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Cephalometric Floating Norms of Nepalese Adults Visiting People's Dental College and Hospital with Harmonious Skeletal Pattern

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ABSTRACT

Background: Orthodontics blends art and science, with facial aesthetics reflecting orthodontists' creative insights, making proper diagnosis and treatment planning crucial for successful outcomes. This study aims to establish cephalometric floating norms for Nepalese adult patients.

Method: A cross-sectional study was conducted among adult patients visiting People's Dental College and Hospital from August 2018 to August 2019. The lateral cephalograms were selected based on inclusion and exclusion criteria. Pearson correlation coefficient was used to identify the highly correlated variables among the five parameters (SNA, SNB, NSBa, ML-NSL and NL-NSL). The bivariate linear regression analysis was used to construct a harmony box, which contained the cephalometric floating norms of the five correlated variables. Multiple regression analysis and the standard error of the estimate were calculated to construct the harmony schema, which describes the individual craniofacial pattern. Mean values of the continuous variables were compared (skeletal parameters) between gender, age group and ethnicity using independent sample t-test.

Result: This study included 144 lateral cephalometric records, with 74% females. Statistically significant correlations were found among the five variables (SNA, SNB, NSBa, ML-NSL, NL-NSL), with SNB showing the highest correlation and used as the main variable for the regression equation. Significant gender differences were noted for NL-NSL ($p < 0.05$), but no significant differences were found among different ethnic and age groups. The harmony box illustrated linear regression equations, while the harmony schema was developed from standard errors and means of cephalometric measurements. Comparing Filipino and Nepalese adults showed Filipinos with a retrognathic maxilla and prognathic mandible, while Czech adults showed a retrognathic maxilla compared to Nepalese adults.

Conclusion: Cephalometric floating norms describing the individual craniofacial pattern among Nepalese adults were established based on five correlated variables in the form of a harmony box.

Key words: Nepalese adult, craniofacial parameter, cephalometric floating norms, harmony box, craniofacial parameter.

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INTRODUCTION

Orthodontics combines art and science, making accurate diagnosis and treatment crucial.[1] Radiographic cephalometry, initiated by Broadbent and Hofrath in 1931, is key for studying facial forms and developing diagnostic norms.[2] Solow's 1966 work on craniofacial patterns led to the creation of the harmony box and schema by Segner and Hasund, which account for the interdependence of cephalometric variables.[3] Floating norms have been developed for various populations but not for Nepalese individuals, despite their diverse ethnic makeup.[4] This study aims to establish cephalometric floating norms for Nepalese adults, comparing parameters across age, ethnicity, and gender. This will enhance orthodontic diagnosis and treatment planning, providing a baseline for future research.

METHODS

A cross-sectional study was conducted at the Department of Orthodontics and Dentofacial Orthopedics, People's Dental College and Hospital, Kathmandu, from August 2018 to August 2019. The study involved 144 adult patients (18+ years) who sought orthodontic treatment, with inclusion criteria including Class I malocclusion, no prior orthodontic treatment, good facial aesthetics, and high-quality cephalometric records. The sampling was purposive and non-probability, aiming to establish a harmony box for Nepalese adults. The study received Institutional Review Board approval and informed consent from

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participants. Lateral cephalograms were collected and traced using acetate paper, with precision ensured by registration crosses and marking patient details. Five cephalometric angular measurements (SNA, SNB, NSBa, ML-NSL, NL-NSL) were analyzed based on Segner and Hasund's floating norms. The parameter with the highest correlation was used to create a regression equation and harmony box. Intra-examiner error was assessed by retracing 20 cephalograms, showing no significant bias ($p < 0.05$) with an intra-class correlation coefficient ranging from 0.842 to 0.998. Data were analyzed using SPSS 16.0, with results displayed in graphs and tables. Continuous variables were described using mean, standard deviation, and regression equations, while categorical variables were summarized by frequency and percentage. Comparisons between genders used the independent sample t-test, and comparisons among ethnic groups used ANOVA. Statistical significance was set at $p < 0.05$.

RESULTS

Table 1 showed the demographic characteristics of the respondents. Among total (144), the majority were female (106, or 73.61%), while 38 (26.39%) were male. The average age for male participants was 22.42±4.68 years, with ages ranging from 18 to 39 years. The average age of female was 21.60 ± 4.06 years, with ages ranging from 18 to 45 years.

Table 1. Descriptive statistical analysis of sample size and age

Gender	Frequency (%)	Age in years			
		Mini.	Max.	Mean	S.D
Male	38 (26.39)	18	39	22.42	4.68
Female	106(73.61)	18	45	21.6	4.06
Total	144 (100)	18	45	21.82	4.23

Table 2 shows the age distribution of the participants. The most common age group was 20 to 29 years, comprising 65.28% of the sample, followed by those under 20 years at 27.78%. Participants aged 30 to 39 years made up 6.25%, and the least common age group was 40 years and older, accounting for 0.69%. Most of the study population were Brahmin (31.94%) followed by Newar (27.08%), Chhetri (23.61%) and others (17.36%) (Figure 1).

Table 2. Age distribution of the study respondents

Age group (years)	Frequency (%)
< 20	40(27.78)
20 - 29	94(65.28)
30 - 39	9(6.25)
>40	1(0.69)

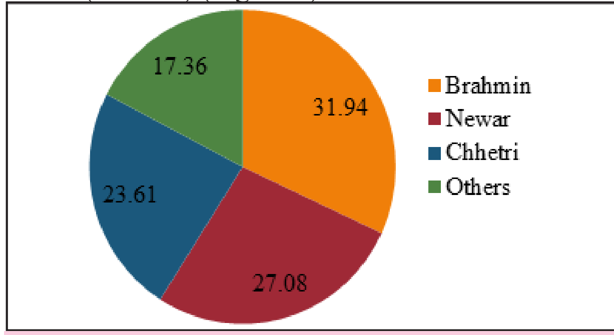

Figure 1. Ethnic distribution of the study population.

Descriptive statistics of cephalometric variables is shown in Table 3.

Table 3. Descriptive statistics of cephalometric variables.(n=144)

Variables	Min.	Maxi.	Mean	SD
SNA	75	99	83.62	3.67
SNB	70	95	79.47	3.95
NSBa	80	145	128.44	10.90
NL-NSL	0	18	8.03	3.32
ML-NSL	11	47	30.68	6.57

Table 4 compares cephalometric variables between males and females. Variance analysis using Levene's test resulted in p-values of 0.4259 for SNA, 0.3094 for SNB, 0.8078 for NSBa, 0.5388 for NL-NSL, and 0.1231 for ML-NSL. These results indicate no significant differences in the means of SNA, SNB, NSBa, NL-NSL, and ML-NSL between males and females ($p > 0.05$). However, a significant difference was found in the mean NL-NSL, with males having a mean of 7.00 and females a mean of 8.40.

Table 4. Comparison of Cephalometric variables between two genders (n=144)

Variables	Male		Female		p-value
	Mean	SD	Mean	SD	
SNA	83.93	3.97	83.51	3.57	0.54
SNB	80.13	4.25	79.24	3.84	0.23
NSBa	127.8	10.03	128.66	11.24	0.68
NL-NSL	7	3.42	8.4	3.23	0.03*

Table 5 compares cephalometric variables across different age groups. Variance analysis using Levene's test yielded p-values of 0.7274 for SNA, 0.3511 for SNB, 0.1704 for NSBa, 0.6318 for NL-NSL, and 0.1207 for ML-NSL. The results show that the means of all cephalometric variables were generally lower in the age group under 20 years and higher in those over 40 years, except for ML-NSL.

Table 5. Comparison of cephalometric variables among different age groups (n=144)

Variables	< 20		20-29		30-39		> 40		p-value
	Mean	S.D	Mean	S.D	Mean	S.D	Mean	S.D	
SNA	82.98	3.69	83.91	3.67	83.22	3.67	86	NA	0.51
SNB	78.55	3.49	79.9	4.12	78.78	3.93	82	NA	0.27
NSBa	130.93	5.43	127.39	12.4	127.78	12.1	133	NA	0.37
NL-NSL	7.98	3.24	8.14	3.39	7	3.32	9	NA	0.79
ML-NSL	31.48	5.4	30.3	7	31.11	7.44	31	NA	0.82

Table 6. Comparison of Cephalometric variables among different ethnic groups (n=144)

Variables	Brahmin		Chhetri		Newar		Others		p-value
	Mean	S.D	Mean	S.D	Mean	S.D	Mean	S.D	
SNA	83.41	3.53	84.44	4.57	83.6	2.96	82.92	3.55	0.43
SNB	78.61	4.01	80	4.48	79.74	3.13	79.88	4.17	0.36
NSBa	127.87	12.55	129.35	8.92	128.72	7.93	127.8	14.21	0.93
NL-NSL	8.11	2.81	7.97	3.41	8.44	3.73	7.32	3.5	0.63
ML-NSL	30.63	5.95	29.47	5.96	32.05	6.89	30.28	7.84	0.4

Table 7. Linear correlation coefficients (r) between SNA, NL-NSL, NSBa, ML-NSL, and SNB of Nepalese adult (n = 144)

	SNA	SNB	NSBa	NL-NSL	ML-NSL
SNA	1	0.77	-0.28	-0.32	-0.27
p-value		<0.001*	<0.001*	<0.001*	<0.001*
SNB		1	-0.37	-0.43	0.47
p-value			<0.001*	<0.001*	<0.001*
NSBa			1	0.09	0.15
p-value				0.2643	0.07752
NL-NSL				1	0.38
p-value					<0.001*

Table 8. Linear regression equations

Variables	Regression equation	R^2	SE
SNA	27.205+0.710SNB	0.586	2.367
NSBa	208.616 -1.009SNB	0.134	10.183
NL-NSL	36.850 - 0.363SNB	0.186	3.009
ML-NSL	92.288 -0.775SNB	0.218	5.833
SNB	10.438+ 0.826SNA	0.586	2.553

Table 10. Standard errors of estimate

Variables	R^2	SE
SNA	0.595	2.367
SNB	0.691	2.231
NSBa	0.139	10.26
NL-NSL	0.233	2.952
ML-NSL	0.275	5.677

Table 9. Mean, Standard Error, Upper Limit and Lower Limit of each variable used for construction of harmony schema (n = 144)

Variable	Mean	SE	Lower Limit	Upper Limit
SNA	83.62	2.367	81.253	85.987
SNB	79.47	2.231	77.239	81.701
NSBa	128.44	10.26	118.18	138.7
NL-NSL	8.03	2.952	5.078	10.982
ML-NSL	30.68	5.677	25.003	36.357

For ML-NSL, the highest mean was observed in the under 20 years group, and the lowest was in the 20 to 29 years group. Despite these observations, there were no statistically significant differences in the means of SNA, SNB, NSBa, NL-NSL, and ML-NSL among the different age groups ($p > 0.05$). Table 8 illustrates the strength and significance of correlations between various cephalometric measurements. SNB exhibited the highest significant correlations (both positive and negative) with other variables. Therefore, SNB was chosen as the primary variable for developing the regression equation. SNA was selected to create this regression equation due to its strong and significant correlation with SNB. Table 9 shows the coefficient of determination (R^2) for various cephalometric measurements. For SNA and SNB, the R^2 value was 0.586, indicating that 58.6% of the variation in SNA or SNB can be explained by changes in the other variable. The R^2 for NSBa was 0.134, meaning that 13.4% of the variation in NSBa can be explained by changes in SNB. For NL-NSL, the R^2 was 0.186, indicating that 18.6% of the variation in NL-NSL is explained by changes in SNB. Similarly, the R^2 for ML-NSL was 0.218, showing that 21.8% of the variation in ML-NSL can be explained by changes in SNB. Table 10 shows that Model R^2 for SNA was 0.595, i.e. 59.5% of the variation in SNA could be explained by changes in the combination of the other four variables. Similarly, model R^2 for SNB was 0.691 which inferred that 69.1% of the variation in SNB could be explained by changes in the combination of the other four variables. Likewise, model R^2 for NSBa was 0.139; i.e.13.9% of the variation in NSBa could be explained by changes in the combination of the other four variables. Also, model R^2 for NL-NSL was 0.233, i.e. 23.3% of the variation in NL-NSL could be explained by changes in the combination of the other four variables. Model R^2 for ML-NSL was 0.275, i.e. 27.5% of the variation in ML-NSL could be explained by changes in the combination of the other four variables. The Standard Errors and means of each cephalometric measurement from multivariate analysis provided the basis for the development of harmony schema.

DISCUSSION

Cephalometric norms based on Caucasian data have long been used worldwide.[5,6] However, "floating norms" revealed that ethnicity influences cephalometric patterns on individual, national, and regional levels.[7] Segner first introduced the correlation box for Central Europeans, leading to the development of similar harmony boxes globally.[8] Nepal, being multicultural, has seen studies showing ethnic variations in dentofacial patterns, but no floating norms have been established for its population.[9] This study aimed to create cephalometric floating norms for Nepalese adults, using Segner and Husand's harmony box. Traditionally, cephalometric values were compared to ethnic-specific norms. This study used floating norms to assess five cephalometric variables (SNA, SNB, NSBa, NL-NSL, and ML-NSL) to determine skeletal patterns. In this study, the harmony schema (Figure 7) was constructed by computing the SE when one of the cephalometric variables was predicted from the other four by multiple regression analysis. It represented the degree of variability allowed among the five correlated cephalometric measurements in describing a harmonious face. For any new measurement of cephalometric variable, the harmony schema provided the basis for harmonious or non-harmonious retrognathic, orthognathic and prognathic description with respect to where the measurement lies within the harmony box and the schema. The harmony schema could be shifted in different zones of the harmony box to fit in the cephalometric variables of a subject. A harmonious combination from a correlation point of view did not necessarily require the values to lie on a perfectly straight horizontal line.[11] The measurements which fell within the harmony schema were considered to be harmonious, while those which fell outside the harmony schema were considered to be non-harmonious. Likewise, the measurements which fell above the horizontal mean line within the schema were considered to be retrognathic yet harmonious, those that fell on the line were considered to be orthognathic and those that fell below the mean line within the schema were considered to be prognathic but still harmonious. Thus, this harmony box was able to detect as well as locate skeletal dysplasia in the craniofacial complex as suggested by Di Paolo et al.[10] The harmony box and schema were constructed to describe harmonious and non-harmonious patterns based on these variables. Measurements within the schema were considered harmonious, with those outsides being non-harmonious. Differences in craniofacial patterns were noted, particularly in the NL-NSL measurement between genders. The study's sample was predominantly young adults, and while there were no significant age-related differences in cephalometric parameters, the harmony schema was strengthened. The study had more female participants, aligning with higher aesthetic concerns among women. Differences in NL-NSL between genders might be due to sample size. Ethnic groups in the sample showed no significant cephalometric differences. SNB showed the highest correlation with other variables, aligning with similar findings in other studies. Correlation coefficients ranged from 0.09 to 0.77, with SNA and SNB showing the highest correlation. NSBa's correlation patterns mirrored those seen in other global studies.[12]The harmony schema for Nepalese adults was narrower for SNA and SNB and wider for NL-NSL, ML-NSL, and NSBa compared to other populations, indicating different variability in mandibular inclination. SNA values for Nepalese adults ranged from 80° to 87°, with values outside this range indicating retrognathic or prognathic faces.[13] SNB values ranged from 75.5° to 83.42°, corresponding similarly to other populations.[14] Overall, the craniofacial morphology of Nepalese adults showed similarities with Filipino and Czech populations, with some differences in maxillary and mandibular positions.

CONCLUSIONS

Pearson correlations showed significant relationships between these parameters. A harmony box was created using bivariate linear regression, and multiple regression analysis detailed craniofacial patterns. The study found no significant differences in craniofacial structures across ethnic and age groups but did observe a notable difference in NL-NSL between genders ($p < 0.05$). Among the parameters, SNB showed the strongest correlation and was used to design the regression equation, establishing cephalometric norms for Nepalese adults.

Limitation

The findings of this study may not be generalizable because patients were selected using non-probability sampling from a single hospital. Additionally, the small sample size may be insufficient for comparing cephalometric parameters across different ethnic groups in Nepal. Furthermore, digital tracing could potentially offer more accuracy compared to manual tracing of cephalograms.

Conflict of Interest: None

REFERENCES

1. Steiner CC. The use of cephalometrics as an aid to planning and assessing orthodontic treatment: report of a case. *American Journal of Orthodontics and Dentofacial Orthopedics.* 1960;46(10):721-735.
2. Broadbent BH. A NEW X-RAY TECHNIQUE and ITS APPLICATION TO ORTHODONTIA. *The Angle Orthodontist.* 1931;1(2):45-66.
3. Solow B. The pattern of craniofacial associations: A morphological and methodological correlation and factor analysis study on young male adults. *Acta Odontol Scand 24.* 1966;46:123-135.
4. Beckmann SH, Segner D. Floating norms and post-treatment overbite in open bite patients. *European Journal of Orthodontics.* 2002;24(4):379-390.
5. Downs WB. Variations in facial relationships: their significance in treatment and prognosis. *American journal of orthodontics.* 1948;34(10):812-840.
6. Jacobson A, Jacobson RL. *Radiographic Cephalometry: From Basics to 3-D Imaging, (Book/CD-ROM set)*1995.
7. Hasund A, Bøe OE. *Clinical cephalometry for the Bergen-technique*: Orthodontic Department, Dental Institute, University of Bergen; 1977.
8. Segner D. Floating norms as a means to describe individual skeletal patterns. *The European Journal of Orthodontics.* 1989;11(3):214-220. Pradhan R, Rajbhandari A,
9. Manandhar P, Maharjan S. McNamara Cephalometric Analysis oF Newars of Kathmandu. *Orthodontic Journal of Nepal.* 2018;8(1):14-17.
10. Di Paolo RJ, Philip C, Maganzini AL, Hirce JD.

The quadrilateral analysis: an individualized skeletal assessment. *American journal of orthodontics.* 1983;83(1):19-32

11. Segner D. Floating norms as a means to describe individual skeletal patterns. *The European Journal of Orthodontics.* 1989;11(3):214-220.
12. Franchi L, Baccetti T, McNamara Jr JA. Cephalometric floating norms for North American adults. *The Angle Orthodontist.* 1998;68(6):497-502.
13. Sevilla-Naranjilla MA, Rudzki-Janson I. Cephalometric floating norms as a guide toward a harmonious individual craniofacial pattern among Filipinos. *The Angle orthodontist.* 2009;79(6):1162-1168.
14. Řeháček A, Janega M, Hofmanová P, et al. Cephalometric floating norms for Czech adults. *Prague medical report.* 2012;113(4):271-278.

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