

Normal Exophthalmometric Values among adults in Central Northern Ethiopia.

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Abstract

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Background: The variation on normal exophthalmometric value due to different factors, makes determining it very crucial for diagnosis and management of different orbital disorders. The main aim of this study was to assess the normal exophthalmometric value (EV) among normal adult population of Debre Birhan town, Central Northern Ethiopia.

Methods: This is a community based cross sectional study conducted from February to April, 2019. The Hertel's exophthalmometer was used to measure EV. Multistage sampling technique was used to identify households which were included in the study. The collected data was entered, processed and analyzed by using SPSS version 20.

Results: A total of 1108 eyes of 554 healthy adults (with a response rate of 93.6%) aged between 18 and 95 years were included in this study. The EV ranged from 10 mm to 20 mm and the mean was 17.47 ± 1.94 mm and 17.47 ± 1.97 mm for the right and left eyes respectively with no difference between genders ($p=0.15$). The mean inter outer canthal distance (IOCD) for males was 96.56 ± 5.21 mm while that of females was 94.61 ± 5.26 mm with ($p=0.004$) mean difference of 1.95, $t=2.85$; 95% CI: (0.61, 3.29). The EV was not different between the sexes ($P=0.1$), but decline of EV measurement was found after fifth decade of life.

Conclusion and recommendation: This population based study identified the normal range of EV and IOCD in a predominantly homogenous Ethnic population in Central North Ethiopia for the first time. No significant difference in EV was observed between the two gender groups, while IOCD values are significantly higher in males than females. Other similar studies that involve various ethnic areas of the country are recommended.

Key words: Exophthalmometric, Ethiopia

Background

Protrusion of the globe is one of the common manifestations of orbital disorders. In order to identify the extent of abnormal protrusion of the globe, it is essential to have a baseline normative values that will help for comparison. Exophthalmometry determines the extent of protrusion of the globe quantitatively and the Hertel's exophthalmometer is the most commonly utilized instrument worldwide (1, 2). It allows this by measurement of the distance between the two lateral orbital rims and the vertical distance of corneal apex to the frontal plane. Traditionally the range of normal exophthalmometric value (EV) is taken to be between 10mm to 21mm, but this value can be affected by various factors including age, sex, and race (3,4). This entails that there should be specific normal EV determined based on race, age, and sex in a society for early diagnosis of orbital disorders. Acquiring such normative values will help to be used by local eye care professionals for identifying abnormality, for the diagnosis and also for follow-up of orbital disorders.

A significant difference in EV among racial groups have been reported previously with normal values ranging from 17.1 mm to 18.2mm in black Americans and 14.7mm to 16.0mm in whites ((3,5). Other studies done in West Africa found the mean EV value to range from 14.82mm to 15.31 mm (4, 6).

In Ethiopia, there have been only two similar published studies that were done in clinic settings, in Addis Ababa, and found EV range of 15.71mm to 15.88mm. This showed the findings among Ethiopian adults to be different from that of Caucasians and African Americans, which were used by practitioners as reference values for blacks. Moreover, these studies also showed EV to vary among different ethnic groups represented in the studies (7, 8). Ethiopia being a country of many ethnic groupings living in varied environs, more studies in community settings and in different parts of the country are needed to acquire adequate data of normative values. This study is the first community based study conducted with the major objective to determine normal EV for adults in central northern Ethiopia.

Methods and materials

Study design, setting and population

A community based cross-sectional study was conducted from

February to April, 2019 in Debre Birhan town, Northern Shewa Zone of the Amhara Region, 130 km north east of Addis Ababa, Ethiopia. The total population of the town is estimated to be 106,447, residing in 9 kebeles (smallest administrative unit in Ethiopia) with a total number of 24,754 households and 62,018 of the population are in the age range 18 years or older.

All Debre Birhan town individuals aged 18 years and older without known thyroid disorder, gross craniofacial abnormality, history of orbital trauma and high myopia were considered for the study.

Sample Size Determination and Sampling

The sample size for this study was determined using the confidence interval type and it was estimated to be 592. Multistage sampling technique was used as a sampling technique. Since the distribution of the population was similar in all the kebeles, 2 kebeles, which account for 20% of the total population, were selected with a lottery method. Then Systematic random sampling was used to identify households which were included in the study from the selected kebeles. When more than one adult 18 years of age or older who fulfill the inclusion criteria were found in a household, only one subject was selected by lottery methods.

Study Instruments and Data Collection

The data for this study was collected using a data record forms used to register participants' age, gender and EV measurements. The data was collected by trained optometrist and the Hertel's exophthalmometer was used for the measurement of EV. It measures the anterior displacement of the globe from the lateral orbital margin to the corneal apex. The EV measurement was done to the nearest 0.5 mm at primary gaze position after adjusting the face of the patient to the same level with that of the examiner. The site of the lateral orbital borders was first localized by palpation at its normal anatomic position, and then the instrument was held horizontally to put its footplate at the lateral orbital margins, with the medial end of the footplates resting at the lateral canthal angles. The distance between the lateral orbital margins at the lateral canthal angles was read off from the exophthalmometer base ruler, to the nearest 0.5mm, and was recorded as inter outer canthal distance (IOCD). The right eye of the patient was examined with the left

eye of the examiner and vice versa. Three measurements were taken and the mean of this is used as a final result. The measured values for right and left eye were documented separately.

Data Analysis

The collected data was entered and analyzed by using SPSS version 20. Mean, standard deviation and graph were used to summarize the findings.

Ethical Considerations

Ethical clearance was obtained from the institutional review board of St. Paul's Hospital Millennium Medical College (SPHMMC). Oral Informed consent was obtained from the participants during the time of investigation. The information collected from each subject was kept confidential. Information was stored in a file, without the name of subjects, only code numbers were used. The study subjects had full right to refuse from participating in this research, to withdraw at any time of the study process and jump any questions. Participants were informed that participation was on voluntary basis..

Results

Socio-demographic characteristics of participants

A total of 1108 eyes of 554 healthy adult subjects were enrolled in this study, with a response rate of 93.6%. The mean age of the participants was 35.9±14.57 years, with a range of 18 to 95 years. The majority of the participants were in the age group 18 to 40 years (See Figure 1). Females accounted for 277 (50%) of the total 554 subjects.

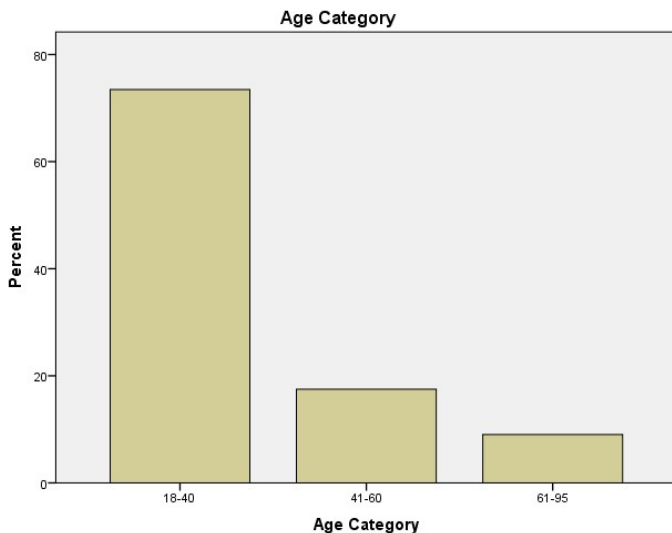


Figure 1: Age distribution of participants, Debre Birhan town, February to April, 2019

Exophthalmometric Values

The Hertel exophthalmometric value (EV) for the whole population ranged from 10 mm to 20 mm and the mean was 17.47 ± 1.94mm and 17.47 ± 1.97 mm for the right and left eyes respectively. For male participants, the mean EV was 17.52±1.94 mm for the right eye and 17.55±1.91mm for the left eye, while for females the value was 17.43±1.93 mm and 17.38±2.0 mm for the right and left eyes respectively (Table 1). There is no significant difference in EV values between males and females for both eyes (Right eye p=0.439, t=0.774 (95% CI:-0.14, 0.32); Left eye p=0.15, t=1.5 (95% C.I:-0.06, 0.40) (data not shown)

Table 1: Mean ± Standard deviation of EV for the right and left eyes by age and sex, Debre Birhan town, February to April, 2019

variable	category	EV of Right Eye(mm)	EV of Left eye (mm)
General population		17.47± 1.94	17.47 ± 1.97
Sex	Male	17.52±1.94	17.55±1.91
	Female	17.43±1.93	17.38±2.0
Age	18-40	17.81±1.67	17.82±1.73
	41-60	16.73±1.67	16.7±2.2
	61-95	16.15±2.27	16.14±2.25

EV; exophthalmometric value

The mean Inter Outer Canthal Distance (IOCD) value for males was 96.56±5.21mm which was found to be slightly lower in females, at 94.61±5.26 mm, (Table 2).

This difference is statistically significant with p=0.004, t=2.85 (95% C.I:0.61,3.29)

Table 2: Mean ± Standard deviation Inter Outer Canthal Distance by age and sex, Debre Birhan town, February to April, 2019

variable	category	IOCD (mm)
age	18-40	96.38±5.13
	41-60	94.25±5.26
	61-95	91.72±4.81
Sex	Male	96.56±5.21
	Female	94.61±5.26

Discussion

Identification of normative values of periocular anthropometric measurements is important for recognition of abnormalities in orbital and eyelid disorders. This study tried to identify the normative values of exophthalmometry using the Hertel's exophthalmometer in a town in Ethiopia and it is the first population based study on the subject from the country.

In this study, the mean EV for the right and left eyes were found to be 17.47 ± 1.94 mm and 17.47 ± 1.97 mm respectively. These are slightly higher than two hospital based studies in Ethiopia that found mean values of 15.77 mm and 15.71 mm respectively in Minelik II Hospital (7) and average of 15.88 ± 2.49 mm in St. Paul's Hospital (8). However, both of the above studies have shown variations of EV among Ethiopians based on Ethnic group, and our finding among participants of homogeneously Amhara Ethnic group is similar to the findings among same Ethnic groups in the latter study (16.12 ± 2.67) (8). The findings are also higher than those reports from Nigeria (4) and Cameroon (6) but similar to those from African Americans (4-6, 9-10).

The mean EV among men was 17.52 ± 1.94 mm in the right eye and 17.55 ± 1.91 mm in the left eye while it was 17.43 ± 1.93 mm and 17.38 ± 2.0 mm in the right and left eyes for females respectively. The measurements are approximately equal in the two gender groups. The finding is supported by a study conducted at St. Paul's hospital, Ethiopia (8), Cameroon (6), Turkey and China (11, 12). However, the other studies conducted in Ethiopia (7), and Sri Lanka (13) showed significant difference of EV between men and women. Normal EV in our study showed a decline pattern of measurement after the fifth decade of life. A similar trend of decreasing IOCD and EV from the sixth decade onwards was reported from other studies (7, 13-15). The range of normal Hertel's exophthalmometry value in our study, 10 mm to 20mm, was similar with other studies (4, 12).

The observed EV was similar to those reported for African Americans. Knowledge of these normal parameters is valuable in the management of eyelids and orbital diseases, as well as in manufacturing spectacles.

There is a significant difference in IOCD measurement between male and female participants. Such difference in IOCD measurement values was reported in multiple publications including those done in Ethiopia (7, 8)

This population based study identified the normal ranges of EV and IOCD in predominantly homogenous Ethnic population in Central North Ethiopia for the first time; this can be considered as strength, while there are limitations; the study findings cannot be generalized for the Ethiopian population since there is lack of ethnic variation in the study area.

Since there are a variety of ethnic groups in Ethiopia, in the future a study with a larger sample size and multisite studies with different ethnic groups can provide much more valuable data about exophthalmometric values that will help determine the normative data of absolute and relative measurements in our setting.

Conclusion

Abbreviations

EV: Exophthalmometry; IOCD: Inter Outer Canthal Distance; SPHMMC: Saint Paul's Hospital Millennium Medical College; SPSS: Statistical Package for the Social Sciences.

Declarations

Acknowledgment

We extend our gratitude to St. Paul's Hospital Millennium Medical College for financial support to conduct the current study and giving ethical clearance.

Availability of data and materials

All information related this study is included in the manuscript and the main data is available and can be accessed up on request.

Competing interest

The authors have declared that they have no competing interests.

Funding

This study was funded by SPHMMC, Ethiopia. The funder has no role in designing the study, data collection, analysis, interpretation and writing the manuscript.

Ethics, Approval and Consent to participate

Ethical clearance was obtained from the institutional review board of SPHMMC. Oral Informed consent was obtained from the participants during the time of investigation. The information collected from each

subject was kept confidential. Information was stored in a file, without the name of subjects, only code numbers were used. The study subjects had full right to refuse from participating in this research, to withdraw at any time of the study process and jump any questions. Participants were informed that participation is in voluntary basis.

Consent for publication

Not applicable.

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