Axial Length and Corneal Curvature of Native Tibetan Adults in Lhasa

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Abstract

Background: Different racial groups may have different ocular biometric parameters, including axial length (AL) and corneal curvature (K). Till now, few studies have reported the such ocular parameters of native Tibetans. The aim of this study is to characterize the variations of the parameters in normal eyes of native Tibetans. and to compare the differences in these parameters with Han Chinese living in Lhasa.

Methods: The study included 53 Han Chinese who had lived in Lhasa for ≥ 6 months and 133 native Tibetan adults. The AL, anterior chamber depth (ACD), lens thickness (LT), vitreous chamber depth (VCD), and K of both groups were determined. The mean AL, ACD, LT, VCD, and K of the two groups, and two sex groups, were calculated and compared using Student's *t*-test.

Results: The mean AL of native Tibetans 23.02 ± 0.88 mm was significantly shorter than that of the Han Chinese ($t = -8.110$, $P < 0.01$). The mean values of the ACD, LT, and VCD of native Tibetans were all lower than those of the Han Chinese, but the two groups had the same K. However, native male Tibetans had a longer AL and ACD than native Tibetan females.

Conclusion: Native Tibetan adults had a shorter AL when compared with the Han Chinese in Lhasa, but had similar AL values as other south and west Asian inhabitants. However, the mean AL and ACD of native Tibetans differed between sexes.

Keywords: *Ocular axial length; corneal curvature; Tibetan*

Background

As the second most common cause of treatable blindness, uncorrected refractive error is prevalent throughout the world, but the associated morbidity differs by region. The etiology of refractive error is related to biometric parameters, such as axial length (AL), corneal refractive power, and lenticular power. In children and adults, the AL and corneal curvature (K) are responsible for most of the variations in refraction that have been reported to cause refractive changes [1].

Different racial groups may have different ocular biometric parameters, because these parameters can be affected by both environmental and genetic factors. However, few studies have reported the ocular parameters of native Tibetans, a racial group that inhabits West China. The aim of our study was therefore to obtain data on the AL and K of native Tibetans near Lhasa, and compare these parameters with those of Han Chinese who were living in the same area and had been examined at the same hospital.

Methods

This study was approved by the Medical Ethics Committee of the Tibet Autonomous Region People's Hospital. All participants granted informed written consent according to the tenets of the Declaration of Helsinki.

From March 2017 to July 2017, the ocular parameters of 133 Tibetan adults who lived near Lhasa were compared with those of 53 Han Chinese adults who lived in Lhasa for > 6 months. Eligible subjects were > 20 years of age, had a normal ophthalmic examination (including a best-corrected visual acuity of > 20/40), a normal slit lamp examination,

and an intraocular pressure < 21 mmHg. Subjects with a history of intraocular surgery and any ocular disease were excluded except for refractive errors and mild cataract. All the measures were carried out on right eyes. Biometric parameters, including the AL, anterior chamber depth (ACD), and lens thickness (LT) of the globe, were measured using an A-mode ultrasonic pachymeter (Compact Touch; Quantel Medical, Bozeman, MT, USA). The mean of at least 10 readings was used for each eye. The vitreous chamber depth (VCD) was calculated by subtracting the ACD and LT from the AL. The K was measured three times using an autorefractometer (Topcon, Tokyo, Japan). All examinations were repeated three times by the same physician, and the mean of the measurements was used as the ocular parameter.

SPSS for Windows statistical software (ver. 14.0; SPSS Inc., Chicago, IL, USA) was used for all statistical analyses. Data exhibiting a normal distribution are expressed as means ± standard deviation. Comparisons were performed between the two groups using the independent Student's t-test. A value of $P < 0.05$ was considered statistically significant.

Results

The mean age of the 133 native Tibetan participants (67 males and 66 females) was 50.78 ± 9.28 years (range: 22–65 years). The mean age of the Han Chinese participants (42 males and 11 females), was 45.80 ± 6.45 years (range: 30–59 years).

The mean AL of the native Tibetans was 23.02 ± 0.88 mm, which was significantly different to that of the Han Chinese (25.08 ± 1.76 mm; $P < 0.05$). The native Tibetans had a shorter ACD, TL, and VCD than the Han Chinese (Table 1). The mean K of the native Tibetans was 43.84 ± 1.75 diopters (D), which was similar to the mean K of the Han Chinese (43.82 ± 1.84 D). The variation in AL between the two groups is shown in Figure 1.

	AL(mm)	ACD(mm)	LT(mm)	VCD(mm)	K(D)
Tibetans(133)	23.02±0.88	3.06±0.46	3.59±0.89	16.36±1.22	43.84±1.75
Han Chinese(53)	25.08±1.76	3.45±0.37	4.01±0.46	17.62±1.69	43.82±1.84
T value	-8.110	-5.877	-4.147	-4.938	-0.211
P	0.000	0.000	0.004	0.000	0.833

Table 1: Ocular biometric parameters of native Tibetans and Han Chinese living in Lhasa

Native Tibetan males had a longer Al and ACD than native Tibetan females (Table 2)

	AL(mm)	ACD(mm)	LT(mm)	VCD(mm)	K(D)
Males (67)	23.18±0.95	3.18±0.46	3.79±0.95	16.21±1.30	43.67±1.54
Females (66)	22.86±0.79	2.95±0.43	3.39±0.79	16.52±1.12	44.02±1.93
T value	2.063	2.895	2.600	-1.457	-1.132
P	0.041	0.004	0.010	0.148	0.260

Table 2: Ocular biometric parameters of native Tibetan males and females

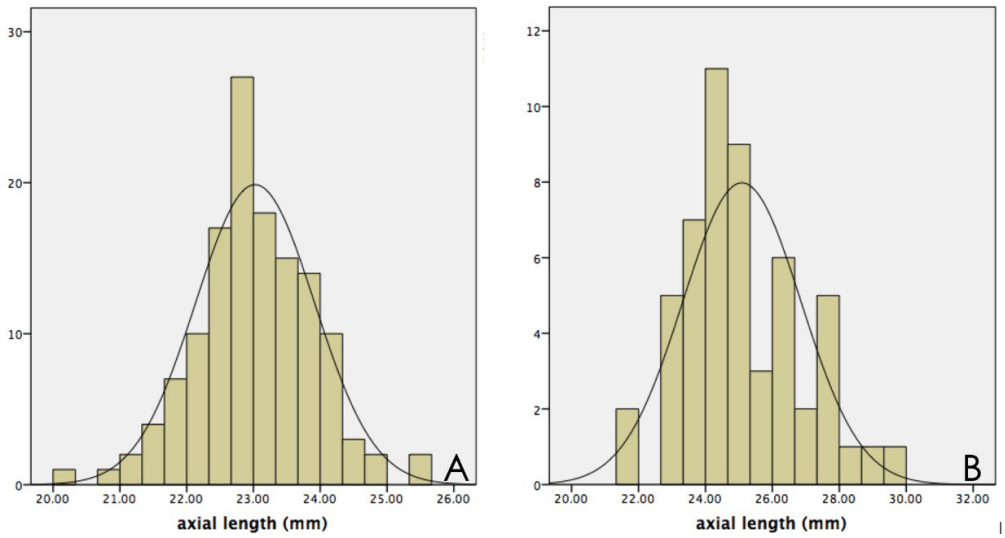

Figure 1: The variation in axial length of the two races lived in Lhasa (A: native Tibetans, B: Han Chinese)

Discussion

Four ocular structures, the cornea, aqueous humor, lens, and vitreous humor, contribute to the refractive status of a human eye and have been implicated in myopia and other refractive errors. The parameters of K, ACD, LT, and VCD are therefore very important in terms of the refractive status of the eye. Variation in these parameters has been implicated in ocular diseases, and shows an association with educational level and economic status. Different racial groups may show differences in their refractive status and AL. Thus, studies including subjects from different racial groups and countries may have different ocular biometric values. For example, the AL of subjects from West and South Asia is shorter than that of Europeans, Americans, and Australians (Table 3). Although there have been some reports on the AL of Han Chinese populations in East China, such as in Beijing [2] and Guangzhou,[3] no biometric parameters of subjects from Tibet have been reported.

Country or region	Supplemental information	Age distribution	sample	Mean AL value (mm)
Mongolia [5]	Central Indian	> 40	1313	23.1±1.1
India [6-7]	South Indian	49.4±13.4 50.0±10.0	4711 2850	22.6±0.91 22.8±0.8
Myanmar [8] Singapore [9]	Rural Amman and Irbid	52.6±11.5 40 to 79	2076 2000	22.66 23.2±1.2
Jordan [10]	North China	17 to 40	1093	23.13±1.0
Britain [11]	South China	48 to 88	2519	23.08±1.16
Australia [12] China [2-3]	Los Angeles Wisconsin	46.5±19.6 64.6±9.8	723 3468	25.53±1.50 23.25±1.14
USA [13-14]		64.4±9.6 54.2 58 to 100	1405 5588 1968	23.11 23.4±1.1 23.69±1.16

Table 3: Mean AL value in adult populations in different countries

Lhasa, located west of China, is > 3,500 km from east China, with a higher elevation (3,650 m) than Beijing. Native Tibetans have a different life style, diet, and genetic background than the Han Chinese, and may therefore also have different ocular biometric parameters.

We compared the ocular biometric parameters of native Tibetans with Han Chinese who lived in Lhasa, and found that the AL, ACD, TL, and VCD values of native Tibetans were lower than those of the Han Chinese participants. Han Chinese have a high incidence of myopia, which significantly increases in prevalence with increasing age [4]. Thus, the ocular AL of Han Chinese may be longer than that of the inhabitants of other countries [2]. The AL of Tibetans was shorter than that of the Han Chinese in this study, and closer to that of African-Caribbeans, Indians, and Mongolians, which may explain why the prevalence of myopia among adult native Tibetans was very low.

We also found that the AL of native Tibetan males was longer than that of native Tibetan females, which has also been shown in males and females of other racial groups. Males, on average, have larger eyeballs than females, which is consistent with sex differences in average body size. Further analyses showed that the major reason for this difference in sexes was the ACD. In our study, no difference in K was found between the two racial or sex groups. As previously reported, [5] the K was relatively stable between the different populations.

The AL is a morphological parameter of the eye that has been associated with the systemic parameters of age, body height, educational level, and urban region of habitation. It is also frequently affected by other ocular parameters, such as the central cornea thickness, K radius, pupil diameter, refractive error, ocular pressure, and best-corrected visual acuity. For these reasons, we studied subjects without any ocular disease (except for refractive error) and conducted this study under constant conditions; i.e., using the same physician, measuring instruments, and measurement locations. Although there have been many comparisons between the ALs of subjects from different regions of the world, these direct comparisons were not optimal, because the measurements may have been affected by both geographical factors and altitude.

The number of Han Chinese living in Lhasa is not particularly high, with most of them having migrated from East China many years ago. Thus, they might have been subjected to a more intensive education system than native Tibetans. All of the Han Chinese in this study were living in cities, but the native Tibetans were from rural and

urban areas of Lhasa. This difference may have played a role in the group difference in AL, and should be further investigated in future studies.

Conclusion

In conclusion, native Tibetans, who are genetically similar to other racial groups of West and South Asia, have a much shorter AL than do Han Chinese. The AL and K values may therefore help to explain the prevalence of refractive errors and other ocular diseases among people living in the Qinghai-Tibet Plateau of China.

Abbreviations
AL: axial length
K: corneal curvature
ACD: chamber depth,
LT: lens thickness
VCD: vitreous chamber depth

Declarations

1. Ethics approval and consent to participate: This study was approved by the Medical Ethics Committee of the Tibet Autonomous Region People's Hospital.

2. Consent to publish: We also confirmed that all the authors had seen the manuscript and agreed to publication on Eye and Vision.

3. Availability of data and materials: The data are available from the corresponding author on reasonable request.

4. Competing interests: All the authors declare that they have no completing interests.

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6. Author's Contributions: Yuan Wu and Ci Ren Qiong Da carried out the data collection, data analysis and grafting manuscript. Yongzhi Zhang and Jing Liu carried out the ocular parameters measurement. All the authors have read and approved the final version of this manuscript.

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