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A STUDY OF BASELINE EXOPHTHALMOMETRY IN THE NORMAL INDIAN POPULATION AND ITS RELATIONSHIP TO AGE, GENDER AND HEIGHT

Ophthalmology

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ABSTRACT

Purpose: To study the relationship between exophthalmometric values with age, gender and height of the normal Indian population.
Methods: Cross-sectional, observational study of 2000 eyes of 1000 subjects aged 5 years to 90 years, from January 2016 to December 2016 (12 months),at Tertiary Care Hospital.
Subjects who already had undergone routine ophthalmic examination and no abnormality was detected during the examination were included.
The data about age, gender and height was noted. Exophthalmometry was performed using the same Hertel exophthalmometer by the same researcher.
Results: The baseline exophthalmometric values in the normal Indian study subjects were in the range of 8-21 mm.
Conclusions: Age and gender may have influence on exophthalmometric values; however, height does not have any significance .

KEYWORDS

Exophthalmometry, age, gender, height

INTRODUCTION

The present research is an attempt to measure the exophthalmometric values in the normal Indian population and to examine whether variations in factors such as age, gender, and height have relationship with the variations in the exophthalmometric values.

Exophthalmometer can be used to measure the displacement of a person's eyeball anteriorly or posteriorly which are termed as 'exophthalmos' and 'enophthalmos' respectively.

Exophthalmos could be caused by an increase in the amount of tissue behind the eyes of a person , most commonly due to thyroid disease, (Graves' disease), which is an autoimmune condition (1) . Other causes can be inflammation, cysts, infections, vascular, neoplastic (malignant and benign) and traumatic factors (2).

Enophthalmos is mostly unilateral (3). It is usually outcome of orbital trauma.

Exophthalmometric values obtained can serve to monitor the progress of an orbital condition by routine serial measurements (4).

Hertel exophthalmometer can be used to measure the distance between the two lateral orbital rims i.e. the distance between the orbitals (Inter-Orbital Distance) and the distance of the corneal apex to the frontal plane vertically. Hertel exophthalmometer can be used to measure the distance of protrusion in both eyes simultaneously. The scale uses a superimposed millimetre scale and a mirror system (5,6).

AIMS AND OBJECTIVES

Aim: To examine the relationship between exophthalmometric values with age, gender and height of the normal Indian population.

Objectives :

1. To study the baseline exophthalmometric measurements in the normal Indian population.
2. To study the relationship of exophthalmometric readings to age, gender and height.

MATERIAL AND METHODS

1) Study Design

Type of study:
A cross-sectional, observational study

Study Sample:
Subjects aged 5 years to 90 years.

Sample size:
2000 eyes of 1000 Indian patients .

Duration of study:
From January 2016 to December 2016 (12 months)

Place of study:
Tertiary Care Hospital

Inclusion criteria

- Subjects aged 5 years to 90 years presenting to the out-patient services of the Ophthalmology Department.
- Subjects who already had undergone routine ophthalmic examination and no abnormality was detected . The examination included visual acuity by Snellen's chart, intraocular pressure measurement by non-contact tonometer, lacrimal sac-syringing , retinoscopy for refractive errors, slit-lamp examination for anterior segment evaluation and indirect ophthalmoscopy for fundus examination.

Exclusion criteria

- History of ocular tumours, trauma or surgery , thyroid eye disease
- Myopia more than -3.00 dioptres
- Proptosis due to any pathology or disease

2) Ethical Considerations
Institutional ethics committee approval was taken. Each participant was given a patient information sheet and a written informed consent was taken. The study was done as per the guidelines suggested by Helsinki's declarations on human research.

3) Data Collection
A detailed history was taken, including ocular tumors, trauma and surgery, thyroid disease, myopia more than -3.0 Diopters and other systemic or local illness which may be associated with proptosis.

Ophthalmic and systemic examination was done.

The data about age, gender and height was noted. Exophthalmometry was performed using the same Hertel exophthalmometer by the same researcher. Patient was made to sit comfortably on a chair with same head height as that of examiner. Patient was made to keep his eyes in primary gaze. The Hertel exophthalmometer was placed over the lateral orbital rims of the patient with the supports provided in the instrument. The closest millimeter reading of the exophthalmometry was taken for both eyes.

For recording the height, patients were made to stand barefoot against a height meter looking straight in primary gaze.

4) Statistical Methods
The collected data was analysed using the Statistical Package for

Social Studies (SPSS) version 20.0 software. The data was analysed with the statistical methods of correlation and regression. The basic analysis of descriptive statistics and percentage analysis was also applied.

OBSERVATIONS AND RESULTS

The results were presented in mean ±2SD and percentages.

Correlation analysis was used to find the relationship between two or more variables. Regression analysis was used to find out the association between independent variables and dependent variables. The p-value <0.05 was considered as significant.

Figure 1: Bar chart for males and females in each age group

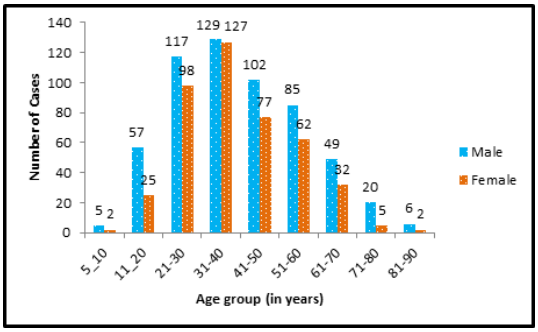

Table 1: Descriptive statistics for right and left eye exophthalm metric values for males and females

Exophthalmometric Values	GENDER					
	Male (n=570)			Female (n=430)		
	Mean±2SD	Max	Min	Mean±2SD	Max	Min
Right eye (mm)	15.00±6.00	21	8	16.00±6.00	21	8
Left eye (mm)	15.00±6.00	21	8	16.00±6.00	21	8

Max- Maximum, Min-Minimum

Table 2: Mean exophthalmometric values for the right and left eye in both males and females for each age group

Age group (years)	Gender			
	Males (n=570)		Females (n=430)	
	Right eye (mm)	Left eye (mm)	Right eye (mm)	Left eye (mm)
	Mean±2SD			
5-10	13±4	13±4	14±2	14±0
11-20	16±6	16±6	15±6	15±6
21-30	16±6	15±6	16±6	16±6
31-40	16±6	15±6	16±6	15±6
41-50	16±6	16±6	16±6	16±6
51-60	15±6	15±6	16±6	15±6
61-70	15±6	15±6	16±4	16±6
71-80	15±6	15±8	14±8	14±8
81-90	13±10	13±10	15±8	15±8

DISCUSSION

Errors in exophthalmometry can result from changing the position of the patient's head (7,8), the position of gaze, from pressing more or less against the orbital rim, or from the presence of swelling at the lateral canthus.

Previous studies:

a) Normal values with consideration to Race

It has been stated that exophthalmos is considered to be so if the protrusion exceeds 18 mm with the upper limit of normal at 21 mm (9).

In adult white males with an upper limit of 21.7 mm, the average distance of globe protrusion was seen at 16.5 mm (10).

The same for adult African-American males was reported with a normal upper limit of 24.7 mm (11,12).

In Iran, for an average age group of 20-70 years, the average ocular protrusion was 14.7 mm (13).

Taiwanese adults showed a normal range of 13.91 mm (14).

In a Turkish study the average was 13 mm with an upper limit of 17 mm (15).

A Dutch study, showed the upper limit to be 20 mm in males and 16 mm in females (16).

b) Normal values with consideration to Gender

Females also showed a racial variation, with the average for African-American women was at 17.8 mm, while for white women it was lesser at 15.4 mm. More generally, the readings for a female have been reported to be lesser than that of the male. (17,18,19).

c) Normal values with consideration to Age

In the paediatric population in the US, it was seen that the exophthalmometric values increased with the increase in age. (20).

For the same population (paediatric) in Iran between the age groups of 6 and 12 years, the average was seen to be 14.2 mm and that for 13-19 years at 15.2 mm (13).

In the Chinese population, for the age of 5-17 years, it was found that the average exophthalmometric reading was 14.48 mm (21).

Through numerous continents, the standard upper limit of exophthalmometric values had been recognised to be 21 mm (10,22,23).

1) **Examining the demographic variables** 570 male patients and 430 female patients were examined during the research (Table 1).
2) **Examination of baseline exophthalmometric measurements in the normal population**

The range of exophthalmometric values for Indian male and female population was 8-21 mm for the right eye and 8-21 mm for the left eye. These readings could benchmark for the overall age range of the selected population wherein the age range is 5- 90 years. A study by Sodhi et al. (24) revealed a different benchmark of baseline exophthalmometric values for normal Indian population wherein patients were selected at the outpatient department of Ophthalmology, University College of Medical Sciences and Guru Tegh Bahadur Hospital, Shahdara, Delhi. The study discerned the fact that among the 3- 80 years' age group with 2500 normal Indians falling under the age group, exophthalmometric values were around 7–19 mm for males and 7–21 mm for females. Chan et al. (25) examined the exophthalm ometric values and the biometric correlates in Kandy, Sri Lanka wherein the study claimed that the range of exophthalmometric values lied within 9.5- 23.5 mm.

The present study revealed exophthalmometric values for the right eye of Indian men to be around 15.00±6.00 mm wherein for the left eye, it was around 15.00±6.00 mm. Similarly, for the selected Indian female population, the exophthalmometric values for the right eye was found to be around 16.00±6.00 mm wherein for the left eye, it was around 16.00±6.00 mm. For both right and left eye, the mean exophthalmometric value was greater in female population than male population.

3) To study the relationship of exophthalmometric readings to age, gender and height of the selected population

Correlational analysis was performed for both left and right eye. For the left eye, age was found to possess negative significance which reveals that with increase in age, exophthalmometric values decrease and vice-versa. Similarly, for the right eye, the negative correlation is the same for age in the male population for both the eyes, the correlation coefficients are negative for age.

In females, there was no relationship between left eye exophthalm ometric value and age, height.

SUMMARY

The exophthalmometric values in both Indian male and female selected population were in the range of 8-21 mm for males and 8-21 mm for females. Further investigations are suggested if the exophthalmometric values lie below 8 mm or above 21 mm. The causes for enophthalmos, e.g. orbital trauma, and for exophthalmos, e.g. Thyroid disease, ocular tumours or any other pathology should be

considered, respectively.

Study conducted by Nath et al. (26) revealed that an average value for exophthalmometric value in normal Indian population was within the range 11.0 to 18.0 mm. Similar study by Sodhi et al. (24) revealed the values to be lying around 7–19 mm for men and 7–21 mm for women population of India. The present research shares almost similar values suggested by previous researches.

It is discerned that in the overall population, age showed negative correlation which tends to state that with increase in the values of this variable, exophthalmometric values decrease and vice versa. Previous researches (13,26,27) state that the values of ocular protrusion decrease with increase in the age. However, researches by Kashkouli et al. (13) and Nath et al. state that with aging in children, the protrusion of eyeball increases. Furthermore, adult protrusion was evident in the later ages of teenage as said by Fledelius and Stubgaard and they stated that it will remain stable in the forthcoming years (28).

It is deemed that the mean exophthalmometric values are high in female population than male population for both eyes in the present research (Table 2). However, Chan et al. (25) state no such differences with respect to gender. In terms of height, it is generally perceived that with increase in body dimensions such as height and weight, protrusion may occur (29). On the whole, the present research identified that age and gender may have influence on exophthalmometric values; however, height does not share any significance either positive or negative.

CONCLUSION

The exophthalmometric values in both Indian males and females were in the range of 8-21 mm .

The exophthalmometric values were higher for right eye in females than males. In the right and left eye of males, the exophthalmometric values were observed to decrease with increase in age. Height does not share any significance.

This study could possibly support researchers conducting researches in India and in neighbouring countries, such as Pakistan, Sri Lanka and Nepal, which share more or less the same environmental factors as that of India. This study will aid with future studies in similar areas of researches to help the researchers to arrive at a standard benchmark exophthalmometric value.

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