

# Periocular anthropometric measurements analysis in ethnic adults of Vindhya region

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## ABSTRACT


**Background:** Periocular measurements are of importance in ophthalmology, optometry, and oculoplastic surgery. The bilateral orbital region is a key determinant in facial characteristics of a person. Normal values which are specific for patient's age, sex, and ethnicity are important to quantify the deformity by comparison. Knowledge of the variations in the morphological and anatomical relationship of periorbital structures among different ethnic groups is important for surgeon's efforts to retain the ethnical features. **Objectives:** The objectives of the study were to study the periocular anthropometric measurements in subjects of Vindhya region. **Materials and Methods:** The normal values of palpebral dimensions are age, gender, and race dependent. A prospective, non-randomized, observational study was done from February to July 2017 on 200 patients of 20–50 years of age attending outpatient department in the department of ophthalmology at tertiary center of Central India. Bilateral direct manual measurements of horizontal palpebral fissure (HPF), vertical palpebral fissure (VPF), and upper eyelid crease (ULC), and margin reflex distance (MRD) were recorded. Patients with conditions likely to affect the values of anthropometric parameters were excluded from the study. **Results:** The mean value in the right eye: HPF  $29.4 \pm 2.06$  mm, VPF  $10.3 \pm 1.55$ , ULC  $5.4 \pm 1.67$ , BH  $9.45 \pm 1.86$ , and MRD  $3.5 \pm 1.04$ . On comparing the mean values of the various measurements in both eyes with age, only MRD was found to be significantly higher when compared between the age groups 20–30 years and 31–40 years (RE –  $P = 0.012$ ; LE –  $P = 0.05$ ) and between 20–30 years and 41–50 years (RE –  $P = 0.020$ ; LE –  $P = 0.001$ ). Mean value did not differ significantly in both the sexes. **Conclusion:** The results of the present study can be useful for anatomists, ophthalmologist, and anthropologists to serve as a basic framework for estimating the standard of periocular dimensions of this population that would help in obtaining satisfactory results in advanced and corrective surgeries.

**KEY WORDS:** Horizontal Palpebral Fissure; Vertical Palpebral Fissure; Upper Lid Crease; Marginal Reflex Distance; Brow Height

## INTRODUCTION

The orbital region of the face is a key determinant for the perception of facial dimensions. The fundamental

topographic anatomical parameters of normal periocular anthropometric measurements are of great use not only in clinical ophthalmology but also in the ophthalmic and optometry industry.<sup>[1,2]</sup> Besides this, studies on measurements of orbital anthropometric parameters also form a reference database to study craniofacial dysmorphology as well as comparative anthropology.<sup>[3]</sup> This standard database would also be helpful in the customized designing of optical products such as spectacle frames, lenses, and ocular prosthetics which could fit most people.<sup>[4]</sup> Normative data on craniofacial anthropometric measurements provide an

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important tool not only for diagnosing lid diseases but also serving as a reference point during various reconstructive and cosmetic lid surgeries like blepharoplasty.<sup>[5]</sup>

To quantify the variations in palpebral fissure dimensions, these measurements need to be compared and contrasted with values that have been specified as normal for a person's age, gender, and race. Some studies in literature have indicated that the anatomical and morphological features of the palpable fissure vary according to age, gender, and ethnicity.<sup>[4,6,7]</sup>

Since no anthropometric reference data were available specifically for Vindhya region in literature, this study was undertaken to compile and establish the baseline periocular anthropometric measurements for this region. The results obtained from this study will provide a normative database of dimensions of this population and thus prove useful for anatomists and anthropologists. Besides this, these will also help ophthalmologists in clinical interpretation of periocular diseases as well as provide reference values during esthetic and surgical lid interventions.

## MATERIALS AND METHODS

This was a hospital-based cross-sectional, observational study conducted between March 2017 and June 2018 in the Departments of Anatomy and Ophthalmology, S. S. Medical College, and associated G.M. Hospital, Rewa, Madhya Pradesh.

### Inclusion Criteria

Age between 20 and 50 years and those willing to give their consent for the study were included in the study.

### Exclusion Criteria

Patients with a history of ocular or periocular surgery/trauma and those with any congenital/acquired ocular or periocular craniofacial anomaly likely to affect the values of any of the measurements were excluded from the study.

A total of 200 patients (400 eyes) were enrolled, informed consent was taken and the purpose of study explained to them. At the time of registration of the patients, a detailed case record was prepared to document the name, age, gender, outpatient department number, and residential address. The periocular anthropometric parameters assessed in the present study included horizontal and vertical palpebral fissure (VPF) measurements, upper lid crease (ULC), brow height (BH), and margin reflex distance (MRD).

### Operational Definitions

#### *Horizontal palpebral fissure (HPF)*

Distance between the medial and lateral canthus.

#### *VPF*

Distance between the upper and lower lid margin measured at the pupillary midline.

#### *ULC*

Distance between the upper eyelid lash line and the lid crease in down gaze.

#### *BH*

Distance from the upper eyelid lash line to the inferior border of the eyebrow at its highest point.

#### *MRD*

Distance between the upper eyelid margin and the corneal light reflex at the center of the pupil.

### *Measurement technique*

All periocular measurements were taken with a transparent plastic millimeter rule, in a well-illuminated room, with the eyes of the subject and the observer at the same horizontal level. All measurements were taken in the primary position of gaze except ULC which was measured in down gaze. MRD measurement was taken after illuminating the subject's pupil with a bright pen torch held in the one hand and measurement taken with the other hand.

All the measurements for both eyes were taken 3 times and the mean value of the three measurements was taken for analysis. Independent *t*-test was used for statistical analysis and  $P < 0.05$  was considered to be statistically significant.

## RESULTS

In this prospective, non-randomized, cross-sectional observational study, a total of 400 eyes of 200 patients were included, and after collecting the data, following observations were made.

The age of the study subjects ranged between 20 and 50 years with the mean age of 32.69 years. The maximum number ( $n = 98$ ; 49%) of patients were in the age group of 20–30 years and the minimum ( $n = 44$ ; 22%) in the age group of 41–50 years. Gender wise, there were 123 females compared to 77 males with a male: female ratio of 1:1.6 [Table 1].

Measuring the various periocular parameters in all the study participants, the HPF values ranged from a minimum of 25 mm to a maximum of 35 mm with the mean of  $29.4 \pm 2.06$  mm for RE and from a minimum of 25 mm to a maximum of 34 mm with the mean of  $29.3 \pm 2.03$  mm for LE. For VPF, the values ranged from a minimum of 6 mm to a maximum of 18 mm with the mean value of  $10.3 \pm 1.55$  mm for RE and for LE, the values ranged from 6 mm to 17 mm with the mean of  $10.4 \pm 1.57$  mm. The ULC measurements range from 2 mm

to 11 mm for both eyes with a mean value of  $5.4 \pm 1.67$  mm for RE and  $5.3 \pm 1.64$  mm for LE.

The BH varied between 4 mm and 15 mm with the mean of  $9.45 \pm 1.86$  mm for RE and 5 mm–17 mm with the mean of  $9.55 \pm 1.95$  mm for LE. The MRD measurements ranged from 1 mm to 7 mm with a mean value of  $3.5 \pm 1.04$  mm for RE and from 1 mm to 7 mm with a mean of  $3.4 \pm 0.99$  mm for LE. None of the measurements showed a statistically significant difference between the two eyes [Table 2].

Analyzing the association of age with the periocular measurement of RE in all the 200 subjects, we found that mean MRD was significantly higher or ( $P = 0.012$ ) in subjects of 31–40 years age group as compared to 20–30 years age group [Table 3]. However, when the MRD was compared between subjects of 31–40 years and those of 41–50 years, the difference in measurement was statistically insignificant ( $P = 0.999$ ) [Table 3], but when the MRD values were compared between the age groups of 20–30 years and 41–50 years, a statistically significant difference ( $P = 0.020$ ) was seen [Table 3].

Comparing the RE parameters in males and females, mean HPF value was significantly ( $P \leq 0.0001$ ) higher in males than females. Conversely, the mean ULC ( $P = 0.0009$ ) and MRD ( $P \leq 0.0001$ ) values were significantly greater in females as compared to males. However, the mean VPF value though higher in females was not statistically significant ( $P = 0.375$ ) while the mean BH measurements were almost similar in both males and females [Table 4].

**DISCUSSION**

The age range of study subjects was from 20 to 50 years and the mean age was 32.69 years. The maximum number

**Table 1:** Demographic characteristics of the study population

Age (in years)	Gender		Total (%)
	Males	Females	
20–30 years	36	62	98 (49)
31–40 years	25	33	58 (29)
41–50 years	16	28	44 (22)
Total	77	123	200 (100)

**Table 2:** Both eyes periocular measurements in all subjects

Parameters	Right eye (Mean±SD mm)	Left eye (Mean±SD mm)	P-value
HPF	29.4±2.06	29.3±2.03	0.625
VPF	10.3±1.55	10.4±1.57	0.521
ULC	5.4±1.67	5.3±1.64	0.546
BH	9.45±1.86	9.55±1.95	0.600
MRD	3.5±1.04	3.4±0.99	0.353

HPF: Horizontal palpebral fissure, VPF: Vertical palpebral fissure, ULC: Upper eyelid crease, MRD: Margin reflex distance

( $n = 98$ ; 49%) of patients belonged to the age group of 20–30 years.

Studies done on Indian population by Patil *et al.*<sup>[8]</sup> (16–60 years), ethnic groups of Thailand by Preechawai<sup>[9]</sup> (20–40 years), and another on Chinese adults in Hongkong by Jayaratne *et al.*<sup>[10]</sup> (18–35 years) had patients belonging in age range similar to our study. However, Erbagci *et al.*<sup>[11]</sup> (3–80 years), Eze *et al.*<sup>[12]</sup> (18–76 years), and Ibraheem *et al.*<sup>[13]</sup> (16–85 years) reported a wider age range of patients in their studies.

The gender distribution showed female preponderance with 123 females and 77 males and a male: female ratio of 1:1.6.

A female dominance was also documented in the study of Bukhari.<sup>[14]</sup> (58.7% females and 41.3% males) and Ibraheem *et al.*<sup>[13]</sup> (515 females and 505 males). In contrast, a male dominance was noted by Erbagci *et al.*<sup>[11]</sup> (55 males and

**Table 3:** Association of age with periocular measurements in all patients (right eye)

Parameters	20–30 years	31–40 years	P-value
HPF	29.5±2.23	29.1±1.93	0.257
VPF	10.4±1.55	10.3±1.66	0.709
ULC	5.2±1.57	5.2±1.50	0.999
BH	9.28±1.83	9.68±1.73	0.182
MRD	3.3±0.8	3.7±1.17	0.012
Parameters	31–40 years	41–50 years	P-value
HPF	29.1±1.93	29.4±1.83	0.428
VPF	10.3±1.66	10.2±2.01	0.783
ULC	5.2±1.50	5.8±2.01	0.087
BH	9.68±1.73	9.57±2.05	0.643
MRD	3.7±1.17	3.7±1.19	0.999
Parameters	20–30 years	41–50 years	P-value
HPF	29.5±2.23	29.4±1.83	0.794
VPF	10.4±1.55	10.2±2.01	0.503
ULC	5.2±1.57	5.8±2.01	0.056
BH	9.28±1.83	9.57±2.05	0.522
MRD	3.3±0.8	3.7±1.19	0.020

HPF: Horizontal palpebral fissure, VPF: Vertical palpebral fissure, ULC: Upper eyelid crease, MRD: Margin reflex distance

**Table 4:** Association of gender with periocular measurements in all patients (right eye)

Parameters	Males	Females	P-value
HPF	30.1±1.98	28.9±1.99	$\leq 0.0001$
VPF	10.2±1.43	10.4±1.62	0.375
ULC	4.9±1.87	5.7±1.47	0.0009
BH	9.48±1.97	9.43±1.8	0.854
MRD	3.1±1.02	3.7±1.01	$\leq 0.0001$

HPF: Horizontal palpebral fissure, VPF: Vertical palpebral fissure, ULC: Upper eyelid crease, MRD: Margin reflex distance

45 females) while studies by Patil *et al.*<sup>[8]</sup> (110 males and 106 females) and Jayaratne *et al.*<sup>[10]</sup> (51 males and 52 females) had an almost equal distribution of male and female patients in their studies.

### HPF

The mean HPF of RE and LE in our study was  $29.4 \pm 2.06$  mm and  $29.3 \pm 2.03$  mm, respectively, and the difference between both was statistically insignificant ( $P = 0.625$ ). Bukhari<sup>[14]</sup> in his study on 668 subjects found the mean value of HPF to be  $30.1 \pm 2.9$  mm, which was similar to our observation. In contrast, Viveiros *et al.*<sup>[15]</sup> in their comparative study on Japanese and Brazilians of European descent found that the mean values of HPF were  $23.2 \pm 2.0$  mm for RE and  $22.9 \pm 2.4$  mm for LE in Japanese subjects and  $21.4 \pm 1.5$  mm for RE and  $21.6 \pm 1.4$  mm for LE in Brazilian subjects. Another study by Mostafa *et al.*<sup>[16]</sup> also documented a lower mean HPF value in their study on Buddhist Chakma females at  $23.4 \pm 0.17$  mm in RE and  $24.1 \pm 0.17$  mm in LE. These values were much lower as compared to those found in our study.

### VPF

In our study, the mean VPF values for RE were  $10.3 \pm 1.57$  mm and for LE were  $10.4 \pm 1.57$  mm and the difference between both these measurements was not significant ( $P = 0.521$ ) statistically. These findings are similar to Bukhari<sup>[14]</sup> who reported a mean VPF of  $10.1 \pm 0.85$  mm in their study on Saudi individuals. However, a study by Viveiros *et al.*<sup>[15]</sup> (Japanese subjects – RE =  $7.6 \pm 1.2$  mm and LE =  $7.5 \pm 1.4$  mm; Brazilian subjects – RE =  $8.6 \pm 1.5$  mm and LE =  $8.6 \pm 1.7$  mm) reported much lower mean VPF values.

### ULC

The mean values of ULC for RE and LE in our study were  $5.4 \pm 1.67$  mm and  $5.3 \pm 1.64$  mm, respectively, and the difference between both was not significant ( $P = 0.546$ ). A study by Bukhari<sup>[14]</sup> (mean ULC =  $9.6 \pm 0.8$  mm) reported higher values of ULC as compared to those measured in our study.

### BH

In our study, the mean values of BH measured  $9.45 \pm 1.86$  mm in RE and  $9.55 \pm 1.95$  mm in LE and these values were almost similar to that documented in the study by Bukhari<sup>[14]</sup> (mean BH =  $10.2 \pm 2.7$  mm).

### MRD

The mean value of MRD measured in our study was  $3.5 \pm 1.04$  mm in RE and  $3.4 \pm 0.9$  mm in the LE. Ibraheem *et al.*<sup>[13]</sup> reported a slightly lower mean value of MRD at  $3.2 \pm 1.0$  mm and  $3.2 \pm 0.9$  mm in the right and left eyes, respectively, in their study on Nigerian subjects.

The difference in the mean values of this study and those obtained by others though not very different can be attributed to the various study groups who differed by age, race, as well as geographical location. The presence of an epicanthal fold and absence of lid crease in oriental could explain the smaller values of HPF and VPF in that group of population.

### Relationship between Age and Periocular Parameters

Analyzing the association of age with the various periocular anthropometric measurements, we found that only the mean MRD values were significantly associated with age. The mean MRD value for the age group 20–30 years in RE was  $3.3 \pm 0.8$  mm and for age group 31–40 years, it was  $3.7 \pm 1.17$  mm ( $P = 0.012$ ) while the LE values for the two groups were  $3.2 \pm 0.7$  mm and  $3.5 \pm 1.21$  mm, respectively, with  $P = 0.05$ . Similarly, when the values were compared between the age groups of 20–30 years and 41–50 years, the values for both eyes were significantly more in the higher age group (in RE,  $3.3 \pm 0.8$  mm for 20–30 years age group and  $3.7 \pm 1.19$  mm for 41–50 years;  $P = 0.020$ ; in LE,  $3.2 \pm 0.7$  mm and  $3.7 \pm 1.05$  mm for both age groups, respectively, and  $P = 0.001$ ).

Erbagci *et al.*<sup>[11]</sup> noted a gradual decline in the HPF value with increasing age which was statistically significant ( $P = 0.0001$ ) but the other study parameters had no significant correlation with age. Patil *et al.*<sup>[8]</sup> in their study analyzed the association of HPF and VPF with age and found a significant ( $P < 0.05$ ) increase in HPF from the age group of 31–45 years to 45–60 years, but could not find any such change for VPF. In the study by Eze *et al.*,<sup>[12]</sup> higher mean values of both HPF and VPF were seen in the age groups of 21–40 and 41–60 years as compared to 18–20 and 61–80 years. Variability in the mean values of both ULC and BH was present when compared across various age groups and the mean MRD value was seen to be decreased from the age of 60 years.

The difference in the findings of association of age with the various parameters between our study and those done by others could be due to the different age groups included as well as variations related to race and ethnicity.

### Relationship between Gender and Periocular Parameters

Comparing the mean values of the periocular measurements between males and females in this study, we observed that except for HPF, all other parameters were greater in females.

The mean value of HPF in both eyes was seen to be significantly greater in males as compared to females (RE males vs. females =  $30.1 \pm 1.98$  mm vs.  $28.9 \pm 1.99$  mm;  $P < 0.0001$  and LE males vs. females =  $30.0 \pm 1.98$  mm vs.  $28.9 \pm 1.96$ ;  $P = 0.0002$ ). This is in accordance with the study of Jayaratne *et al.*<sup>[10]</sup> who documented a significantly higher

mean HPF in males for both eyes (RE males vs. females =  $27.64 \pm 1.67$  mm vs.  $26.04 \pm 1.83$ ;  $P < 0.0001$  and LE males vs. females =  $27.07 \pm 1.74$  mm vs.  $25.37 \pm 1.43$ ;  $P < 0.001$ ) and Vasanthakumar *et al.*<sup>[17]</sup> (males vs. females =  $31.08 \pm 1.79$  mm vs.  $29.09 \pm 2.18$ ;  $P < 0.001$ ). Studies by Bukhari,<sup>[14]</sup> Eze *et al.*,<sup>[12]</sup> and Park *et al.*<sup>[7]</sup> also reported a greater mean HPF value in males than females but the difference in their studies was not significant in statistical terms. The mean VPF values in our study were greater in females in both eyes but this difference did not reach statistical significance. Similar observations were made by Oztürk *et al.*,<sup>[2]</sup> Jayaratne *et al.*,<sup>[10]</sup> and Vasanthakumar *et al.*<sup>[17]</sup> all of whom reported an insignificantly higher mean VPF value for females as compared to males. In contrast, studies by Patil *et al.*<sup>[8]</sup> and Bukhari<sup>[14]</sup> reported a greater mean HPF for males but in both these studies, the difference in values between both genders was statistically not significant while Eze *et al.*<sup>[12,13]</sup> reported similar values of mean VPF for both genders.

In our study, we found that the ULC was significantly higher in females compared to males (RE =  $4.9 \pm 1.87$  mm in males and  $5.7 \pm 1.47$  mm in females;  $P = 0.0009$  and LE =  $4.8 \pm 1.76$  mm in males and  $5.6 \pm 1.49$  mm in females;  $P = 0.0007$ ). Our findings are in contrast to other studies by Bukhari<sup>[14]</sup> (males =  $9.6 \pm 0.8$  mm and females =  $9.6 \pm 0.9$  mm;  $P = 0.695$ ), Eze *et al.*<sup>[12]</sup> (males =  $8.2 \pm 2.5$  mm and females =  $7.9 \pm 2.2$  mm;  $P = 0.155$ ), and Oztürk *et al.*<sup>[2]</sup> (males =  $6.0$  mm and females =  $5.9$  mm) all of whom reported marginally higher but statistically insignificant ULC values in males.

The BH mean values in our study were not much different when compared between both eyes and both genders (males =  $9.48 \pm 1.97$  mm in RE and  $9.36 \pm 2.15$  mm in LE; females =  $9.43 \pm 1.8$  mm in RE and  $9.67 \pm 1.81$  mm in LE), with the difference not reaching statistical significance between genders (RE –  $P = 0.854$ ; LE –  $P = 0.274$ ). Similar results were found in the studies of Oztürk *et al.*<sup>[2]</sup> (mean BH =  $9.7 \pm 2.5$  mm for males and  $9.9 \pm 2.3$  mm for females;  $P = 0.39$ ). However, in the studies of Bukhari<sup>[14]</sup> (mean BH =  $9.1 \pm 2.49$  mm for males and  $10.9 \pm 2.6$  mm for females;  $P = 0.001$ ) and Eze *et al.*<sup>[12]</sup> (mean BH =  $13.1 \pm 2.4$  mm for males and  $13.6 \pm 2.7$  mm for females;  $P = 0.029$ ), females had a significantly greater mean BH value.

When we compared the mean MRD values between both genders, we found that the mean values in both eyes were significantly greater in females as compared to males (RE =  $3.1 \pm 1.02$  mm in males and  $3.7 \pm 1.01$  mm in females;  $P < 0.0001$  and LE =  $3.1 \pm 0.94$  mm in males and  $3.6 \pm 0.98$  mm in females;  $P = 0.0005$ ). Eze *et al.*<sup>[12]</sup> in their study also observed a slightly higher MRD in females than males but the difference was statistically insignificant (MRD =  $4.1 \pm 0.5$  mm in males and  $4.2 \pm 0.8$  mm in females;  $P = 0.095$ ).

## CONCLUSION

The strength of this study lies in the fact that each measurement was taken 3 times in each eye by same person and the mean of the three measurements was entered for analysis. However, this study was limited by the relatively smaller sample size with the study subjects having been selected from a convenient sample and hence the results cannot be considered as representative for the entire population of Vindhya region. Besides, the use of manual methods for measurement could have caused errors and the cross-sectional study design could not assess the longitudinal trends.

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