Orbitofacial Anthropometry in a Pakistani Population

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Purpose: To demonstrate the anthropometric variations in head circumference, inner and outer canthal distances and interpupillary distance in Pakistani population.

Study Design: Cross sectional study.

Place and Duration of study: The data was collected for a period of three months from August 2015 to October 2015 at the OPD of the Dow University of Health Science, Dow International Medical College, Karachi, Pakistan.

Material and Methods: A total of 500 patients were recruited from an Outpatient Ophthalmology department of Dow University of Health Science, Dow International Medical University. ICD(inter canthal distance) was measured between the medial angles of the palpebral fissures and the OCD(outer canthal distance) from the lateral canthus of each eye using a metal rule .The head circumference was measured using an inch tape and the IPD(inter pupillary distance) was measured using an autorefractrometer. Each of the measurements were done twice to the nearest 0.5 mm by two different researchers and an average was taken of these two measurements.

Results: Total 500 subjects were used. Males were 227 (45.4%) and female were little more 273 (54.6%). The mean values for the parameters measured are as following: Head Circumference (Mean: 55.0cm ± 1.8cm), Inner canthal distance (Mean: 3.4cm ± 0.4cm), Outer canthal distance (Mean: 10.7cm ± 3.9cm), Inter pupillary distance (Mean: 61.4mm ± 4.3mm). Overall there is no mean difference found by gender or age group separately except difference in age groups for Inter pupillary distance.

Conclusion: This study shows that anthropometric variations for head circumference, inner canthal distance, outer canthal distance and the interpupillary distance are seen with age and gender. Standard baseline values should be defined for these parameters and these should be considered when classifying a patient with hypertelorism, hypotelorism or telecanthus or when planning an orbital surgery.

Keywords: Anthropometry, inner canthal distance (ICD), outer canthal distance (OCD), interpupillary distance (IPD) and head circumference (HC).

Anthropometry is the study in which we measure the different components of the human body in order to estimate their relative parts.[1] Medical craniofacial anthropometry methods are different from those of classical physical anthropology, in such a way that there are increased number of craniofacial landmarks and measurements.

Also there are more ways used to make some measurements, and in the interpretation of the findings. There are different ways to take measurements in medical anthropology. These comprise of direct anthropometry (in which measurements are taken directly from the subject) and three indirect anthropometric methods: photogrammetry, soft-tissue

facial-profile cephalometry, and computer-imaged three-dimensional (3D) craniofacial surface scans. Nevertheless, these methods have some things in common. They all require identification of the craniofacial surface landmarks, execution of measurements, and assessment of the data comparing the results to the normal population.[2]

A careful evaluation of the orbital region of the face is an integral part in the description of phenotypic anomalies, which can be classified as qualitative or quantitative anomalies. Qualitative anomalies are described as being present or not present in comparision to a normal human phenotype. The rationale of conducting this study is that we are able to deduce basic standard values of anthropometric measurements in a given population so that quantitative anomalies such as hypertelorism can be identified.[3]

Fronto-occipital circumference, inner canthal distance, outer canthal distance and interpupillary distance are important measurements in the evaluation of several systemic syndromes and craniofacial abnormalities and in the surgical treatment of posttraumatic telecanthus.[3,4] The interpupillary distance (IPD) is the distance measured between the centers of the pupils, and it is important for the creation of the stereoscopic vision, which results in a single tridimensional image.[5] Canthus is either corner of the eye where the upper and lower eyelids meet. The inner canthus is called as nasal or medial cantus while Outer canthus is known as lateral or temporal canthus.[6]

Studies on Anthropometry have revealed variations in craniofacial features as well as in body attributes amongst people belonging to different racial background[7]. Earlier many researchers have studied craniofacial parameters and come up with standard formulations based on ethnic or racial data.[8-11] The objective of the study is to determine basic standard values for the inter pupillary distances, inner and outer canthal distances and head circumference measurements and to study the differences in these anthropometric values with variation of gender and age in the Pakistani population.

MATERIAL AND METHODS

All patients were recruited from the ophthalmology department of Dow University of health Science, Dow International Medical College through convenience sampling. The patients were aged between 5 and 60

years Younger subjects were not taken due to lack of cooperation while subjects older than 75 years years were also not taken due to arrest of craniofacial development. Also subjects with cranio facial anamolies, telecanthus, epicanthus, strabismus were omitted.

After taking informed consent each measurement was taken by two expert ophthalmologists and an average value of the two readings was noted. The measurements that were taken included the head circumference, the inner canthal distance, the outer canthal distance and the inter pupillary distance. All measurements were taken with the patient seated comfortably sitting in an upright position in a well illuminated room. The head circumference was measured using an inch tape drawn across the head over the occipital protuberance posteriorly and over the supra orbital ridges anteriorly. The female subjects with buns and braids were asked to let their hair down before the measurements were taken. The inner canthal distance was measured using a non stretchable ruler from one medial canthus to the other with the patient seated comfortably and instructed to look straight ahead.The outer canthal distance was measured from one lateral canthus to another using the same millimeter ruler with the patient looking upward. The inter pupillary distance was measured in millimeters using an autorefractometer.(RM 8800 Topcon,Tokyo,Japan).
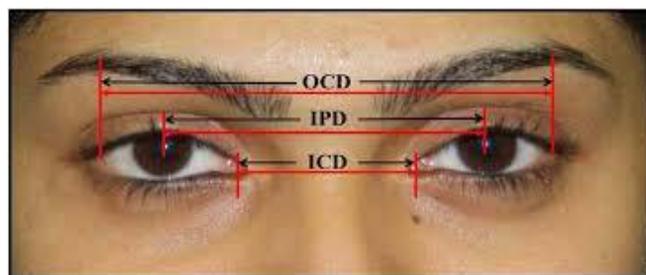

Fig. 1: Details of measurements.

The data was analyzed on IBM SPSS version 22.0 and the results were presented as mean ± SD with confidence interval. Statistical comparisons were performed using first Factorial design for the each response variable with Age groups and Gender as independent variables to see which covariate or interaction effect significance. If it is significant than for comparisons of gender by each age group which interaction effect significant we use Bonferroni post hoc test due to the assumption of non-normal data. A

p-value of 0.05 or less was considered statistically interaction or covariate significance. However, for each pair of interaction p-value revised due to the Bonferroni test and a p-value of 0.036 or less was considered statistically significant.

RESULTS

Total 500 subjects were enrolled. Males were 227 (45.4%) and female were little more 273 (54.6%). There were gradually increasing number of subjects in age groups, for 5 to 15 group 46 (9.2%), 16 to 30 group 131 (26.2%) and most population was found in 31 to 75 age group 323 (64.6%). Table 1 describe the descriptive statistics for Head circumference, Inner canthal distance, outer canthal distance, all measured in centimeters except Inter pupillary distance which was measured in millimeters. For Head Circumference (Mean ± SD: 55.0cm ± 1.8cm), Inner canthal distance (Mean ± SD: 3.4cm ± 0.4cm), Outer canthal distance (Mean ± SD: 10.7cm ± 3.9cm), Inter pupillary distance (Mean ± SD: 61.4mm ± 4.3mm). Overall there was no mean difference found by gender or age group separately except difference in age groups for Inter pupillary distance. These means are unadjusted means and no involvement of any covariate.

Table 1: Mean (SD) of HC, ICD, OPD, IPD for Age groups and Gender

Characteristics	No. of Patients n (%)	HC (cm)	ICD (cm)	OCD (cm)	IPD (mm)
Overall	500	55.0 (1.8)	3.4 (0.4)	10.7 (3.9)	61.4 (4.3)
Gender					
Female	273 (54.6)	54.7 (1.7)	3.4 (0.4)	10.5 (0.8)	61.3 (4.1)
Male	227 (45.4)	55.4 (1.8)	3.5 (0.5)	10.9 (5.7)	61.5 (4.6)
Age Groups					
5 – 15	46 (9.2)	54.1 (2.2)	3.4 (0.4)	10.5 (1.0)	58.7 (4.7)
16 – 30	131 (26.2)	54.9 (1.6)	3.5 (0.4)	10.7 (0.9)	62.2 (3.3)
31 – 75	323 (64.6)	55.2 (1.7)	3.4 (0.5)	10.7 (4.8)	61.5 (4.5)
HC: Head circumference; ICD: Inner canthal distance					
OCD: Outer canthal distance; IPD: Inter pupillary distance					

Table 2: Head circumference (cm) for different age groups

Characteristics	No. of Patients	Mean[a] (SD)	95% C.I	P-value
5 - 15 (n = 46)				
Female	23	53.8 (2.0)	(53.1 , 54.5)	**< 0.99**
Male	23	54.3 (2.4)	(53.6 , 55.0)	
16 - 30 (n = 131)				
Female	74	54.7 (1.6)	(54.3 , 55.1)	**< 0.99**
Male	57	55.2 (1.6)	(54.7 , 55.6)	
31 - 75 (n = 323)				
Female	176	54.8 (1.6)	(54.6 , 55.1)	**< 0.001****
Male	147	55.7 (1.8)	(55.4 , 55.9)	
****Significant at 0.036, Bonferroni Post Hoc Test				
a: Adjusted means with covariate Inner canthal distance				

Table 3: Inner canthal distance (cm) for different age groups

Characteristics	No. Patients	Mean (SD)	95% C.I	P-value
5 - 15 (n = 46)				
Female	23	3.4 (2.0)	(3.2 , 3.6)	
Male	23	3.5 (2.4)	(3.3 , 3.6)	
16 - 30 (n = 131)				
Female	74	3.4 (1.6)	(3.3 , 3.5)	0.747
Male	57	3.5 (1.6)	(3.4 , 3.6)	
31 - 75 (n = 323)				
Female	176	3.4 (1.6)	(3.3 , 3.5)	
Male	147	3.4 (1.8)	(3.4 , 3.5)	
B: Adjusted means with covariate Head circumference				

Table 4: Outer canthal distance (cm) for different age groups

Characteristics	No. of Patients	Mean (SD)	95% C.I	P-value
5 - 15 (n = 46)				
Female	23	10.4 (1.0)	(8.8 , 12.0)	
Male	23	10.6 (1.1)	(9.0 , 12.2)	
16 - 30 (n = 131)				
Female	74	10.6 (0.9)	(9.7 , 11.5)	0.747
Male	57	10.9 (0.9)	(9.9 , 11.9)	
31 - 75 (n = 323)				
Female	176	10.5 (0.8)	(9.9 , 11.1)	
Male	147	11.0 (7.0)	(10.4 , 11.7)	

Table 2 to 5 shows our comparison of male and female by age groups. For each response variable we calculated their mean, standard deviation and 95% confidence interval and presented in a separate table. We have just shown results for three pair comparison although total fifteen pairs were there. There was no mean difference found in all combination of groups for each response variable except just one i.e. 31 to 75 age group male and female head circumference mean to was different statistically. However, it may not be a large clinical difference. A little bit adjustment for the means were reported in Table 2 and 3 since effect of the covariate Inner canthal distance and head circumference.

There was similar mean of Inner canthal distance for males and females. i.e. 3.4cm or 3.5cm. A similar high mean value was found of males compared to females for outer canthal distance and Inter pupillary distance. For outer canthal distance, maximum mean was 11.0cm for male (31 to 75 age group) and 10.6cm for female (16 to 30 age group). For Inter pupillary distance, maximum mean was 62.8mm for male (16 to 30 age group) and 61.7mm for female in the same age group.

DISCUSSION

There are many studies done to measure the anthropometric parameters in adults.[12,13,14] The anthropometric parameters differ in measurements in individuals due to several factors that include hereditary factors, inadequate nutrition in growth years and endurance of the human body on the physical activity it is subjected to.

The inter pupillary distance is the distance between the center of a pupil in one eye to the center of the pupil in the other eye with the patient looking straight ahead. There are four objective methods of assessment for inter pupillary distance. They include the Victorian method, the pupillometer method, corneal reflection and the autorefractrometer. We used the autorefractrometer in our study as this was used to measure IPD and refractive errors at the same time. Our study showed that the mean IPD values measured amongst males were larger than females in all age groups. In Iran the mean IPD in females was 61.1 ± 3.5 mm in females and 63.6 ±3.9mm in males[15]. In another study on Caucasians the IPD was also larger in male subjects versus female subjects[16]. In the Turkish population Evereklioglu et al showed that in the study conducted in Turkish population aged between 7 and 40 years the overall mean IPD values for distance in males were 60.76 ± 4.04 in males and 59.46 ± 3.51 in females.[17]We also studied the IPD in relation to age and divided our subjects into three groups. The age groups were 5 – 15 years, 16 – 30 years and 31 – 75

years. The IPD increased from 58.7 ± 4.7 mm in the age group of 5 – 15 years (table 1) to 62.2 ± 3.3mm in the age group 16 – 30 years and there was no further increase noted with age as the mean value of IPD was 61.5 ± 4.5 mm in individuals aged between 31 – 70 years.

Craniofacial anthropometry is an important asset to both clinical genetists and ophthalmologists. In a study done on 1000 subjects from ljaw within the age range of 3–21 years found the mean inner inter canthal distance for male and female subjects are 28.30 ± 4.16 mm and 28.15 ± 2.75 mm respectively and the outer mean canthal distance for males and females was 92.49 ± 6.30 mm and 91.96 ± 5.81 mm respectively[18]. In a study done on a Nigerian population the mean ICD for males and females were 43.90 ± 4.11mm and 41.77 ± 3.37mm respectively while the mean OCD for males and females is 118.34 ± 0.66 mm and 114.76 ± 0.34 mm respectively.[19]In our study done on 500 subjects the mean ICD in males and females was 35mm ± 5 mm and 34mm ± 4mm respectively. Thus the mean ICD value in our subjects was less as compared to the Nigerian population and more as compared to the ljaws however the latter can be due to younger subjects that were recruited with age range between 3 and 21 years. In our study the ICD and the OCD in males are larger than those of females which is consistent with the study done on the ljaws, Turks, Nigerians, and Latvians[20]. Another study done on 1000 subjects in Chattisgarh region of India showed that the

Table 5: Inter pupillary distance (mm) for different age groups.

Characteristics	No. of Patient	Mean (SD)	95% C.I	P-value
5 - 15 (n = 46)				
Female	23	58.6 (5.4)	(56.8 , 60.3)	
Male	23	58.8 (4.0)	(57.1 , 60.6)	
16 - 30 (n = 131)				
Female	74	61.7 (3.2)	(60.7 , 62.6)	**<0.99~**
Male	57	62.8 (3.3)	(61.7 , 63.9)	
31 - 75 (n = 323)				
Female	176	61.5 (4.1)	(60.9 , 62.1)	
Male	147	61.5 (4.9)	(60.8 , 62.1)	
~Three above pairs are not significant except other possible pairs.				

measured parameters were higher in males than females but the difference was not statistically significant(p value ≥ 0.001)[21]. This was in contrast to a study on a mixed European population where the mean ICD of 32.00 was observed and there was no difference in gender[22].

A study done on Harvani adults showed that the average values for head circumference in male subjects was 55.91 cm while in female subjects it was 54.61cm which clearly shows that Harvani males had a slight increased head circumference as compared to their female counterparts[23]. This was consistent with our study in which the mean head circumference was observed to be slightly higher in males as compared to females. Maximum mean was 55.7cm for male (31 to 75 age group) and 54.8cm for female (31 to 75 age group) in our study. Another similar study done on 408 adults by Ahmet Riffat et al showed mean HC in men 55.90 ± 1.85 and 54.57 ± 1.61 in women[24]. Another study done on Canadian male adults aged between 18 to 71 years showed them to have a mean value of head circumference of 56.69cm[25].

The data of our study will be helpful to anthropologists and orbital surgeons. Short comings of our study included a small sample size which is not a true representation of the Pakistani population and also there was no study done on the racial differences of these parameters in the given population as Pakistan is a multiracial country and comprises of a very large population. We hope to conduct studies in future in regard to the above mentioned points.

CONCLUSION

This study shows that anthropometric variations for head circumference, inner canthal distance, outer canthal distance and the interpupillary distance are seen with age and gender. Standard baseline values should be defined for these parameters and these should be considered when classifying a patient with hypertelorism, hypotelorism or telecanthus or when planning an orbital surgery.

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REFERENCES

1. **Kolar JC, Salter EM.** Craniofacial anthropometry practical measurements of the head and face for clinical, surgical and research use. Charles Thomas Publisher Ltd. USA 1996.
2. **G Leslie,K Curtis.** Antgropometric Determination of craniofacial Morphology. Am J of Medical Genetics 1996; 65: 1-4.
3. **Dollfus H, Verloes A.** Dysmorphology and the Orbital Region: A Practical Clinical Approach. Surv Ophthalmol. 2004; 49: 547– 61.
4. Laestadius, Aase NDJM, Smith DW. Normal inner canthal and outer orbital dimensions. J Pediatr. 1979; 74: 465–468.
5. **Aslankurt M, Aslan L, Aksoy A, Ozdemir M.** Dane, "Laterality does not affect the depth perception, but interpupillary distance," Journal of Ophthalmology. 2013; Article ID 485059, 5.
6. **Spencer F.** ed. History of physical anthropology. Gerland, Newyork and London. 1997; pp-80.
7. **Farkas LG, Katic MJ, Forrest CR.** International anthropometric study of facial morphology in various ethnic groups/races. The Journal of Craniofacial Surgery. 2005; 16: 616–46.
8. **Pryor HB.** Objective measurements of interpupillary distance. Pediatrics. 1969; 44: 973-7.
9. **Singh JR, Banerjee S.** Normal values for interpupillary, inner canthal and outer canthal distances in an Indian population. Hum Hered 1983; 33: 326-8.
10. **Fledelius HC, Stubgaard M.** Changes in eye position during growth and adult life as based on exophthalmometry, interpupillary distance and orbital distance measurements. Acta Ophthalmol. 1986; 64: 481-6.
11. **Sanchez-Andres A, Mesa MS.** Heritabilities of morphological and body composition characteristics in a Spanish population. Anthropol Anzeiger. 1994; 52: 341-9.
12. **Nellhaus G.** Composite international and interracial graphs. Pediatrics. 1968; 41: 106-10.
13. **Farkas LG, Posnic JC, Hreczko TM.** Anthropometric

growth study of the head. Cleft Palate-Craniofacial J. 1992; 29: 303-8.

14. **Murphy WK, Laskin DM, Richmond MS.** Intercanthal and interpupillary distance in the black population. Oral Surg Oral Med Pathol. 1990; 69: 676–80.

15. **Fesharaki H, Rezaei L, Farrahi F, Banihashem T, Jahanbakhshi A.** Normal interpupillary distance values in an Iranian population. J Ophthalmic Vis Res. 2012; 7: 231–4.

16. **Pointer JS.** The interpupillary distance in adult Caucasian subjects, with reference to 'readymade' reading spectacle centration. Ophthalmic Physiol Opt. 2012; 32: 324–31.

17. **Evereklioglu C, Doganay S, Er H, Gündüz A.** Distant and near interpupillary distance in 3448 male and female subjects: final results. Turgut Özal Tip Merkezi Dergisi. 1999; 6: 84–91.

18. **E.A Osunwoke, B.C Didia, E.J, Otutu, A.H Yerikema.** A study on the normal values of inner and outer canthal distance, inter papillary distance and head circumference of 3-21 years ijaws. Am J of Scientific and Industrial Research. 2012, 3: 441-5.

19. **OA Egwu, EO Ewunonu et al.** Normal values of inner and outer canthal distance in a study population in South east Nigeria. Int. J. Biol. Chem. Sci. 2008; 2: 355-8.

20. **Naegles E.** Craniofacial Anthropometry in a group of healthy Latvian residents. Actamedica Lituanica, 2005; 12: 47-53.

21. **J Agrawal, AS Yogesh, CK Shukla et al**. Orbitofacial Anthropometric Assessment of inter-canthal and outer canthal distance measurement in Chattisgarh Region. Biomed Res-India 2013; 24: 365-9.

22. **ER Mohammed, Jalalifar S.** Correlation between interpupillary distance and Inner-Outer Distances in individuals younger than 20. Jr of Ophthalmic and Vision Research. 2008; 3: 16-22.

23. **K Mahesh, L Mohd Muzzafar.** A Study of Sexual dimorphism in stature and Horizontal Head Circumference among Haryanvi Adults. Int. J. Rec. Biotech. 2013; 1: 1-4.

24. **Riffat OA.** Adult Head Circumferences and Centiles. Jr of Turgut Özal Medical Center. 197; 4: 261-4.

25. **Nguyen AKD, Simard-Meilleur, Berthiaume AA et al.** Head circumference in Canadian male adults: Development of a normalized chart. Int. J. Morphol. 2012; 30: 1474-80.