Original Article

Upper Eyelid and Eyebrow Dimensions in Adult Filipinos

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ABSTRACT

Objectives: To determine the normative values for upper eyelid and eyebrow dimensions among adult Filipinos and the effects of age and sex on these parameters.

Methods: This was a prospective, descriptive study involving 75 Filipino adults who were recruited from a single tertiary government hospital in the Philippines. Profile data collected included age and sex, while clinical data included measurements of the pretarsal skin height (PSH), eyelid crease height (ECH) and eyebrow height (EBH) by a single observer, with the average of an individual's eyes used as the representative measurement. An inter-eye correlation coefficient was calculated. The subjects were categorized into 4 age groups (i.e. early, early middle, late middle, and late adulthood) and according to gender for statistical analyses. All measurements were compared across age groups using Analysis of Variance (ANOVA) and between sexes using t-test.

Results: This study included 43 males and 32 females. Overall, mean PSH measured was 4.5 ± 1.5 mm; mean ECH was 5.9 ± 1.7 mm, while mean EBH was 10.4 ± 2.7 mm. Means of PSH and EBH showed similar measurements between sexes. The mean ECH of females in early adulthood was significantly higher than the mean ECH of males belonging to the same age group (p=0.01). Among the female group, mean EBH was also observed to increase with age (p=0.02). A high degree of inter-eye correlation was observed (r = 0.94 to 1.00).

Conclusion: Filipinos have unique upper eyelid and brow features compared to other races. Sex-related differences were not identified in PSH and EBH. While EBH increased with age among female subjects.

Keywords: Eyelid, Eyelid Crease Height; Pretarsal Skin Height; Eyebrow Height; Adult Filipinos

Understanding the anatomy of the eyelids and upper face helps provide information on their functions and roles in one's appearance. The eyebrows, eyelid crease, and pretarsal skin are among the facial features that play important roles in facial appearance and ethnic identification.[1] It is well known that these facial features vary with race, age, and sex.[2-12]

The upper eyelid skin crease is created by attachments of the posterior layer of the levator aponeurosis into the orbicularis muscle and subcutaneous tissue.[13] Among Whites, the eyelid skin crease varies in height and tends to lie 8 to 11 mm above the eyelid margin centrally in males and 6 to 9 mm above the eyelid margin centrally in females.[14] Eyebrow position is also different between males and females. The eyebrows tend to be heavier, flatter, and higher in males whereas they are more arched in females. Although, there are inter-individual variations.[1]

Several published studies have reported the anthropometrics of the eyelid crease height, visible pretarsal skin, and eyebrow height among various races.[2-3,5-12] Caucasians have smaller pretarsal skin and eyelid crease height than African-Americans while Malays have larger pretarsal skin and eyebrow height than Whites.[3,5] Filipinos have a diverse ethno-linguistic background with roots dating back to pre-Hispanic Austronesian expansion before colonization of the Spaniards and Americans.[15] Furthermore, Filipinos are known to have Hispanic, Latino, Native-American, and Chinese ancestries.[16] To date, there are no studies published on eyebrow and eyelid measurements among Filipinos. Thus, our study aimed to determine normative measurements for upper eyelid and eyebrow dimensions among adult Filipinos and compare these measurements between sexes and age groups. Improving appearance while maintaining ethnic characteristics is one of the keys to a successful oculoplastic surgery. These measurements may serve as guides to ophthalmologists and oculoplastic surgeons in surgical planning and decision-making.

METHODOLOGY

Study Design and Patients

This was a prospective, descriptive study conducted at the Eye Training and Facilities Center – Outpatient Department of Rizal Medical Center from May 1, 2019 to January 30, 2020 after approval from the Rizal Medical Center-Institutional Review Board. The minimum required sample size was 74 patients, based on the 1994 study by Cartwright, using a standard deviation of 4.4, confidence level of 95% and margin of error of 1%.[2] We included patients aged 20 years old and above since upper eyelid and eyebrow dimensions are affected by sexual maturation that usually ends by the age of 19 years.[17] Patients with deformities or malposition of the eyelid and ocular adnexae from various reasons (i.e. congenital anomalies, periocular and eyelid trauma, severe dermatochalasis, tumors, inflammatory disorders, previous ocular or orbital surgery), history or current use of topical antiglaucoma eyedrops, soft or rigid contact lens wear, strabismus, or eyebrow tattoo were excluded from the study.

A total of 75 patients were screened and recruited in this study. A convenience type of non-probability sampling wherein consecutive patients that met the inclusion and exclusion criteria were recruited.

Data Collection

Written consent were obtained and participants were categorized into 4 age groups: early (20 to 34 years); early middle (35 to 44 years); late middle (45 to 64 years); and late (65 years and above). Data collected include age, sex, and measurements of the pretarsal skin height, eyelid crease height and of the eyebrow height.

Measurements of the pretarsal skin height (PSH), eyelid crease height (ECH), and eyebrow height (EBH) were taken by a single examiner, along the vertical projections of the pupillary axis in a well-lighted room. The study participant was seated at the same eye level as the examiner with the study participant looking straight ahead. Without manipulation of the eyelid and with the eyes open, PSH was measured as the distance from the visible upper eyelid lash line to the eyelid skin fold. EBH was measured in primary gaze as the distance between the upper eyelid lash line and the first row of mature eyebrow hairs at the inferior eyebrow margin (Figure 1). With the eyes gently closed, ECH was measured from the upper eyelid lash line to the eyelid crease (Figure 2). The first row of mature eyebrow hairs was determined using a dermatoscope. All measurements were done to the nearest 0.1 millimeter (mm) using a vertically

held metric ruler. Three measurements were taken for each parameter in each eye and the average was recorded. The results from each individual's two eyes were averaged as well, and the average was used as the representative measurement.
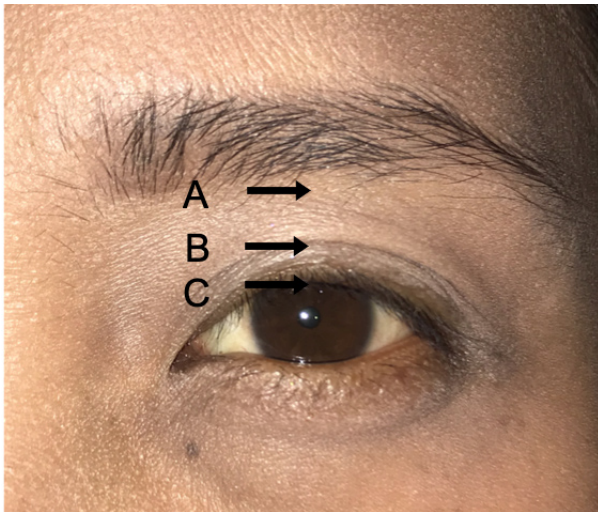
Figure 1. Measurements of pretarsal skin height and eyebrow height on primary gaze position. Visible pretarsal skin is distance from B to C while eyebrow height is distance between A and C.
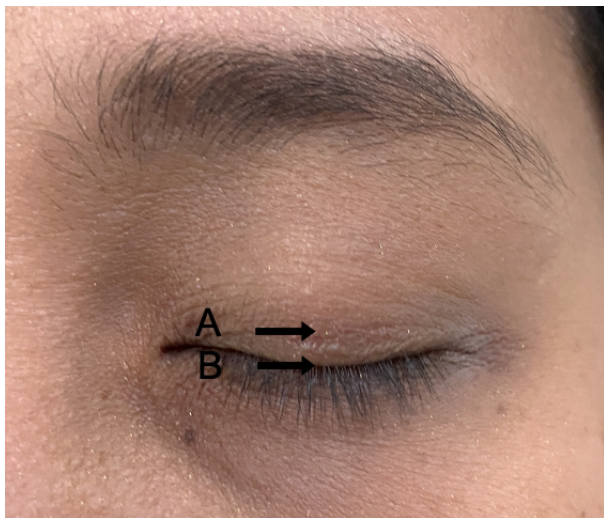
Figure 2. Eyelid crease height is the distance from A to B when the eye is gently closed.

Statistical Analyses

The measurements of PSH, ECH, and EBH were expressed in terms of mean and standard deviation (SD). An inter-eye correlation coefficient was calculated to determine the closeness of relationship of measurements between eyes. All measurements were compared across age groups using Analysis of Variance (ANOVA) and between sexes using t-test. All statistical analyses were performed using Medical statistical software version 18.11. A p-value of <0.05 was considered significant.

RESULTS

A total of 75 adult Filipinos were included in the study, with majority (n=30 or 40%) within the 20 to 34 years old followed by late middle-aged group (27 or 36%). Forty-three (43 or 57%) were male. The distribution of subjects according to gender and age groups is shown in Table 1.

Table 1. Age and Sex Distribution of Study Participants

Adult Age Groups	Age (Years)	Sex		Total
		Male	Female	
Early	20-34	19	11	30
Early Middle	35-44	11	3	14
Late Middle	45-64	12	15	27
Late	≥65	1	3	4
Total		43	32	75

Overall, mean PSH was 4.5 ± 1.5 mm. Although men have higher mean PSH than females across all age groups, differences between the two sexes were not statistically significant (p=0.05). There were no statistical differences among the different age groups as well (Table 2).

Mean ECH of all subjects was 5.9 ± 1.7 mm. Females have a higher mean ECH than males but the difference was not statistically significant (6.1 ± 1.5 vs. 5.8 ± 1.8 mm, p=0.41) (Table 3). When categorized according to age groups, females in the early adulthood had significantly higher ECH than males belonging in the same age group (6.9±1.0 vs. 5.2±1.8 mm p=0.01). There were no significant differences in the means of ECH between the sexes in the other age groups.

Overall, mean EBH measured was 10.4 ± 2.7 mm (Table 4). Means of EBH of all male and female participants were 10.3 ± 3.2 and 10.5 ± 2.1 mm, respectively (p=0.77). A significant age effect was observed in the EBH of females with a pattern of progressive increase in EBH with age (p=0.02). This was not observed in the all-male group.

Table 2. Measurements of Pretarsal Skin Height (PSH) by Adult Age Groups and Sex

Adult Age Groups	Male (n = 43)		Female (n = 32)		p value[a]	Overall (n = 75)		p value[d]
	Mean PSH (mm)	SD	Mean PSH (mm)	SD		Mean PSH (mm)	SD	
Early	4.7	1.7	4.0	1.2	0.24	4.5	1.5	
Early Middle	5.0	1.8	4.0	0.0	0.37	4.8	1.6	
Late Middle	4.7	1.4	4.4	1.8	0.63	4.5	1.6	0.07
Late	4.0	-	3.1	0.2	0.05	3.3	0.5	
p value[b]	0.93		0.56		p value[c]	0.43		
All Groups Mean Range	4.8 3.0-8.0	1.6	4.1 3.0-9.0	1.4	-	4.5 3.0-9.0	1.5	

PSH - Pretarsal skin height; SD - standard deviation
[a] Analysis of Variance (ANOVA) between males and females per age group
[b] Analysis of Variance (ANOVA) among age groups per sex
[c] Analysis of Variance (ANOVA) among age groups (all sexes)
[d] t-test between males and females (all age groups)

Table 3. Measurements of Upper Eyelid Crease Height (ECH) by Adult Age Groups and Sex

Adult Age Groups	Male (n = 43)		Female (n = 32)		p value[a]	Overall (n = 75)		p value[d]
	Mean ECH (mm)	SD	Mean ECH (mm)	SD		Mean ECH (mm)	SD	
Early	5.2	1.8	6.9	1.0	0.01	5.9	1.7	
Early Middle	6.1	1.9	6.3	0.6	0.83	6.1	1.7	
Late Middle	6.4	1.8	5.5	1.7	0.23	5.9	1.8	0.41
Late	5.0	-	5.7	0.6	0.42	5.5	0.6	
p value[b]	0.33		0.11		p value[c]	0.91		
All Groups Mean Range	5.8 3.0-9.0	1.8	6.1 3.0-8.0	1.5	-	5.9 3.0-9.0	1.7	

ECH - eyelid crease height; SD - standard deviation
[a] Analysis of Variance (ANOVA) between males and females per age group
[b] Analysis of Variance (ANOVA) among age groups per sex
[c] Analysis of Variance (ANOVA) among age groups (all sexes)
[d] t-test between males and females (all age groups)

Table 4. Measurements of Eyebrow Height (EBH) by Adult Age Groups and Gender

Adult Age Groups	Male (n = 43)		Female (n = 32)		p value[a]	Overall (n = 75)		p value[d]
	Mean EBH (mm)	SD	Mean EBH (mm)	SD		Mean EBH (mm)	SD	
Early	9.7	2.3	9.7	1.2	0.99	9.7	2.0	
Early Middle	10.2	4.4	11.9	3.3	0.56	10.6	4.2	
Late Middle	11.4	3.0	10.2	1.8	0.22	10.7	2.4	0.77
Late	10.5	-	13.6	2.9	0.46	12.8	2.8	
p value[b]	0.59		0.02		p value[c]	0.15		
All Groups Mean Range	10.3 5.0-21.0	3.2	10.5 7.0-15.5	2.1	-	10.4 5.0-21.0	2.7	

EBH - eyebrow height; SD - standard deviation
[a] Analysis of Variance (ANOVA) between males and females per age group
[b] Analysis of Variance (ANOVA) among age groups per sex
[c] Analysis of Variance (ANOVA) among age groups (all sexes)
[d] t-test between males and females (all age groups)

Table 5 shows very high degree of concordance between right and left eyes in the three eyelid measurements, with inter-eye correlation coefficients ranging from 0.94 to 1.00.

Table 5: Inter-eye Correlation Coefficient of Eyelid Measurements by Sex

Eyelid Feature measured	Inter-eye Correlation Coefficient Values		
	Males (n = 43)	Females (n = 32)	Overall (n = 75)
Pretarsal skin height	0.995	0.98	0.99
Eyelid crease height	0.98	1.00	0.99
Eyebrow height	0.98	0.94	0.97

DISCUSSION

Surgical correction and reconstruction of the upper eyelids and eyebrow require knowledge of normal anatomy and its important landmarks.[2,3] PSH, ECH, and EH are among the features that provide

Table 6: Key studies with pretarsal skin height, eyelid crease height and eyebrow height measurements

First Author	Population studied (n)	Year Published	Upper Eyelid and Brow Feature Measurements, in millimeters					
			PSH		ECH		EBH	
			M	F	M	F	M	F
Cartwright[2]	Caucasian (n=143)	1994	1.6	2.8	6.9	7.3	6.4	7.6
Dharap[3]	Malay (n=305)	1995	2.9	3.0	6.1	6.5	11.7	11.0
Sim[11]	Singapore Chinese (n=100)	2000	-	-	6.0		-	
Price[5]	African-American (n=89)	2009	3.1	3.6	7.2	7.7	18.9	21.7
	Caucasian (n=75)		2.0	3.3	6.2	7.5	14.1	20.7
Wu[12]	Chinese (n=102)	2010					R:12.11, L:12.22	R:12.53, L:12.50
Preechawai[8]	Thai-Chinese,	2011	-		4.0		-	
	Thai-Malay (n=101)		-		6.6		-	
Packiriswamy[6]	South Indians (n=200)	2013	2.24	2.91	-		5.19	7.92
	Malaysian South Indians (n=200)		2.38	3.33	-		5.43	9.20
Chen[9]	Chinese: 21-30 y (n=260)	2013	2.4		6.0		-	
	Chinese: 31-40 y		2.6		6.1			
Park[10]	Asian Male (n=234) Asian Female (n=264)	2013	-	-	6.6	6.5	12.4	12.0
Lu[7]	Malays (n=103)	2017	3.99		8.33		11.10	
	Chinese (n=97)		2.29		4.91		11.79	
Omana	Filipinos (n=75)	2020	4.8	4.1	5.8	6.1	10.3	10.5

*EBH - eyebrow height; ECH - eyelid crease height; PSH - pretarsal skin height; M- males; F- females; R-right; L-left

a significant impact to one's facial appearance. There are several published race-specific studies on these 3 parameters involving Caucasians, African-Americans, Indians, Malays, and Chinese as summarized in Table 6.[2,3,5-12]

Our study findings show that the mean PSH of all study participants was 4.5 mm. Our overall mean PSH is higher compared to studies involving Caucasians, African-Americans, Malays, Chinese and South Indians.[2,3,5,6,12] On the other hand, the mean ECH was 5.9 mm. ECH values in our study group were similar to multiple studies involving Asians[3,8,10] However, our measurements were lower compared to Caucasians.[2,5] It is widely known that Asians have lower insertion of the levator aponeurosis to the orbicularis muscle than Caucasians which explains for the lower ECH values in our study.[2,3] Lastly, the mean EBH in our study was 10.4 mm. Our measurements were very close to values reported by studies involving Asians.[3,7,10,12] EBH measurements had the largest standard deviation compared to PSH and ECH values similar to the study by Dharap et al.[3] This may be attributed to the difficulty in determining the exact upper limit or lowest row of mature eyelashes, especially in females who pluck their eyebrow hairs.[2,3]

The Effect of Sex

Our study demonstrated no significant differences in the means of PSH between sexes. This is contrary to other studies that showed higher PSH in females than males.[2,3,5-7] Our smaller sample size may account for the differences in study findings.

On the other hand, our study findings showed that mean ECH among females in the early adulthood age group was significantly higher than the mean ECH among males belonging to the same age group. This is in agreement with the study by Lu *et al.* involving Chinese participants.[7] Conflicting results were reported among Caucasians.[2,5]

Studies involving Caucasians, African-Americans, and South Indians showed higher EBH in females than males.[2,5,6] Among the Chinese, data were conflicting. Wu *et al.* reported higher EBH in females than males. Whereas, Lu *et al.* reported similar measurements between the two sexes.[7,12] Our study findings are more consistent with Lu *et al.*

The Effect of Age

Our study failed to show any effect of age on PSH and ECH. Although a few studies have reported increasing PSH with age, the same relationship was not observed in this study.[2,3] Furthermore, the age-related increases in ECH and PSH are usually proportional and these contribute to symmetry of the upper eyelids.[2,3]

Our study findings demonstrate that EBH increased with age among females subjects ($p = 0.016$). This was also reported among Malays and African-Americans.[3,5] On the other hand, Cartwright *et al.* found no relationship between EBH and age among Caucasians.[2] Variations in the technique in measuring EBH may partially account for these differences. Our study used the same technique in measuring EBH with Dharap *et al.* which was different from Cartwright *et al.*[2,3]

An increase in EBH with age was mainly attributed to tonic frontalis contraction associated with aging, preventing the lowering of the eyebrow even in relaxation.[18,19] The frontalis muscle only acts on approximately the medial two-thirds of the eyebrow. The lateral third of the eyebrow is not affected by the muscle activity and is expected to sag with age.[20-21]

In this study, there was some difficulty in taking measurements among females subjects who had non-surgically altered or enhanced their eyebrows. Thus, considering this factor along with the patient's age and sex, oculoplastic surgeons should be meticulous in planning any eyebrow procedures since an over-elevation creates a surprised look and aged appearance.[5]

Limitations of this study included the small sample size and lack of representations from other regions of the Philippines. Our institution caters to residents of Metro Manila and Calabarzon. Our findings are also only applicable to the age groups included in the study. For future studies, we recommend including the younger age groups and representatives from other regions of the country for a more varied and comprehensive data analysis that will better represent the Filipino population.

In summary, Filipino participants included in our study have higher mean PSH compared to Caucasians and African-Americans while ECH and EBH values were similar with Chinese, Malay, and Thais. No sex-related differences were identified in both PSH and EBH. While females in early adult age have higher ECH than their counterpart males. Significant age effect was only seen in EBH measurements among our female subjects.

ACKNOWLEDGMENTS

REFERENCES

1. Leatherbarrow B, Jones PF. *Oculoplastic Surgery* (2nd ed.). London: Informa Healthcare, 2010;39.
2. Cartwright MJ, Kurumetry UR, Nelson CC, *et al.* Measurements of upper eyelid and eyebrow dimensions in healthy white individuals. *Am J Ophthalmol.* 1994;117(2):231-234.
3. Dharap AS, Reddy SC. Upper eyelid and eyebrow dimensions in Malays. *Med J Malaysia.* 1995;50(4):377-381.
4. Kunjur J, Sabesan T, Ilankovan V. Anthropometric analysis of eyebrows and eyelids: An inter-racial study. *Br J Oral Maxillofac Surg.* 2006;44(2):89-93.
5. Price KM, Gupta PK, Woodward JA, *et al.* Eyebrow and eyelid

dimensions: An anthropometric analysis of African Americans and Caucasians. *Plast Reconstr Surg.* 2009;124(2):615-623.

6. Packiriswamy V, Kumar P, Bashour M. Photogrammetric analysis of eyebrow and upper eyelid dimensions in South Indians and Malaysian South Indians. *Aesthet Surg J.* 2013;33(7):975-982.

7. Lu TY, Kadir K, Ngeow WC, Othman SA. The Prevalence of Double Eyelid and the 3D Measurement of Orbital Soft Tissue in Malays and Chinese. *Sci Rep* 2017;7(1):14819.

8. Preechawai P. Anthropometry of eyelid and orbit in four southern Thailand ethnic groups. *J Med Assoc Thai.* 2011;94(2):193-199.

9. Chen MC, Ma H, Liao WC. Anthropometry of pretarsal fullness and eyelids in oriental women. *Aesthetic Plast Surg.* 2013;37:617-624.

10. Park DH, Choi WS, Yoon SH, Song CH. Anthropometry of Asian eyelids by age. *Plast Reconstr Surg.* 2008;121(4):1405-1413.

11. Sim RS, Smith JD, Chan AS. Comparison of the aesthetic facial proportions of southern Chinese and white women. *Arch Facial Plast Surg.* 2000;2:113-120.

12. Wu XS, Jian XC, He ZJ, *et al.* Investigation of anthropometric measurements of anatomic structures of orbital soft tissue in 102 young Han Chinese adults. *Ophthalmic Plast Reconstr Surg.* 2010;26:339-343.

13. Kakizaki H, Malhotra R, Madge SN, Selva D. Upper eyelid anatomy: An update. *Ann Plast Surg.* 2009;63(3):336-343.

14. Medscape. Upper eyelid blepharoplasty. February 5, 2021; https://emedicine.medscape.com/article/842137-overview (Accessed June 21, 2021).

15. Delfin F, Salvador JM, Calacal GC, *et al.* The Y-chromosome landscape of the Philippines: extensive heterogeneity and varying genetic affinities of Negrito and non-Negrito groups. *Eur J Hum Genet.* 2011;19(2):224-30.

16. Comyn T, Jagor F, Virchow RLC, Wilkes C. Chapter V. Craig A, ed. The Former Philippines thru Foreign Eyes. New York: D. Appleton and Company, 1917;chap. 5.

17. DeLamater J, Friedrich WN. Human sexual development. *J Sex Res.* 2002;39(1):10-14.

18. Van der Lei B, Fechner MF. Does the eyebrow sag with aging: An anthropometric study of 95 Caucasians from 20 to 79 years of age. *Plast Reconstr Surg.* 2016;138(4):763e-765e.

19. Bruneau S, Foletti JM, Muller S, *et al.* Does the eyebrow sag with aging? An anthropometric study of 95 Caucasians from 20 to 79 years of age. *Plast Reconstr Surg.* 2016;137(2):305e-312e.

20. Van den bosch WA, Leenders I, Mulder P. Topographic anatomy of the eyelids, and the effects of sex and age. *Br J Ophthalmol.* 1999;83:327-352.

21. Kashkouli MB, Abdolalizadeh P, Abolfathzadeh N, *et al.* Periorbital facial rejuvenation: applied anatomy and pre-operative assessment. *J Curr Ophthalmol.* 2017;29(3):154-168.