Original Article

Linear and Angular Filipino Cephalometric Norms According to Age and Sex

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ABSTRACT

Objective: To quantify relevant cephalometric parameters for Filipinos according to age and sex.

Materials and Methods: A total of 157 Filipino subjects (78 males, 79 females) who fulfilled specific criteria were selected from elementary, high school, and college students affiliated with Manila Central University. They were divided into comparison groups (GI, GII, GIII, and GIV) on the basis of chronological age and sex. Lateral cephalograms were taken for all subjects, and the mean and standard deviation for each parameter was recorded and compared among groups.

Results: The male group had a longer anterior cranial base (S-N), total facial height (N-Me), longer lower anterior facial height (N-ANS), longer ramus height (Cd-Go), longer lower posterior dentoalveolar height (Mo-Mi′), and total mandibular length (Gn-Cd) than the female group. All these linear measurements were statistically significantly different between males and females in GI, GIII, and GIV. On the other hand, SNB angle showed significant differences ($P = .0271$) in GIV only. In the lower third of the face, significant opposite tendencies were found in GIV. The female group showed a clockwise rotation, whereas the male counterpart had a counterclockwise rotation of the mandibular plane. The denture pattern of both groups was characterized by a proclination of both lower incisor (Ii to MP) and upper incisor (Is to SN).

Conclusions: Convexity due to dentoalveolar protrusion is the naturally occurring facial profile for Filipinos. The adult females showed steeper mandibular and occlusal plane angles than the male samples.

KEY WORDS: Convex profile; Dentoalveolar protrusion; Mandibular rotation; Linear and angular cephalometric measurements

INTRODUCTION

The diagnosis of dentofacial deformity is derived by comparing the patient's cephalometric values with statistically defined population norms. Downs[1] compared the dentofacial patterns of what he termed ''Negro, Japanese, Chinese, and Australians to Native Americans whites'' and found differences in the facial profiles. Likewise, detailed studies on Japanese facial structures revealed a facial convexity distinct to Asians,[2] which was particularly exhibited in the lower face region.[3] In addition, the growth pattern of Japanese samples from 4 years of age to adulthood was reported to express a strong sexual dimorphism.[4] These findings show that the confounding variables brought about by age, sex, and race must be recognized for a meaningful diagnosis.

In modern orthodontics, computer-based cephalometry has produced a generation of craniofacial normative databases for most ethnic groups. However, a comprehensive Filipino cephalometric database is still lacking. Current cephalometric studies on Filipino dentofacial morphology were mostly conceived from Steiner's analysis.[5,6] These studies show that Filipinos present a convex profile because of more proclined upper and lower incisors when compared with other ethnic groups. Nevertheless, the samples in these studies

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Table 1. Demographics

Subjects	GI	GII	GIII	GIV
Male (N)	21	16	20	21
Age (Mean ± SD) (y)	7.0 ± 0.6	9.1 ± 1.1	14.5 ± 1.2	22.6 ± 4.2
Range (y)	6.1–7.9	8.0–11.2	12.8–16.2	18.3–34.5
Female (N)	29	10	19	21
Age (Mean ± SD) (y)	7.0 ± 0.5	9.8 ± 1.6	13.8 ± 0.9	21.6 ± 1.5
Range (y)	6.0–7.9	8.1–11.9	12.2–15.3	19.9–24.8

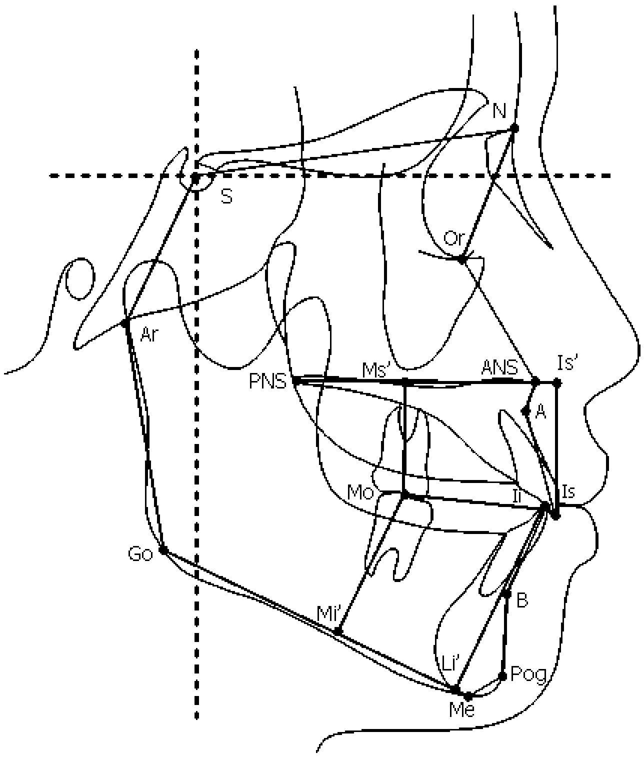

FIGURE 1. The x–y coordinate system and the landmarks used to construct the cephalometric parameters investigated in this study.

were mostly adults and were not pooled according to sex. Expectedly, the study with predominantly male samples generated larger readings of Pog to NB, suggesting a strong sexual dimorphism in the lower third of the face.[6]

Sexual dimorphism in craniofacial structures normally appears between 12 and 15 years of age when orthopedic therapy is initiated. This being the case, both male and female population groups in this age bracket should have their own cephalometric normative data for meaningful diagnosis.

The purpose of this study is to quantify relevant cephalometric parameters for Filipinos according to age and sex.

MATERIALS AND METHODS

From the elementary, high school, and college students associated with Manila Central University, 157 Filipino subjects (78 males, 79 females) were selected who fulfilled the following criteria: (1) natural-born Filipinos, (2) acceptable facial profile and facial symmetry, (3) Class I occlusion with no crowding or proximal caries, (4) all teeth present except third molars, and (5) no previous orthodontic therapy. Clinical examinations were conducted and records (eg, name, birthday, sex, health status) were obtained to ensure that

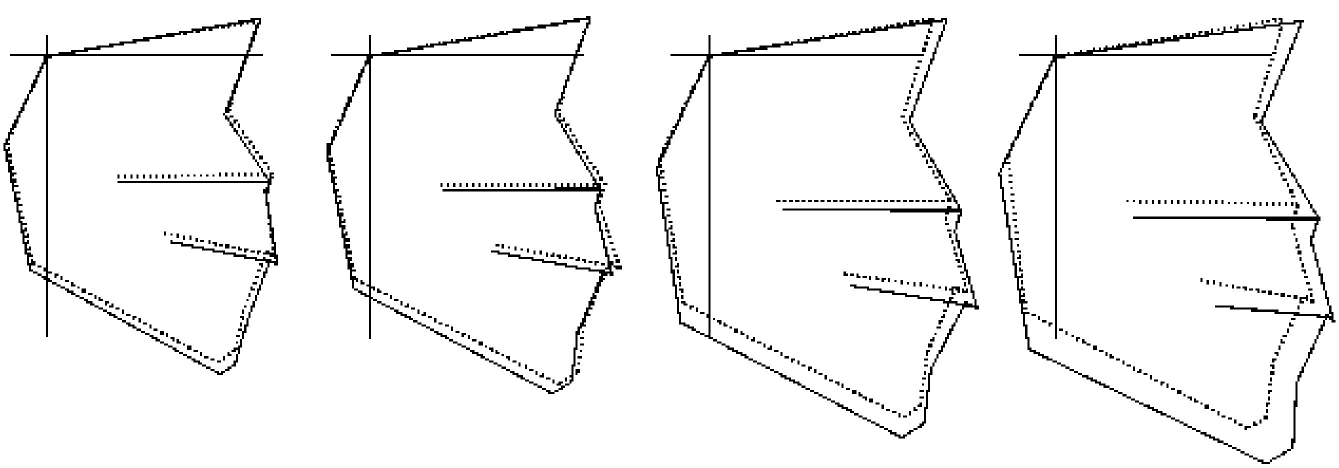

FIGURE 2. Facial diagrams of male (solid line) and female (broken line) Filipino samples showing sexual dimorphism appearing at GIII and to a more noticeable degree at GIV.

Table 2. Linear Cephalometric Measurements (mean ± SD, mm) of Filipino Samples According to Sex

	GI			GII		
	Male	Female	*P*	Male	Female	*P*
N-S	65.2 ± 2.8	63.5 ± 2.8	.034*	67.0 ± 2.0	66.4 ± 2.5	.547
N-Me	108.2 ± 5.8	104.4 ± 4.6	.012*	111.7 ± 5.7	110.8 ± 5.4	.681
N-ANS	49.6 ± 2.9	46.7 ± 2.8	.001**	51.2 ± 2.8	50.7 ± 3.5	.693
ANS-Me	60.0 ± 4.1	59.5 ± 3.1	.596	61.7 ± 4.5	61.6 ± 2.9	.942
A′-Ptm′	45.8 ± 2.5	44.8 ± 1.9	.123	46.6 ± 2.4	48.4 ± 2.5	.090
Gn-Cd	102.4 ± 4.7	98.9 ± 3.4	.003**	106.0 ± 6.1	107.9 ± 6.1	.438
Pog′-Go	67.4 ± 4.0	65.3 ± 3.2	.048*	69.6 ± 4.5	71.9 ± 4.6	.215
Cd-Go	48.3 ± 3.6	46.6 ± 2.5	.042*	51.2 ± 4.7	50.5 ± 5.4	.733
Is-Is′	24.7 ± 2.4	25.3 ± 1.6	.327	25.7 ± 2.5	25.3 ± 1.8	.692
Ii-Ii′	37.2 ± 2.8	36.2 ± 2.6	.217	38.9 ± 2.5	39.5 ± 2.8	.547
Mo-Ms′	17.9 ± 2.6	17.4 ± 2.1	.520	18.0 ± 2.6	18.0 ± 1.8	.964
Mo-Mi′	28.5 ± 1.8	27.1 ± 1.7	.005**	29.4 ± 2.2	28.8 ± 2.3	.474

* $P < .05$; ** $P < .01$; *** $P < .001$.

Table 3. Angular Cephalometric Measurements (mean ± SD, degrees) of Filipino Samples According to Sex

	GI			GII		
	Male	Female	*P**	Male	Female	*P**
Facial A.	86.1 ± 2.6	85.9 ± 2.1	.792	86.4 ± 1.9	88.0 ± 1.8	.041
Convexity	12.0 ± 5.6	12.8 ± 4.0	.572	9.0 ± 4.8	10.4 ± 3.5	.426
A-B plane	−5.4 ± 2.2	−5.8 ± 2.3	.516	−4.5 ± 2.9	−5.3 ± 1.9	.461
Y-axis	60.0 ± 3.5	60.0 ± 2.1	.964	59.9 ± 1.4	58.7 ± 1.7	.050
FH to SN	10.6 ± 2.0	9.9 ± 2.1	.263	10.3 ± 2.0	10.1 ± 2.5	.800
SNA	81.3 ± 3.9	82.2 ± 3.0	.332	80.4 ± 3.0	82.9 ± 3.6	.063
SNB	76.7 ± 3.2	77.2 ± 2.7	.574	76.9 ± 2.8	78.9 ± 3.1	.095
ANB	4.6 ± 2.0	5.0 ± 1.7	.362	3.5 ± 2.1	4.0 ± 1.3	.485
FP to SN	75.5 ± 2.9	76.0 ± 2.6	.543	76.1 ± 2.7	78.0 ± 3.2	.120
PP to SN	10.7 ± 2.5	8.9 ± 2.9	.022*	10.3 ± 3.0	10.2 ± 3.8	.973
MP to SN	38.3 ± 4.8	37.7 ± 4.3	.645	36.5 ± 4.3	36.9 ± 4.5	.790
RP to SN	91.0 ± 4.6	91.0 ± 5.3	.997	91.8 ± 3.3	91.3 ± 4.3	.755
Gonial A.	127.3 ± 6.2	126.7 ± 6.3	.740	124.7 ± 4.3	125.6 ± 5.2	.617
Is to SN	103.1 ± 5.6	101.5 ± 7.0	.388	106.6 ± 5.4	112.9 ± 4.3	.005
Ii to MP	93.4 ± 5.3	93.5 ± 6.2	.940	96.7 ± 5.5	96.7 ± 4.5	.994
Is to Ii	125.2 ± 7.0	127.2 ± 9.9	.446	120.3 ± 6.9	113.6 ± 6.5	.022*
OP to SN	21.9 ± 3.5	21.2 ± 2.8	.411	21.2 ± 2.8	19.8 ± 3.5	.286
OP to FH	11.3 ± 3.3	11.3 ± 2.7	1.000	10.9 ± 2.2	9.8 ± 2.2	.227

* $P < .05$; ** $P < .01$; *** $P < .001$.

the established criteria were observed strictly. The school research committee permitted the taking of radiographs only if both parents and subjects were informed of the amount of radiation and risks and they consented to the procedure. On the basis of chronological age and sex, the subjects were divided into comparison groups (GI ~ 7 years of age; GII ~ 9.5 years of age; GIII ~ 14 years of age; and GIV ~ 22 years of age). Demographics for each group are summarized in Table 1.

The cephalometric films of all subjects were obtained using the same X-ray unit (Panoura Ultra, Yoshida Dental Mfg Co Ltd) at natural head position, with teeth in maximum interdigitation and lips in a relaxed posture. The author traced all head films according to established procedures,[7] identified all the relevant landmarks (Figure 1), and measured both the linear and angular parameters. The glossary for the parameters used in this study are extensively reported elsewhere.[4,7,8] An x–y coordinate was constructed for all tracings with a line parallel to FH and a line perpendicular to it at sella (Figure 1). All relevant angular and linear parameters and coordinates were measured with the aid of Windows-based cephalometric software (WinCeph, Rise Corp, Sendai, Japan).

For data management, Microsoft Excel 2002 for Windows XP was used. Descriptive analysis and Student's *t*-tests were generated with the assumption that each

Table 2. Extended

GIII			GIV		
Male	Female	P	Male	Female	P
72.1 ± 3.3	67.4 ± 3.2	<.001***	74.9 ± 3.7	69.7 ± 2.1	<.001***
126.3 ± 6.9	119.1 ± 2.9	<.001***	133.4 ± 6.2	124.3 ± 6.1	<.001***
56.9 ± 2.9	53.9 ± 2.6	.002**	59.3 ± 3.3	56.3 ± 2.9	.003**
71.3 ± 5.8	66.6 ± 3.8	.005**	75.5 ± 5.1	69.4 ± 5.1	<.001***
52.4 ± 2.5	50.0 ± 2.5	.005**	54.7 ± 2.8	50.9 ± 2.3	<.001***
120.7 ± 5.6	115.4 ± 4.5	.003**	130.2 ± 4.2	119.2 ± 5.1	<.001***
78.7 ± 3.7	76.9 ± 5.0	.196	84.2 ± 3.8	79.0 ± 4.4	<.001***
60.3 ± 5.6	55.6 ± 3.3	.003**	67.3 ± 3.6	58.6 ± 3.8	<.001***
30.0 ± 3.3	27.9 ± 2.4	.028*	30.9 ± 3.2	29.5 ± 2.8	.139
45.1 ± 3.6	42.1 ± 2.9	.007**	47.9 ± 3.3	43.2 ± 2.9	<.001***
23.3 ± 2.2	21.8 ± 1.7	.023*	26.6 ± 2.0	23.7 ± 2.2	<.001***
34.2 ± 2.7	31.1 ± 2.2	<.001***	37.0 ± 2.8	33.0 ± 2.4	<.001***

Table 3. Extended

GIII			GIV		
Male	Female	P*	Male	Female	P*
86.7 ± 2.8	88.1 ± 2.1	.101	88.8 ± 2.2	87.4 ± 3.3	.120
10.9 ± 6.5	10.3 ± 3.8	.721	7.4 ± 3.2	9.9 ± 6.1	.104
−6.2 ± 3.4	−5.8 ± 2.5	.695	−4.6 ± 1.8	−5.3 ± 2.8	.330
61.6 ± 2.7	60.6 ± 2.8	.270	60.6 ± 2.2	61.3 ± 3.6	.453
8.5 ± 2.2	8.8 ± 2.9	.696	8.0 ± 2.4	9.5 ± 2.8	.068
83.5 ± 3.7	84.2 ± 3.0	.515	84.4 ± 3.3	82.7 ± 4.0	.144
78.9 ± 3.1	80.0 ± 2.6	.218	81.2 ± 3.2	78.7 ± 3.6	.027*
4.7 ± 2.8	4.2 ± 1.6	.581	3.3 ± 1.2	4.0 ± 2.2	.204
78.2 ± 3.2	79.3 ± 2.5	.241	80.8 ± 3.2	78.0 ± 3.7	.012*
8.9 ± 3.0	8.7 ± 4.3	.877	8.3 ± 2.9	10.6 ± 3.1	.016*
34.6 ± 5.2	34.7 ± 3.6	.965	31.8 ± 4.9	36.1 ± 5.8	.014*
92.3 ± 4.2	92.9 ± 3.6	.671	91.7 ± 5.1	95.7 ± 5.0	.014*
122.3 ± 5.4	121.8 ± 4.4	.767	120.1 ± 7.3	120.3 ± 6.2	.903
111.0 ± 5.4	112.1 ± 5.7	.540	111.4 ± 6.0	108.2 ± 6.0	.096
101.3 ± 4.5	99.4 ± 3.9	.166	99.1 ± 4.9	98.3 ± 5.4	.616
113.0 ± 5.9	113.7 ± 5.6	.690	117.7 ± 6.8	117.4 ± 5.7	.887
17.2 ± 4.5	16.6 ± 4.2	.663	13.4 ± 3.9	18.5 ± 4.2	<.001***
8.8 ± 4.0	7.8 ± 3.8	.428	5.5 ± 2.7	9.1 ± 3.8	.001**

variable measured was normally distributed. The level of significance was set at .05. The method error was determined by retracing and remeasuring 10 randomly selected cases, which generated an average error of less than 0.3 mm for the linear, 0.4 mm for the x–y coordinates, and 0.4° for the angular measurements.

RESULTS

Comparison between Male and Female Filipino Samples

The means, standard deviations, and statistical differences for linear and angular measurements are shown in Tables 2 and 3 and depicted in Figure 2.

Linear Measurements

In general, the male craniofacial dimensions were larger than the female counterparts. The size difference was noticeable in GIII and increased to a more significant level in GIV. The male group had a longer anterior cranial base (S-N), total facial height (N-Me), longer lower anterior facial height (N-ANS), longer ramus height (Cd-Go), longer lower posterior dentoalveolar height (Mo-Mi′), and total mandibular length (Gn-Cd) than the female group. All these linear measurements generated statistical differences between males and females in GI, GIII, and GIV. However, all the variables in GII did not show any statistical differences between sexes. In addition, the anterior lower facial height (ANS-Me), maxillary size (A′-Ptm′), anterior upper dentoalveolar height (Ii-Ii′), and posterior upper dentoalveolar height (Mo-Ms′) were significantly larger in males than females in GIV.

Angular Measurements

In general, both groups showed no statistical differences in the facial angle except in GII, which may be related to the moderate differences in the direction of the mandibular rotational pattern (y-axis angle $P = .0503$). The maxillae showed no statistical differences as shown by the angle SNA. Interestingly, the mandible showed significant differences ($P = .0271$) between sexes in GIV only, as shown by the SNB angle. The denture pattern of both groups was characterized by a degree of proclination of both lower incisors (Ii to MP) and upper incisors (Is to SN). Moreover, the incisor proclination was statistically significantly more pronounced in the female than in the male group in GII ($P = .0051$). The convexity of the male group was less (Angle of convexity: 7.4°) than that of the female group (9.9°). Nevertheless, no statistically significant differences were present. In the lower third of the face, significant opposite angular rotation was found in GIV. The female group showed a clockwise rotation resulting in steeper occlusal and mandibular plane angles, whereas the male counterpart had a counterclockwise rotation of the mandibular plane.

DISCUSSION

Filipino craniofacial structures were investigated at the early mixed dentition (GI), prepuberty (GII), adolescence (GIII), and adulthood (GIV) stages. In essence, the single film of one subject provided only a static revelation of linear and angular relationships at a particular developmental stage.

Nevertheless, despite the cross-sectional nature of the study, some findings were in conformity with earlier findings regarding craniofacial growth standards.[9–14] This was exemplified by the statistically significant smaller linear measurements in females shown in Figure 2. GI reflected a delayed growth experience, whereas the confluent delineation of facial diagrams in GII displayed catch-up growth in females resulting in parallel growth patterns in both sexes. Thus, the prepubertal skeletal configurations of both sexes were essentially analogous at this stage.

The greater growth increments between GII and GIII described a circumpubertal growth pattern. The marked contrast in size at GIV showed a more pronounced and longer growth spurt in males. In clinical practice, these developmental processes, especially from puberty to adulthood, are major considerations in orthopedic, orthodontic, and orthognathic surgical planning.

Deviations in linear dimensions can result in varied tendencies in the lower third of the face. The backward positioning of the chin and steeper occlusal and mandibular planes in the female samples at GIV obviously was due to a shorter ramus height (Cd-Go). On the other hand, the flatter occlusal and mandibular plane angles in the male samples could be related to a generous increase in the ramus height (7.0 mm) and a minimal increase in the anterior lower face height (4.3 mm) from GIII to GIV. These tendencies generated significant differences in Cd-Go, OP to SN, SNB, and MP to SN between male and female adult samples.

The profile assessment included the anteroposterior position of the chin (pogonion), maxilla (Point A), and the anterior teeth (U1 and L1). The adult male subjects showed a tendency toward a counterclockwise rotation of the mandible, whereas the females showed a clockwise rotation. Thus, the females had a more posteriorly placed chin. When the angle of convexity was plotted against the range established by Downs (-8 $+$ 10°), both groups showed positive values within the limits of acceptable facial convexity. Both groups, however, displayed comparable denture pattern characterized by proclination of the anterior teeth.

It should be noted that the profile assessment is not complete unless the soft tissue integument is also described. Hence, an equally important study on the soft tissue contours should be designed to evaluate how the integuments overlay the dentofacial hard tissues of the Filipino face.

This study has provided descriptive means and range of deviations in linear and angular cephalometric measurements and their interpretations. A bias may exist in this study because of to possible inclusion of early- and late-maturing individuals in the samples. In particular, a discrepancy of growth spurt timing is likely at GII, whereby the early-maturing female samples were already undergoing pubertal growth, but the male samples were yet to experience their growth spurt at GIII. Future research should rather pursue a longitudinal approach with a larger sample size and pooled according to skeletal maturation to refine our understanding about the Filipino face.

CONCLUSIONS

- Convexity due to dentoalveolar protrusion is the norm in Filipino facial profiles.
- Bimaxillary protrusion is the norm especially in Filipinos who suffers from arch length deficiency.
- Extraction therapy is usually indicated to lessen the effect of dentoalveolar protrusion on the facial profile.

- The decision to extract must be made only if aligning the teeth will result in unmanageable protrusion of the lips.
- Practitioners (and perhaps to some extent, the patients)[5] who prefer lesser convexity must not ignore the fact that the profile they want to change is normal and a distinct expression of an Asian face.

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