CEPHALOMETRIC PROFILE NORMS FOR SOUTHEASTERN AFRICAN-BRAZILIAN ADULTS ACCORDING TO THE LEGAN-BURSTONE ANALYSIS: A PILOT STUDY

Teresa Cristina Pereira de **Oliveira**[1], Flávio de Mendonça **Copello**[1], Isabela Maria de Carvalho Crusoé **Silva**[2], Lincoln Issamu **Nojima**[1], Matilde da Cunha Gonçalves **Nojima**[1*]

[1]Department of Pedodontics and Orthodontics, Universidade Federal do Rio de Janeiro, Brazil
[2]Odontoclinica Central da Marinha, Brazil.

Palavras-chave: Ortodontia. Brasil. Cefalometria. Grupo de Ancestrais do continente africano. Estética.

RESUMO:

Objetivo: O objetivo deste estudo piloto foi determinar as normas do perfil cefalométrico para uma amostra de jovens adultos afro-brasileiros com oclusão excelente e, compará-las com os padrões caucasianos. **Métodos**: Cefalogramas laterais de 43 indivíduos de ambos os sexos (28 homens e 15 mulheres), com idade média de 22,40 ± 3,40 anos, foram utilizados para avaliar 13 variáveis propostas pela análise de Legan-Burstone. O teste t independente de Student foi utilizado para comparar os valores resultantes com os estabelecidos pelos padrões euro-americanos. **Resultados**: Foram encontradas diferenças significativas (p <0,001) entre afro-brasileiros e caucasianos quanto a: prognatismo maxilar e mandibular, razão vertical da altura, menor ângulo face-pescoço, menor razão vertical altura-profundidade, ângulo nasolabial, protrusão labial superior e inferior, sulco mentolabial e razão vertical lábio-mento. O ângulo de convexidade facial, a exposição dos incisivos superiores e o *gap* interlabial não apresentaram diferenças estatísticas quando comparados os grupos étnicos. Os homens apresentaram maiores ângulos face-pescoço e razões verticais lábio-queixo (p <0,05), enquanto as mulheres apresentaram maior exposição dos incisivos superiores (p <0,05). **Conclusão**: As normas cefalométricas caucasianas não se aplicam a jovens adultos afro-brasileiros. Portanto, diferenças morfológicas nas faces desses indivíduos devem ser levadas em consideração durante as etapas de diagnóstico e planejamento do tratamento ortodôntico.

Keywords: Orthodontics. Cephalometrics. African-continent Ancestry Group. Esthetics. Brazil.

ABSTRACT:

Objective: The aim of this pilot study was to determine cephalometric profile norms for a sample of African-Brazilian young adults with excellent occlusion and compare them to Caucasian standards. **Methods**: Lateral cephalograms of 43 individuals of both genders (28 male and 15 female), with average age of 22.40 ± 3.40 years, were used to evaluate 13 variables proposed by the Legan-Burstone analysis. Student´s independent t-test was used to compare resulting values with those set by European-American standards. **Results**: Significant differences were found (p < 0.001) between African-Brazilians and Caucasians as for: maxillary and mandibular prognathism, vertical height ratio, lower face-throat angle, lower vertical height-depth ratio, nasolabial angle, upper and lower lip protrusion, mentolabial sulcus and vertical lip-chin ratio. Facial convexity angle, maxillary incisor exposure and interlabial gap did not present statistical differences when ethnic groups were compared. Males displayed increased lower face-throat angles and vertical lip-chin ratios (p <0.05) while females presented increased maxillary incisor exposures (p <0.05). **Conclusion**: Caucasian cephalometric norms do not apply to African-Brazilian young adults. Therefore, morphological differences in the faces of such individuals should be taken into account during diagnosis and orthodontic treatment planning stages.

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***Correspondence to:**
Matilde da Cunha Gonçalves Nojima,
Department of Pedodontics and Orthodontics,
Universidade Federal do Rio de Janeiro, Brazil (UFRJ),
Address: Avenida Professor Rodolpho Rocco, 325, Ilha do Fundão, Rio de Janeiro, RJ, Brazil. - Zip code: 21941-617
E-mail: matildenojima@uol.com.br

INTRODUCTION

Facial beauty, as determined by well balanced and esthetic features, is a determining factor in dictating standards for human beauty. Portrayed by different art forms over time, facial features represent to this day, a relevant issue when it comes to social interactions and for the establishment of the individual´s self-esteem. Having said that, the pursuit of facial attractiveness is often the main reason driving patients to orthodontic or orthognathic treatments, aiming to correct facial deformities.[1,2]

Cephalometrics represents an important diagnostic tool, with vast applicability. Several authors[2-6] have proposed normative values in analyses that aim to quantify through a means of comparison, the amount of disharmony between skeletal and soft tissues, as well as to provide planning guidelines for treatment to be initiated. The Legan-Burstone soft tissue analysis is frequently used in orthodontic and orthognathic treatment planning. Nevertheless it is only applicable to populations with European or North-American ancestry, seen as it is based on patterns found in young Caucasian adults and therefore should not be used in diagnosis or treatment planning of other ethnic groups.

There are literature reports of studies that investigated facial differences in various ethnic groups, such as Chinese,[7-9] Japanese,[9-11] Korean,[12,13] Turkish,[14] Jordanian,[15] Yemenite,[16] Indian,[17,18] African[19-21] and African-American.[22-24]

African descendants living today in Southeastern Brazil are very heterogeneous in morphology, because most of them descend from African Bantu slaves who mixed with Mediterranean European colonizers and Native American Indians. The Bantu people in turn, prevail in two vast regions of the African continent: Mid-Eastern Africa, including the Old Portuguese colonies of Angola and Mozambique, as well as the Congo region; and Western Africa ranging from the Southern coast up to the Guinea Golf.[24]

Cephalometric standards for Brazilians of African-Descent have been previously published[25], however the dentoskeletal patterns were emphasized in detriment of soft tissue analysis. There are no literature records of manuscripts attempting to establish cephalometric soft tissue standards for adult African-Brazilians, justifying the present study which aims to use the Legan-Burstone analysis to determine cephalometric soft tissue norms for a sample of young adult, southeastern African-Brazilians and compare them to the Caucasian European-American standards. Therefore, the following null hypotheses were tested: the lack of differences in facial profile norms between African-Brazilians and Caucasian European-Americans; and the lack of differences in facial profile norms between male and female African-Brazilians.

MATERIALS AND METHODS

The study was approved by the Ethics in Research Committee of the Institute for General Health Studies at the Universidade Federal do Rio de Janeiro (IESC – UFRJ – statement n.66/2011). Five individuals that fitted the inclusion criteria refused to take part in the study. All other participants signed an Informed Consent that explained the nature and reason for the study previously to the start of the project. The required sample size was calculated according to a previous pilot study (power analysis at = 0.05 significance level and 80% power) using the facial convexity angle parameter (minimum clinical difference adopted was 5°) with standard deviation of 7.8°. The result showed that at least 39 patients would be necessary for the study.

Forty-three volunteers (28 male and 15 female) were selected from 396 Brazilian active duty Navy personnel attending the Naval Central Dental Clinic (Rio de Janeiro – Brazil). These individuals, born in southeastern Brazil, affirmed to having African ancestry up to the third generation. The average age in the group was 22.4 ± 3.4 years with the age ranging from 18 to 30 years. Females presented an average age of 22.00 ± 4.28 years, and males of 22.6 ± 3.10 years. All individuals were in good state of general health. The individuals were recruited between September 2011 and April 2012 following the inclusion criterion: excellent occlusion of first molars and canines in the permanent dentition (except third molars); 1 to 3 mm overjet; slight rotations of up to 2 mm permitted, distributed over the arch; anterior crowding of up to 2 mm; 20 to 30% overbite; small gaps of up to 2 mm permitted, distributed over the arch; absence of cross bites or previous orthodontic or orthognathic treatments.

Intra and extra-oral photographs, as well as study casts and cephalograms were obtained for all participants. The same operator (IMCS) was trained to take all the lateral cephalograms using the cephalostat (Ortophos Plus DS; Sirona Dental System, Bensheim, Germany) with the following settings: radiation time 15.4s, exposure time 0.4s, X-ray tube voltage 73 kV and X-ray tube current 15mA). Individuals were placed in maximum intercuspation, with lips at rest and Frankfort´s horizontal plane parallel to the ground, as in natural head position. All the digitalized images were obtained in TIFF format and 18 x 24 cm in size.

All cephalometric tracings were performed digitally using Dolphin Imaging® System 11.0 (Dolphin Imaging, Chatsworth, Califórnia, USA) by the same operator (TCPO), so that inter rater reliability was maintained. Tracings were limited to 5 to 10 per day, to minimize fatigue induced

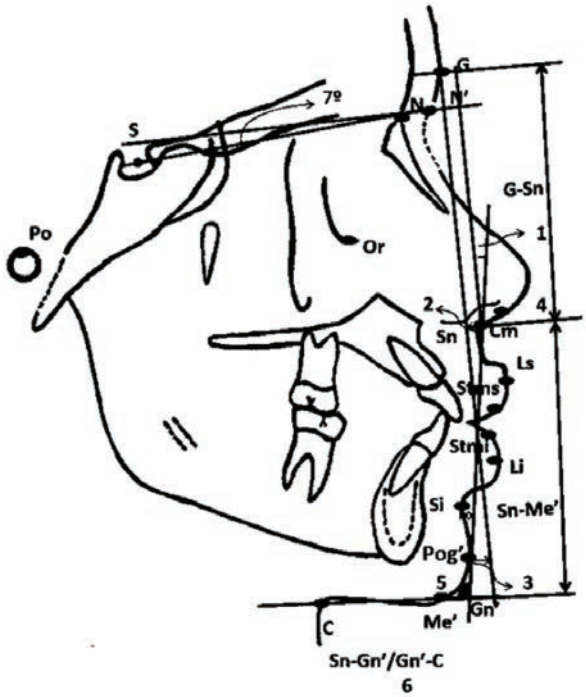

***Figure 1**: Legan-Burstone analysis: Facial morphology – Cephalometric landmarks: S (Sella); N (Nasion); G (Glabella); Sn (Subnasale); Pog´ (Soft tissue pogonion); Gn´ (Soft tissue gnathion); Me´ (Soft tissue menton); C (Cervical point); HP (Horizontal perpendicular plan). Measurements evaluated: 1, Facial Convexity Angle; 2, Maxillary Prognathism (distance from line perpendicular to HP to Sn point); 3, Mandibular Prognathism (distance between line perpendicular to HP and Pog´); 4, Facial Height Ratio (G-Sn/Sn-Me´); 5, Lower Face-Throat Ratio (Sn-Gn'-C); 6, Lower Vertical Height-Depth Ratio (Sn-Gn´/C-Gn´).*

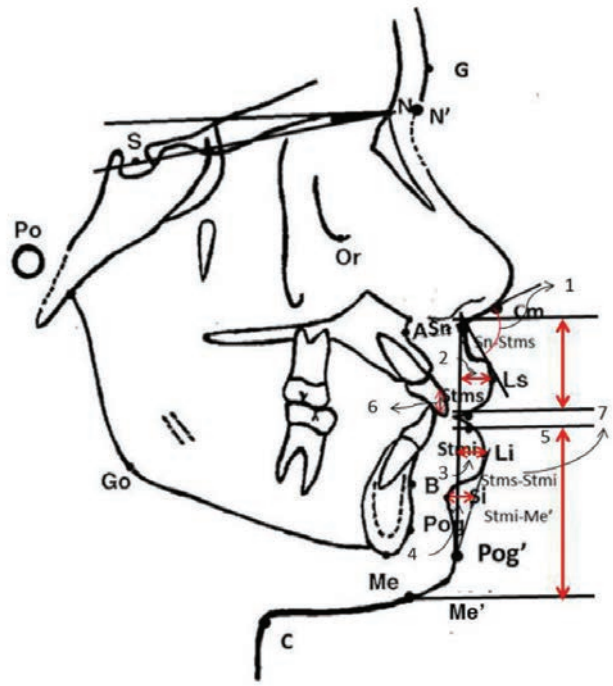

***Figure 2**: Legan-Burstone analysis: lip position and morphology. Cephalometric landmarks: S (Sella); N (Nasion); Sn (Subnasale); Cm (Columella point); Pog´ (Soft tissue pogonion); Me´(Soft tissue menton); Ls (*Labrale Superius*); Li (*Labrale Inferius*); Stms (*Stomion Superius*); Stmi (*Stomion Inferius*), Si (mentolabial sulcus). Measurements evaluated 1, Nasolabial Angle (CmSnLs); 2, Upper Lip Protrusion (Distance from Ls to Sn-Pog´ line); 3, Lower Lip Protrusion (Distance from Li to Sn-Pog´); 4, Mentolabial Sulcus (Distance from Si to Li-Pog´ line); 5, Vertical Lip-Chin Ratio (Sn-Stms/Stmi-Me´); 6, Maxillary Incisor Exposure (Stms-U1); 7, Interlabial Gap (Stms-Stmi).*

errors. Dolphin imaging system corrected X-ray distortions before tracing began, so that angular and linear measurements were not altered. Cephalometric landmarks, reference lines and planes, angular and linear measurements used in the analysis are illustrated in Figures 1 and 2.

Fifteen radiographs were measured twice with a 30-day interval checking for intrarater reliability, and the statistical significance of this procedure was verified by the I.C.C (Intraclass Coefficient Correlation).

Data were subjected to descriptive statistical analysis so that central tendency measures (mean and standard deviations) could illustrate the most common characteristics found in the studied group. Student's t test for independent samples with Bonferroni Correction (α=0.003) was used to assess differences found in African-Brazilian subjects as opposed to the European-American Caucasians norms, as well as to determine whether sexual dimorphism was significant for the studied measurements. Normality of all variables was assessed using Kolmogorov-Smirnov test. Statistical Package for Social Sciences version 16.0 (SPSS Inc., Chicago, Illinois, USA) was used in the analysis.

RESULTS

Descriptive data analysis and statistical comparison between African-Brazilian adults and Caucasian norms as defined by Legan and Burstone (1980) are presented in Table 1. Significant differences (p< 0.003) were found in the African-Brazilian group. Data on facial morphology evidenced that Brazilians of African descent have more pronounced maxillary and mandibular prognathism, smaller facial height ratios and more obtuse throat to neck angles, as well as increased lower vertical height-depth ratio. Lip position analyses showed that African-Brazilians have more acute nasolabial angles, more pronounced upper and lower lip protrusion as well as mentolabial sulcus, besides increased vertical lip-chin ratio. Variables that evaluated facial convexity angle, interlabial gap and maxillary incisor exposure did not present statistical significance when compared to Caucasian norms (Table 2).

The average age in the group was 22.4 ± 3.4 years with the age ranging from 18 to 30 years. Females presented an average age of 22.00 ± 4.28 years, and males of 22.6 ± 3.10 years."

Sexual dimorphism significant difference was not found in the measures evaluated in the present study (Table 3).

***Table 1**: Mean and standard deviation (SD) values found in angular (°) and linear (mm) measurements on soft tissue analysis of African-Brazilian adults versus European-American cephalometric standards, according to the Legan-Burstone analysis (1980). Student´s independent t-test with Bonferroni correction were used for comparison.*

Variable	African-Brazilian (Mean ± SD)	Caucasians Norms (Mean ± SD)	*p*- Value
Facial Morphology			
Facial Convexity Angle (°)	13.02 ± 5.7	12 ± 4	0.247 NS
Maxillary Prognathism (mm)	8.42 ± 3.01	6 ± 3	0.001*
Mandibular Prognathism (mm)	4.58 ± 5.13	0 ± 4	0.001*
Facial Height Ratio	0.80 ± 0.08	1.0 ± 0	0.001*
Lower Face-Throat Angle (°)	110.06 ± 9.90	100 ± 7	0.001*
Lower Vertical Height-Depth Ratio	1.39 ± 0.29	1.2 ± 0	0.001*
Lip position and form			
Nasolabial Angle (°)	89.06 ± 9.32	102 ± 8	0.001*
Upper Lip Protrusion (mm)	8.74 ± 2.16	3 ± 1	0.001*
Lower Lip Protrusion (mm)	8.44 ± 2.34	2 ± 1	0.001*
Mentolabial Sulcus (mm)	-5.63 ± 1.30	4 ± 2	0.001*
Vertical Lip-Chin ratio	0.52 ± 0.05	0.5 ± 0	0.002*
Maxillary Incisor Exposure (mm)	2.41 ± 1.74	2 ± 2	0.124 NS
Interlabial Gap (mm)	1.86 ± 0.66	2 ± 2	0.174 NS

Note: *p ≥ 0.003; not significant (NS). * significant to the level of p < 0.003.*

***Table 2**: Cephalometric data comparison of soft tissue evaluations performed in different ethnic groups* according to the Legan-Burstone analysis.*

Variable	African-Americans (Mean ± SD)	South-Africans (Mean ± SD)	African-Brazilians (Mean ± SD)
Facial Convexity Angle (°)	12.5 ± 5.9	10.7 ± 4.8	13.02 ± 5.7
Maxillary Prognathism (mm)	7.7 ± 4.2	7.0 ± 3.6	8.4 ± 3.0
Mandibular Prognathism (mm)	1.1 ± 8.3	2.1 ± 8.1	4.5 ± 5.1
Facial Height Ratio	1.0 ± 0.1	0.8	0.8 ± 0.1
Lower face-Throat Angle (°)	104.3 ± 13.3	94.1 ± 10.6	110.1 ± 9.9
Lower Vertical Height-Depth Ratio	1.4 ± 0.3	1.2	1.4 ± 0.3
Nasolabial Angle (°)	91.3 ± 14.1	82.6 ± 10.9	89.0 ± 9.3
Upper Lip Protrusion (mm)	8.6 ± 1.8	9.8 ± 1.7	8.7 ± 2.1
Lower Lip Protrusion (mm)	6.9 ± 2.7	9.9 ± 2.7	8.4 ± 2.3
Mentolabial Sulcus (mm)	-5.9 ± 1.5	5.8 ± 1.5	-5.6 ± 1.3
Vertical Lip-Chin Ratio	NA	0.5	0.52 ± 0.0
Maxillary Incisor Exposure (mm)	1.8 ± 2.2	2.3 ± 1.8	2.4 ± 1.7
Interlabial Gap (mm)	0.4 ± 1.1	0.5 ± 0.9	1.8 ± 0.6

Note: *Not significant (NS); not applicable (NA)*

***Table 3**: Mean and standard deviation (SD) values found in angular (º) and linear (mm) measurements on cephalometric soft tissue analysis of both genders of young adult African-Brazilians according to the Legan-Burstone analysis (1980). Student´s independent t-test used for comparison.*

Variable	Males (Mean ± SD)	Females (Mean ± SD)	*p*- Value
Facial Form			
Facial Convexity Angle (º)	12.37 ± 6.48	14.23 ± 3.76	0.241 NS
Maxilar Prognathism (mm)	8.45 ± 3.02	8.36 ± 3.09	0.926 NS
Mandibular Prognathism (mm)	4.93 ± 5.80	3.92 ± 3.69	0.545 NS
Facial Height Ratio	0.80 ± 0.07	0.79 ± 0.08	0.596 NS
Lower Face-Throat Angle (º)	112.57 ± 8.68	105.38 ± 10.61	0.021 NS
Lower Vertical Height-Depth Ratio	1.45 ± 0.27	1.28 ± 0.30	0.074 NS
Lip Position and Form			
Nasolabial Angle (º)	87.43 ± 9.63	92.10 ± 8.17	0.119 NS
Upper Lip Protrusion (mm)	9.05 ± 2.20	8.18 ± 2.04	0.211 NS
Lower Lip Protrusion (mm)	8.54 ± 2.35	2.38 ± 1	0.701 NS
Mentolabial Sulcus (mm)	-5.91 ± 1.16	-5.12 ± 1.42	0.056 NS
Vertical Lip-Chin Ratio	0.54 ± 0.05	0.50 ± 0.04	0.024 NS
Maxillary Incisor Exposure (mm)	1.94 ± 1.63	3.30 ± 1.64	0.013 NS
Interlabial Gap (mm)	1.91 ± 0.71	1.75 ± 0.54	0.443 NS

Note: *p ≥ 0.003; not significant (NS).*

DISCUSSION

The inclusion criteria chosen for this group of African-Brazilians selected from active duty military personnel included: black ancestry up to the 3rd generation, lack of previous orthodontic treatment, southeastern in origin, and age ranging from 18 to 30 years. The predominance of males (*n*=28) over females (*n*=15) reflect the prevalence rate found in the Brazilian Navy, where subjects were selected. Such restrictive inclusion criteria when applied to populations with high miscegenation tend to limit significantly sample sizes. Nevertheless, there are recent literature reports using groups of similar sizes.[15,25]

Despite the lack of statistical significance when compared against Caucasian norms, the facial convexity angle found in African-Brazilians was higher, so more pronounced soft tissue convexity was seen in this group than in European-Americans (12º) (Table 1). Maxillary (8.42mm ± 3.01mm) and mandibular (4.58 mm ± 5.13 mm) prognathism values were highly significant and inconstant (Table 1). This could be due to the high variation in sagittal positioning of the glabella,[18] and a shorter skull base (Sella-Nasion-SN) found in African-Brazilians. There was a posterior dislocation of Nasion point and possibly also of the reference line, which is dropped from the glabella perpendicular to the horizontal reference plane (HP), constructed by drawing a line through Nasion 7º up from Sella-Nasion line (SN).[20]

The lower face-throat angle was found to be more obtuse in African-Brazilians. Its appreciation is critical when it comes to treatment of sagittal discrepancies, as a more obtuse angle indicates that procedures with a potential to reduce chin prominence should be avoided. The increased lower facial height-depth ratio (1.39±0.29) showed that African-Brazilians have a shorter neck, which reinforces that care should be taken with chin-reducing procedures. The smaller vertical height ratio (0.80±0.08) characterized the predominance of lower facial height (Sn-Me') over upper facial height (G-Sn) (Table 1).

Mild differences were observed while comparing sexes. Males had more obtuse lower face-throat angles (112.57º ± 8.68º) than females (105.38º±10.61º), as well as a higher vertical lip-chin ratio (0.54± 0.05) than females (0.50 ± 0.04). In contrast, women presented higher values for incisor exposure (3.30mm ± 1.64 mm) than men (1.94 mm ± 1.75mm) (Table 2).

Significant differences were found while comparing African or African-descending ethnic groups to the Legan-Burstone Caucasian pattern (Table 3). Flynn *et al*[23] studied African-American individuals and found more convex faces, with more pronounced maxillary and mandibular

prognathism, lower nasolabial angle, more protruding lips and pronounced mentolabial sulcus, when compared to European-Americans. In a similar study, Naidoo and Miles[21] evaluated a group of black South-African adults and compared them to Caucasians. It was shown that the first group displayed smaller facial convexity, more pronouced lip protrusion, more acute lower face-throat angle and nasolabial angle as well as shallower mentolabial sulcus. Except for mandibular prognathism and upper lip protrusion, average values found in all analyzed variables for African-Brazilians were closer to African-American findings than to South African findings. This is probably due to the similar heterogeneous origin of African ancestors that were brought to the American Continent, which aside from gathering different African ethnic groups, also interconnected with Native American Indians and European colonizers. Therefore, morphological differences in the faces of such individuals should be taken into account during diagnosis and orthodontic treatment plan.

This research has some limitations such as the possible magnification difference of the devices used to obtain the radiographic images compared to the previous studies[2-6] used as European standard. Nevertheless, these same studies are used in the orthodontist's routine as usual. The number of male and female included in our sample does not comprise enough power to comparisons for sexual dimorphism evaluation, and maybe the reason is associated to the small sample size and difference of individuals number from each sex. In addition, it would be interesting to compare this Afro-Brazilian group to another African standards and with a control group of white southeastern Brazilians.

CONCLUSIONS

The null hypotheses proposed by this study were rejected. Caucasian cephalometric norms do not apply to African-Brazilian young adults.

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