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Periocular Measurements Among Filipino Adult Employees of Dr. Paulino J Garcia Memorial Research and Medical Center

ABSTRACT

Objective: To determine the normative values of interpupillary distance (IPD), intercanthal distance (ICD), outer canthal distance (OCD), and palpebral fissure length (PFL) among a sample of Filipino adults.

Methods:

Design: Cross-Sectional Study
Setting: Tertiary Government Training Hospital
Participants: 300 Filipino hospital employees aged 19 to 65 years old

Results: Out of 300 participants, 156 (52%) were men and 144 (48%) were women. The mean IPD was significantly different $t(296) = 12.89, p = .00001$ between males (62.59mm; SD 1.65) and females (60.29mm; SD 2.07). The mean ICD was significantly higher among males (34.91mm; SD = 1.37) than females (31.19mm; SD = 1.52); $t(288) = 9.58, p = .00001$. Men had a significantly higher mean OCD (93.05mm; SD 4.14) than women (91.31mm; SD = 3.97); $t(298) = 3.73, p = .0002$. The PFL was significantly broader among men (32.60mm; SD = 1.25) than women (31.05mm; SD = 0.99); $t(291) = 11.96, p = .00001$.

Conclusion: Our study determined normative values of IPD, ICD, OCD and PFL among a sample of Filipino adults. We found a sexual dimorphism with men having significantly higher values than women.

Keywords: *Interpupillary distance (IPD); intercanthal distance (ICD); outer canthal distance (OCD); palpebral fissure length (PFL); periocular measurements; craniofacial anthropometry; telecanthus.*

Anthropometric studies play a crucial role in craniofacial surgery and syndromology, particularly in assessing telecanthus for detecting naso-orbito-ethmoid (NOE) complex fractures.^{1,2} Full avulsion or detachment of the bone can lead to displacement of the medial canthal liga-

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ment, causing lateral, anterior and inferior movement.² In cases of telecanthus, the intercanthal distance (ICD) is increased while the interpupillary distance (IPD) remains within normal range. This condition needs to be distinguished from orbital hypertelorism, a usual feature of craniofacial syndromes, where both ICD and IPD are increased.^{1,3} Additionally, measurements such as outer canthal distance (OCD) and palpebral fissure length (PFL) are valuable in identifying syndromes with craniofacial involvement.⁴ Figure 1 illustrates the distance between the two mid-pupillary regions (the IPD) and between the two medial canthi (ICD).^{3,4} The OCD is the distance between the two lateral canthi, while the distance between the medial and lateral canthi of one eye is the PFL.⁴ Understanding population-specific IPD and canthal measurements and not solely relying on facial physical features is essential for recognizing subtle deviations in orbitocranial growth patterns, diagnosing syndromes, and managing craniofacial deformities and trauma.⁵⁻⁷ Factors such as race, ethnicity, gender, and age can influence the measurements, making it challenging to obtain consistent scientific data.²

A search across various databases including HERDIN Plus, the ASEAN Citation Index, the Western Pacific Region Index Medicus, the Directory of Open Access Journals, MEDLINE (PubMed and PubMed Central), and Google Scholar using the search terms “periocular measurements,” “interpupillary distance,” “intercanthal distance,” “outercanthal distance,” “palpebral fissure length” and “telecanthus” showed only two studies regarding these or among Filipinos. Barone *et al.* examined intercanthal distance (ICD) and outercanthal distance (OCD) in Filipino children, while Luague and Mangubat described palpebral fissure length (PFL) and interpupillary distance.^{4,8}

The absence of local data prompted this research to determine the normative values of interpupillary distance (IPD), intercanthal distance (ICD), outer canthal distance (OCD), and palpebral fissure length (PFL) among a sample of Filipino adults.

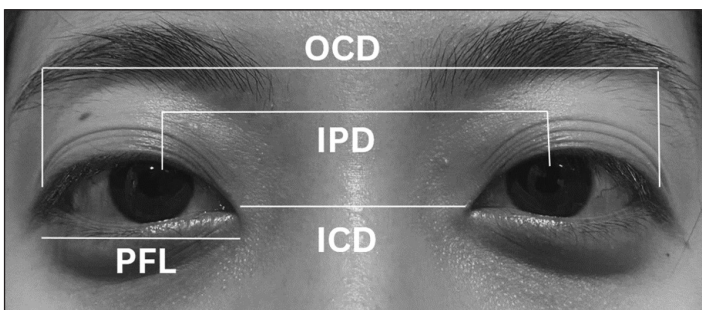


Figure 1. Periocular Measurements: ICD: Inter canthal distance; IPD: Inter pupillary distance; OCD: Outer canthal distance; PFL: Palpebral fissure length

METHODS

With Institutional Review Board approval (2021-031-AJALBERTO-PERIOCLAR MEASUREMENTS-ADULT FILIPINOS), this cross-sectional study was performed in a 6-month period from January to June 2022. Considered for inclusion were Filipino employees aged 19-65 years, of our tertiary government hospital in Cabanatuan City, Philippines. Convenience sampling was done to include participants. A sample size of 300 was computed for the study using the Slovin formula $n = N / (1 + Ne2)$,⁹ based on a total of 1,303 employees of the hospital as of July 2021, computed on a 95% confidence interval and 5% margin of error.

Because this study was conducted during the COVID-19 pandemic, all participants had to be fully vaccinated, with at least one booster shot against COVID-19, and have no symptoms of COVID-19 or recent exposure to a COVID-19 suspect or patient in the previous two weeks. Those with disease pertaining to eye, orbit, or face, congenital or acquired craniofacial deformity, strabismus and orbital disease were excluded. Prospective participants with previous ocular surgery, orbital trauma, orbital inflammation, or tumor history were also excluded from the study.

Data collection and measurements were obtained in the well-lit Otorhinolaryngology-Head and Neck Surgery Out-Patient Unit. After obtaining written informed consent and accomplishing data forms, two Otorhinolaryngology residents other than the principal investigator screened and confirmed the potential participants met inclusion and exclusion criteria. Measurements were obtained by only one examiner (the primary investigator) to avoid interobserver variability.

Based on the protocol of Hayat *et al.*,¹⁰ each participant was seated with face well illuminated by a headlight worn by the examiner; the heads of the examiner and the participant were on the same level and 40 cm apart. The examiner closed one eye while measuring. A digital 150-mm caliper (Mitutoyo®, Kanagawa, Japan) with a 0.1 mm accuracy was used. While asking the patient to maintain a frontal gaze, the distance between the centers of the pupils was measured as the IPD. The caliper was placed on the root of the nose at the forehead with the distance between the two medial canthi corresponding to the ICD. The OCD was obtained by placing the zero mark at the lateral canthus of one eye, measuring until the other lateral canthus. The average value obtained by two measurements of the distance between the medial and lateral canthi of each eye was derived as the PFL. All measurements were done twice. A photograph of the face was taken for documentation.

Data Analysis

Descriptive statistics including mean and standard deviation were employed to describe all variables. Data analysis was conducted using IBM Statistical Package for the Social Sciences (IBM SPSS Statistics for Windows), version 21.0 (IBM Corp., Armonk NY USA). The independent two sample t-test was utilized to compare outcome variables by sex.

RESULTS

Out of the 300 participants included in the study, 156 (52%) were male and 144 (48%) were female. The mean age was 33.52 years (males: 33.22; females: 33.85).

The mean IPD was significantly higher, $t(296) = 12.89, p = .00001$ among the men ($M = 62.59$ mm, $SD = 1.65$) compared to the women ($M = 60.29$, $SD = 2.07$). The ICD also exhibited a significant difference between the sexes $t(288) = 9.58, p = .00001$, with males having a higher mean of 34.91 mm ($SD = 1.37$) compared to females’ 31.19 mm ($SD = 1.52$). Additionally, the OCD was significantly different $t(298) = 3.73, p = .0002$ between males (93.05 mm; $SD = 4.14$) and females (91.31 mm; $SD = 3.97$). The averaged PFL showed a statistically significant difference $t(291), = 11.96, p = .00001$ with 32.60 mm ($SD = 1.25$) for men and 31.05 mm (0.99) for women. (Table 1)

Table 1. Summary of Periocular Measurements for Filipino Males and Females

Variable	Male (156)		Female (144)		Independent 2 sample T Test		
	Mean	SD	Mean	SD	df	t statistic	p value
IPD (mm)	62.59	1.65	60.29	2.07	296	12.89	.00001
ICD (mm)	34.91	1.37	31.19	1.52	288	9.58	.00001
OCD (mm)	93.05	4.14	91.31	3.97	298	3.73	.0002
PFL (mm)	32.60	1.25	31.05	0.99	291	11.96	.00001

DISCUSSION

We determined normative values for IPD, ICD, OCD and PFL in a sample of Filipino adults. The obtained normative values of the periocular measurements were compared by sex, revealing higher values among male adult employees. Fesharaki et al. also reported similar findings in an Iranian population and attributed them to a larger craniofacial skeleton in males.⁵ Tables 2-5 provide comparisons of our results with normative values established in various study populations from different literature sources.

Interpupillary Distance (IPD)

Kelmann established 60 mm as the normal IPD while ICD is typically half of IPD.² As seen in Table 2, adult Filipino employees from our

study sample were found to have a wider IPD compared to the Turkish population studied by Ozturk et al.¹¹ and Evreklioglu *et al.*¹² However, other studies on the Turkish population reported higher IPD values than our sample.^{13,14} This underscores significant variations even within a single country. Therefore, further region- or ethnicity-specific studies are needed to assist physicians in managing craniofacial abnormalities.

Studies among Iranian,⁵ Pakistani,¹⁰ Korean,¹⁵ Indian,¹⁶ and Black American^{17,18} populations reported higher inter-pupillary distance (IPD) measurements compared to our present study. Across most studies,^{5,10,15-18} males consistently exhibited significantly higher variables compared to females, except for the findings of Gupta *et al.*, which reported that sex did not typically influence normal IPD values in a normal Indian population aged 3–80 years.⁷ Among a Turkish sample, a significant increase in both near and distant IPD measurements with age was observed, continuing until 19 years in males and 14 years in females, indicating earlier maturation in females than males.¹

Intercanthal Distance (ICD) and Outercanthal Distance (OCD)

Table 3 presents a comparison of intercanthal distance (ICD) measurements from our present study with other populations. Although Mangubat and Luague used the term “interpalpebral distance,” their operational definition aligned with the measurement of ICD.⁸ Their study found a range of 31-34 mm among a sample of Filipino adults at the Philippine General Hospital as far back as 1966, which closely corresponds to our study findings of 32.7 mm in men and 31.19 mm in women. The mean ICD of our subjects was also close to samples of Pakistanis,¹⁰ Indians,¹⁷ Malaysian Indians,¹⁹ and Arabs.²⁰ Studies of South Indians⁶ and Turks¹¹⁻¹³ reported smaller values but those of South Nigerians (Ibibios²¹ and Ijaws²²) and Americans^{17,18} reported larger values.

In comparison to other populations shown in Table 4, the mean outercanthal distance (OCD) of Filipino samples in our study was wider than those reported for Pakistanis,¹⁰ Malaysian Indians,¹⁹ and Turks,¹¹⁻¹³ but narrower than those reported for South Indians⁶ and South Nigerians.^{21,22}

Palpebral Fissure Length (PFL)

PFL is also important for the overall size and appearance of the eye.¹⁶ While our samples showed a similar ICD, there was a difference of at least 5 mm in PFL compared to the findings of Mangubat and Luague.⁸ This difference hints at potential changes in facial features within the current Filipino population over the nearly six decades since the earlier study. Such changes could be attributed to various factors, including intermarriages



Table 2. Comparison of IPD of Present Study with Other Populations

Authors (Year Published)	Population	IPD: Mean+SD of Males (mm)	IPD: Mean+SD of Females (mm)
Present Study	Filipino	62.59+1.65	60.29+2.07
Jung <i>et. al</i> (2020) †	Korean (single eyelid) women	N/A	61.6+3.1
	Korean (double eyelid) women	N/A	62.8+3.6
Hayat <i>et. al</i> (2019)	Pakistani	62.7 ± 6.8	60.7 ± 5.03
Ylidrim <i>et. al</i> (2015)	Turkish	63.9±4.4	61.4±3.7
Ozturk <i>et. al</i> (2006)	Turkish	60.6 ± 3.8	60.1 ± 3.7
Everekliogu <i>et. al</i> (2001)	Turkish	60.91+3.04	59.16+2.55
Bashi <i>et. al</i> (2021) ‡	Turkish	65.32 ± 3.77	
Fesharaki <i>et. al</i> (2012)	Iranian	63.58±3.9	61.13±3.5
Patil <i>et. al</i> (2011)	Indian	64.2 ± 2.2	63.1 ± 1.8
Osuobeni & Faden (2003) †	Females of Arab origin	N/A	58.7+3.01
Barretto & Mathog (1999)	White (American)	65.15+3.81	61.47+4.25
	Black (American)	68.97+4.10	65.93+2.73
Murphy & Laskin (1990)	Black (American)	66.3+3.6	62.6+3.2

*SD not given; † Study only investigated females; ‡Study did not compare results between sexes

Table 4. Comparison of OCD of Present Study with Other Populations

Authors (Year Published)	Population	OCD: Mean+SD of Males (mm)	OCD: Mean+SD of Females (mm)
Present Study	Filipino	93.1+4.14	91.31+3.97
Jung <i>et. al</i> (2020)	Korean (Single eyelid)	N/A	85.3+3.8
	Korean (Double eyelid)	N/A	87.9+4.9
Radha & Srinivasan (2021)	South Indian	103.5±8.1	101.9±10.2
Ngeow & Aljunid (2009)	Malaysian Indian	92.1+4.1	89.4+3.2
Hayat <i>et. al</i> (2019)	Pakistani	86.3 ± 7.0	84 ± 6.0
Oladipo <i>et. al</i> (2011)	Ibibios (South Nigerian)	111.5±5.1	107.3±6.3
Oyinbo <i>et. al</i> (2008)	Ijaws (South Nigerian)	111 ± 14	120 ± 7
Ozturk <i>et. al</i> (2006)	Turkish	91.3 ± 6.9	90.1 ± 6.2
Everekliogu <i>et. al</i> (2001)	Turkish	89.51+4.26	87.30+3.42
Bashi <i>et. al</i> (2021)*	Turkish	97.75 ± 5.09	

*Study did not compare results between sexes

between races and ethnicities, migration, and environmental influences. It is essential to recognize that both their study and ours were conducted at single centers, suggesting that these findings may not fully represent

Table 3. Comparison of ICD of Present Study with Other Populations

Authors (Year Published)	Population	ICD: Mean+SD of Males (mm)	ICD: Mean+SD of Females (mm)
Present Study	Filipino	32.7+1.37	31.19+1.52
Mangubat & Luague (1966)*	Filipino	31-34	31-34
Jung <i>et. al</i> (1995)	Korean (single eyelid) women	N/A	38+3.1
	Korean (double eyelid) women	N/A	38.2+1.8
Radha & Srinivasan (2021)	South Indian	26.4±5.1	25.1±4.6
Patil <i>et. al</i> (2011)	Indian	32.8 ± 1.7	32.7 ± 1.5
Ngeow & Aljunid (2009)	Malaysian Indian	31.7+1.9	30.5+1.7
Hayat <i>et. al</i> (2019)	Pakistani	31.2 ± 3.2	30.6 ± 2.5
Oladipo <i>et. al</i> (2011)	Ibibios (South Nigerian)	35.2±2.7	33.6 ± 3.0
Oyinbo <i>et. al</i> (2008)	Ijaws (South Nigerian)	42 ± 5	39 ± 3
Al Wazzan (2001)	Arab	32.94 ± 2.67	31.91 ± 2.91
Ozturk <i>et. al</i> (2006)	Turkish	30.7 ± 2.7	30.2 ± 1.9
Everekliogu <i>et. al</i> (2001)	Turkish	30.65+2.79	30.28+2.18
Bashi <i>et. al</i> (2021)*	Turkish	65.32 ± 3.77	
Barretto & Mathog	White (American)	35.53+3.76	32.95+2.90
	Black (American)	35.80+3.24	34.18+2.97
Murphy & Laskin (1990)	Black (American)	35.7+3.7	33.1+2.3

*Study did not compare results between sexes

Table 5. Comparison of PFL of Present Study with Other Populations

Authors (Year Published)	Population	PFL: Mean+SD of Males (mm)	PFL: Mean+SD of Females (mm)
Present Study	Filipino	32.6+1.25	31.05+0.99
Mangubat & Luague (1966)*	Filipino	21-26	
Patil <i>et. al</i> (2011)	Indian	32.3± 2.2	33.7±1.8
Ngeow & Aljunid (2009)	Malaysian Indian	30.7+1.6	29.6+1.4
Jung <i>et. al</i> (2020)	Korean (Single eyelid)	N/A	24.1+1.5
Jung <i>et. al</i> (2020)	Korean (Double eyelid)	N/A	25.5+1.7
Bashi <i>et. al</i> (2021) *	Turkish	32.48 ± 2.06 (right) 32.22 ± 2.01 (left)	

*Study did not compare results between sexes

the entire Filipino population.

As presented in *Table 5*, the Filipino samples from our study have higher PFL values than the Turks,¹³ Indians,¹⁵ and Malaysian Indians.¹⁹

The men have larger values than women; however, it is worth noting that the study by Patil *et al.* indicated a wider PFL in Indian women than in men.

Due to incomplete public immunization against the coronavirus during the study period, our sample was limited to adult participants from a single center. However, a multisite study was initially planned to encompass other regions and ethnicities. It is essential for future research to consider all age groups to observe the pattern of growth using these measurements. The operational definition of a “Filipino” should be further refined in future studies to account for such factors as citizenship, ethnicity, and the impact of migration and colonialism

on the current population mix. Establishing who qualifies as a “Filipino” may prove challenging due to historical complexities and may be a subject for other disciplines to elucidate.

Our study determined the normative values of IPD, ICD, OCD and PFL among a sample of adult Filipinos. We observed sexual dimorphism with males showing significantly higher values than females. While our findings are limited to a single center and cannot be generalized to the entire Filipino population, they can serve as a pilot study for future, broader research. This has potential applications in clinical practice and basis of future research, including but not limited to maxillofacial surgery, aesthetic surgery, and the correction of congenital malformations.

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