Comparative study of facial proportions between Afro-Brazilian and white Brazilian children from 8 to 10 years of age*

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Abstract

Objective: To evaluate the vertical facial proportions of Afro-Brazilian and white Brazilian female children, aged 8-10 year-old, and to evaluate differences between the race groups. **Methods:** The authors evaluated 70 cephalometric radiographs, in lateral norm, equally divided into the two groups, 22 at 8-year-old, 18 at 9-year-old, and 30 at 10-year-old. All the patients showed harmonious facial esthetics, normal occlusion and none of them were subjected to previous orthodontic treatment. The following proportions were evaluated: LAFH/TAFH (ANS-Me/N-Me), TPFH/TAFH (S-Go/N-Me), LPFHTPFH (Ar-Go/S-Go), LPFH/LAFH (Ar-Go/ANS-Me). Data were analyzed by descriptive statistics and Student's t-test in order to compare the differences between the race groups, ANOVA with Bonferroni's test for comparison between the ages and Pearson's correlation coefficient to examine the level of association between facial proportions. Statistical analysis was performed at the 0.05 level of significance. **Results:** The findings showed no statistically significant differences between the groups and between the ages for each group, for all variables. **Conclusion:** There were no significant differences in facial proportions between Afro-Brazilian and white Brazilian female children. The facial proportions remained constant from 8 to 10 years of age, regardless the racial group.

Keywords: Cephalometrics. Facial proportions. Afro-Brazilian children. White Brazilian children.

INTRODUCTION AND LITERATURE REVIEW

Nowadays, many researches[9,18,19,23,29] are increasingly trying to improve scientific knowledge of cephalometry, especially those related to the vertical dimensions of the face, since many experienced clinicians agree that the malocclusion with marked facial vertical imbalance generally are more difficult to treat and have less stability than those with severe anteroposterior discrepancy.[25] The control of the vertical dimension of the face represents a point of fundamental importance to the success of orthodontic treatment.[13,25,29]

The lack of attention from the orthodontist's side in this regard would help a retrusive positioning of the chin[13,25,26,29] due to clockwise mandibular rotation, worsening facial esthetics.

Aiming at finding a normal pattern in the vertical proportions of the face, several authors[4,5,6,14,17,18,20,30] have established mean values considered normal for these proportions, noting that patients with such measures or who were close to them, had more balanced and harmonious faces.

Although there are several studies[4,5,7,12,14,17,18,20,21,22,27,30] evaluating facial proportions, few of them have set out to check these proportions in young black individuals[19,23]. Knowing that this group has some craniofacial characteristics that are different from the white individuals,[1,2,10,11,15,16] on which the routinely used data are based for diagnosing and planning the orthodontic treatment, one sees the need for further studies concerning the black subjects.

In a comparative study between white and black subjects, it is important to clearly distinguish from an anthropological point of view, so that no subjective aspects guide the indication of what individual belongs to which racial type. Skin color, hair type, and nasal and labial morphology are characteristics of utmost importance in determining the racial type,[3] since the white individuals present fair skin, straight or wavy hair, high and thin nose and thin lips, while the black individuals exhibit dark skin, coiled hair, low and flat nose and bulky lips. The term "race" seems more appropriate for anthropological studies, since it expresses biological characteristics of the population studied, as opposed to "ethnicity", which indicates socio-cultural aspects.[24]

While comparatively studying cephalometric characteristics between the races Afro-Brazilian and white Brazilian, according to Downs and Sassouni's analysis, we observed higher absolute values, as well as dental and labial double-protrusion in the Afro-Brazilian group[2]. The mandibular plane was more inclined, the maxilla was more anteriorly positioned and the dental double-protrusion was more prevalent in the black children when compared to the white ones[10]. The dental double-protrusion in Afro-Brazilians is the result of a wider mandibular ramus in this racial group,[11] and the lip double-protrusion is a normal feature indicating that the normal values of the facial profile, recommended in Ricketts's, Steiner's, and Holdaway's analysis, cannot be applied to that group.[28]

For females, most of the craniofacial growth occurs before menarche, in most cases occurring early in the second decade of life.[8] Thus, it becomes imperative to know the normal standards of young women in pre-menarche so that the diagnosis and treatment can be applied in time to obtain satisfactory results.

The aim of this study is to assess and quantify the facial proportions observed in cephalometric radiographs obtained in lateral norm, from Afro and white Brazilian females, from 8 to 10 years of age, searching for differences in proportions between races and ages, within each racial group. Also, we intend to verify the presence of a correlation between different facial proportions.

MATERIAL AND METHODS

The development of this research was initiated only after submission and approval of the Ethics Committee in Research at PUC Minas, under the number 135/2004.

The sample for this retrospective cross-sectional study consisted of 70 cephalometric radiographs, taken in lateral norm, from 70 young Brazilian females, 35 white and 35 black, ages 8, 9 and 10 years. The sample was evenly distributed among the racial groups according to age groups, being 11 8-year-old children, 9 9-year-old children, and 15 10-year-old children for each racial group.

The classification of the children as Afro or white Brazilian followed the anthropological characteristics such as skin color, hair type, nose and lip morphology described by Ávila.[3]

The inclusion criteria adopted for the sample selection were based on Siqueira and Prates's[26] work and included: chronological age of 8, 9 and 10 years; Brazilian nationality; radiographic images with adequate sharpness and contrast, without distortion; general good health; harmonious facial profile with passive lip seal; absence of facial asymmetries; profile tending to straight in white, and bimaxillary protrusion of mild to moderate intensity in the Afro-Brazilians; normal occlusion; no previous orthodontic treatment; and black and white racial types with descent of the same racial type.

The development of the cephalograms was based in Bishara's,[4] Jarabak and Fizzel's,[17] Nanda's[21], Nanda and Rowe,[22] and Schendel et al's[25] postulates, identifying the dentoskeletal and tegumental profile structures that allowed the demarcation of the following points and lines (Fig 1):

1) N-Me - distance between points N and Me. Represents the total anterior facial height (TAFH).

2) ANS-Me - distance between points ANS and Me. Represents the lower anterior facial height (LAFH).

3) S-Go - distance between points S and Go. Represents the total posterior facial height (TPFH).

4) Ar-Go - distance between points Ar and Go. Represents the lower posterior facial height (LPFH).

According to the works of Bishara and Jakobsen,[5] Horn,[14] Jarabak and Fizzel[17] and Wylie and Johnson,[30] we used the following measurements for evaluation of vertical craniofacial proportions:

1) ANS-Me/N-Me - Proportion between LAFH and TAFH.

2) S-Go/N-Me - Proportion between TPFH and TAFH.

3) Ar-Go/S-Go - Proportion between LPFH and TPFH.

4) Ar-Go/ANS-Me - Proportion between LPFH and LAFH.

Statistical methodology

All tracings and measurements were performed twice, at random, with an interval of approximately 30 days, by the same investigator and checked by a second, obtaining two measures, knowing that the mean values were used for statistical analysis. For verification of random error between the first and second measurements, we used Dalhberg's formula.

The descriptive analysis consisted in demonstrating the values of the variables and in the calculation of the synthesis (mean) and variability (standard deviation) measures, besides the minimum and maximum values. For comparison of means between groups of young white and Afro-Brazilians we used the Student's t-test. In the intra-racial assessment between the ages of 8, 9 and 10 years, we used the ANOVA (Analysis of Variance) with Bonferroni's test indicating where the differ-
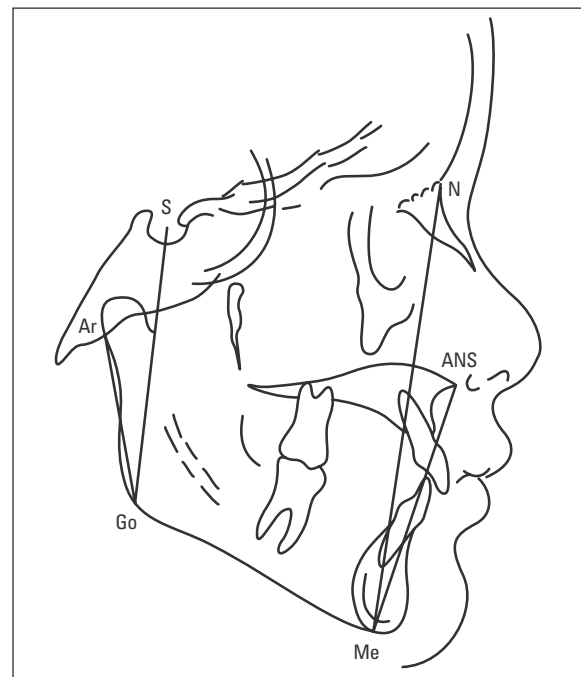

FIGURE 1 - Landmarks and lines that were used in this study.

ence occurred. To determine the degree of association between the different proportions, we used Pearson's correlation coefficient. The level of significance previously defined for this study was 5%.

RESULTS

The verification of random error between the first and second measurements did not show any significant errors in any variable mea-

sured, indicating the reliability of the cephalometric values obtained (Table 1).

Table 2 shows the mean values, standard deviations and Student's t-test results for proportions LAFH/TAFH, TPFH/TAFH, LPFH/TPFH and LPFH/LAFH for the white and Afro-Brazilian groups. According to the results, no statistically significant differences were found between the groups.

The ANOVA results for the proportions LAFH/TAFH, TPFH/TAFH, respectively, showed no statistically significant differences, considering the groups separately and the total sample, but pointed to the existence of statistically significant differences for the proportions LPFH/TPFH and LPFH/LAFH, considering the total sample (Table 3).

Thus, we performed Bonferroni's test in order to identify at what point was the difference

TABLE 1 - Random error for measurements according to Dahlberg's formula.

Measurements	Values
Total Anterior Facial Height (TAFH)	0.77
Lower Anterior Facial Height (LAFH)	0.64
Total Posterior Facial Height (TPFH)	0.65
Lower Posterior Facial Height (LPFH)	0.92

TABLE 2 - Mean values, standard deviations, and values for Student's t-test for the proportions LAFH/TAFH; TPFH/TAFH; LPFH/TPFH and LPFH/LAFH, according the racial group, age and total sample.

Propor-tion	Mean values and s.d. for White children at 8, 9, and 10 years of age and for the total sample				Mean values and s.d. for the black children at 8, 9, and 10 years of age and for the total sample				p values			
LAFH/TAFH	0.55 (±0.02)	0.57 (±0.01)	0.55 (±0.01)	0.55 (±0.01)	0.56 (±0.02)	0.56 (±0.01)	0.55 (±0.02)	0.56 (±0.02)	0.063[NS]	0.778[NS]	0.771[NS]	0.218[NS]
TPFH/TAFH	0.63 (±0.03)	0.63 (±0.03)	0.64 (±0.04)	0.63 (±0.03)	0.64 (±0.02)	0.62 (±0.02)	0.61 (±0.04)	0.62 (±0.03)	0.387[NS]	0.734[NS]	0.167[NS]	0.371[NS]
LPFH/TPFH	0.61 (± 0.03)	0.59 (±0.02)	0.60 (±0.01)	0.60 (±0.02)	0.61 (±0.03)	0.58 (±0.02)	0.59 (±0.03)	0.60 (±0.03)	0.807[NS]	0.406[NS]	0.527[NS]	0.587[NS]
LPFH/LAFH	0.71 (± 0.07)	0.66 (± 0.05)	0.69 (± 0.04)	0.69 (±0.06)	0.70 (±0.07)	0.64 (±0.04)	0.66 (±0.07)	0.67 (±0.06)	0.846[NS]	0.559[NS]	0.169[NS]	0.221[NS]

NS = non-significant, p>0.05.

TABLE 3 - Analysis of Variance (ANOVA) results for the proportions LAFH/TAFH; TPFH/TAFH; LPFH/TPFH and LPFH/LAFH for age, in each racial group, and for age and race, in the total sample studied.

Proportions	F and p values > F for white children	F and p values > F for black children	F and p values > F for the total sample
LAFH/TAFH	3.13 / 0.057[NS]	0.86 / 0.433[NS]	1.92 / 0.154[NS]
TPFH/TAFH	0.21 / 0.811[NS]	1.79 / 0.183[NS]	0.43 / 0.654[NS]
LPFH/TPFH	1.10 / 0.345[NS]	2.57 / 0.091[NS]	3.72 / 0.029*
LPFH/LAFH	1.69 / 0.200[NS]	1.85 / 0.174[NS]	3.32 / 0.042*

* Significant (p<0.05); NS = Non-significant.

TABLE 4 - Bonferroni's test for comparing the variance of the proportion LPFH/TPFH according to age.

AGE	8	9
9	- 0.026 **0.026***	
10	- 0.014 0.276	- 0.011 0.627

* Significant (p<0.05).

for the proportion LPFH/TPFH (Table 4).

The value found has a negative sign, indicating that the mean observed at 9 years was smaller than the mean observed at 8 years of age. The value in bold indicates that the significant difference occurred between 8 and 9 years of age.

We also performed Bonferroni's test in order to identify at what point was the difference in the proportion LPFH/LAFH (Table 5).

The value found has a negative sign, indicating that the mean observed at 9 years was lower than the mean observed at 8 years of age. The value in bold indicates that the significant difference occurred between 8 and 9-year-old.

To verify the degree of association between the proportions, we used Pearson's correlation coefficient, where the observed values for both variables in a single observational unit are compared and the quantification of the correlation is given by Pearson's coefficient "r". It is the mean product of standard deviations of variables "x" and "y". If its value is negative, it indicates that when the value of a variable (x) increases, the value of another variable (y) decreases or vice versa. In case of a positive value, it means that the two variables have changing values in the same direction. Two variables have a perfect correlation when the value of "r" is equal to 1.00; and there is total lack of correlation when "r" takes the value zero. Values equal to or greater than 0.90 indicate the presence of a strong correlation, between 0.50 and 0.90, of moderate correlation. Values below 0.50 indicate a weak correlation.

According to Table 6, the results indicated the presence of a mild correlation between the variables under evaluation. Positive and significant correlations were observed between LPFH/LAFH with TPFH/TAFH and with LPFH/TPFH; negative and significant correlation was observed between LPFH/LAFH with LAFH/TAFH. All these correlations can be classified as moderate. The other correlations are weak and non significant.

The results among black Brazilian children were very similar to those among the white children, in relation to the statistical significance of correlations, observing the positive correlations between LPFH/LAFH with TPFH/TAFH and with LPFH/TPFH, but with slightly higher intensity than the white children (Table 7).

TABLE 5 - Bonferroni's test for comparing the variance of the proportion LPFH/LAFH according to the age.

AGE	8	9
9	- 0.052 **0.037***	
10	- 0.025 0.467	- 0.026 0.508

* Significant, p<0.05.

TABLE 6 - Pearson's correlation coefficient among the variables LAFH/TAFH; TPFH/TAFH; LPFH/TPFH and LPFH/LAFH in white children (n=35).

Variable	LAFH/ TAFH	TPFH/ TAFH	LPFH/ TPFH	LPFH/ LAFH
LAFH/TAFH				
TPFH/TAFH	-0.065 0.710			
LPFH/TPFH	-0.282 0.100	-0.057 0.742		
LPFH/LAFH	-0.583 0.000	0.663 0.000	0.608 0.000	

TABLE 7 - Pearson's correlation coefficient among the variables LAFH/TAFH; TPFH/TAFH; LPFH/TPFH and LPFH/LAFH in Afro-Brazilian children (n=35).

Variable	LAFH/ TAFH	TPFH/ TAFH	LPFH/ TPFH	LPFH/ LAFH
LAFH/TAFH				
TPFH/TAFH	-0.041 0.812			
LPFH/TPFH	-0.275 0.109	0.249 0.148		
LPFH/LAFH	-0.528 0.001	0.676 0.000	0.802 0.000	

DISCUSSION

Considering that the pattern of facial and skeletal malocclusions are early determined,[5,8,21] the diagnosis of an imbalance before the maximum period of craniofacial growth would allow a greater usage of this in favor of orthodontic treatment, making it more biological and personal.

The orthodontic literature, referring to cephalometric standards, is highly concentrated in the evaluation of white individuals.[1,2,10,11,15,16,19,23,24,28] However, studies show differences in the cranio-dento-facial complex between the groups of white and black people, justifying the execution of comparative research, minimizing the use of information that may exert negative influences on the diagnosis and, consequently, on the results of the orthodontic treatment. Features such as greater maxillo-mandibular cephalometric linear measurements,[1,2,11,15] greater buccal inclination of the incisors,[1,2,10,11] differences in mandibular plane[10] inclination, more protrusive facial profile,[2,10,28] and more anteriorly placed maxilla and/or jaw,[1,10,16] were found in black children when compared to the white ones. Few studies[19,23] aimed at evaluating the vertical facial proportions in black individuals and in age groups different from the present study.

The proportion LAFH/TAFH reports on the proportional relationships of the anterior region of the face. The higher the LAFH value, the higher the proportion, which indicates a tendency to an open bite. The opposite is true for a pattern of deep bite.[7,9,12,13,14,20,25,30] In this study, in the groups of white and Afro-Brazilian children, the proportion LAFH/TAFH was at 0.55 and 0.56, respectively, and no statistically significant differences were found between ages or groups. Lopes,[19] assessing white and black children from 4 to 6 years of age with normal primary dentition, found higher values of LAFH for blacks, being 0.60 at 4 and 0.59 at 6 years old and, consequently, higher values from the proportion LAFH/TAFH.

Among the white children, the results of this study were proved according to Wylie and Johnson,[30] where the LAFH represented 0.55 of the TAFH in patients with a good facial standard. Nahoum,[20] evaluating patients with normal occlusion and good facial profile, found the value 0.55, without specifying age. In young Brazilians with Angle Class I, between 8 and 11 years-old, Locks et al[18] found a value of 0.58 for LAFH.

The proportion TPFH/TAFH, also called facial height ratio,[17] informs the proportional relationships of the posterior region of the face with the anterior region. The lower the value of TPFH and/or higher the value of TAFH, the lower the proportion, indicating a tendency to an open bite. The opposite is true for a pattern of deep bite.[9,17,28]

In this study, in the white and Afro-Brazilian group, this proportion was 0.63 and 0.62, respectively, and was not found statistically significant differences among ages or groups. These values are close to those observed by Lopes,[19] who obtained 0.62 at 4 years and 0.61 at 6 years old for white, and 0.60 at 4 years and 0.61 at 6 years old for black children with no statistically significant differences between races and ages.

Among white subjects, Jarabak and Fizzel,[17] in a study of 200 patients of both sexes aged between 17 and 20 years and Bishara,[4] studying female patients from 4.5 to 12-years-old, affirmed that this proportion should be 0.65, being the mean of the present study compatible with the value previously recommended by the authors.

The proportion LPFH/TPFH reports the proportional relationships of the posterior region of the face. The lower the value of the SPFH (S-Ar), the lower is the value of TPFH, indicating a tendency to an open bite. This trend will be even worse if the LPFH is also reduced. The opposite is true for a pattern of deep bite.[17] According to Jarabak and Fizzel,[17] the ideal proportion of SPFH/LPFH at the age

of 11 would be 3:4, or 0.75; i.e., the proportion LPFH/TPFH would be 4:7, or 0.57. However, one must consider the sum of the sella (N.S.Ar), articular (S.Ar.Go) and gonial (Ar. Go.Me) angles, which, in patients with balanced faces, is 396±6°.

In this study, in the white and Afro-Brazilian group, this ratio was 0.60 and 0.60, respectively, and statistically significant differences between the races were not found. Evaluating the total sample and considering the age group, this proportion was significantly higher at 8 years of age (0.61) than at 9 (0.59). These results occurred due to a higher mean of the TPFH and lower of the LPFH at the age of 9 in both races, indicating a changing pattern of these measures among the children within one year.

The absence of statistically significant differences between the races and ages studied for the values of the proportion LPFH/TPFH was also observed by Lopes[19] when evaluating the normal deciduous dentition in white and black children, since the author obtained values of 0.58 for 4-year-old and 0.58 for 6-year-old for white, and 0.58 for 4-year-old and 0.57 for 6-year-old for black children.

In white individuals, Bishara, Peterson and Bishara[6] found that in female patients, age 10, with clinically acceptable occlusion, this proportion was 0.64; against 0.60 in the present study, this difference occurred due to a higher mean value of the LPFH in the first work. According to Bishara and Jakobsen,[5] this proportion does not vary significantly in patients with balanced facial pattern from 10 to 26-year-old.

The proportion LPFH/LAFH, also called the facial height index,[14] informs the proportional relationships of the lower, posterior, and anterior regions of the face. The lower the LPFH value and/or higher the LAFH value, the lower the proportion, indicating a tendency to a skeletal open bite. The opposite is true for a pattern of deep bite.[13,14,18,20,29]

In this study, in the white and Afro-Brazilian group, this ratio was 0.69 and 0.67, respectively, with no statistically significant differences between the races. Considering the total sample and the age group, this proportion was significantly higher at 8 (0.70) than at 9-year-old (0.64). These results were mainly due to a higher mean of the LAFH for 9-year-old in both groups.

Evaluating white patients with an average age of 11 years, Horn[14] found a mean number of 0.70, similar to that found in this study. According to this author, cases with values below 0.55 and above 0.85 should be considered for surgical treatment.[14] Studying white Brazilian children of both sexes, 8-11 year-old, Locks et al[18] found the value of 0.66.

Lopes[19] assessed the proportion LPFH/LAFH in white and black children with normal deciduous dentition, from 4 to 6-year-old, and found 0.61 and 0.61 for the white and 0.58 and 0.59 for the black children at 4 and 6 years old, respectively, which indicates a lower value of LAFH in these ages. Nouer[23] evaluating young females with excellent occlusion, from 10 to 14-year-old, found the value of 0.69, similar to that found in this study. This could suggest a pattern of maintenance of this ratio in Afro-Brazilian females with normal occlusion, from 8 to 14-year-old.

According to the results obtained in this study, no variable showed a strong correlation value, either positive or negative, with any other, indicating no solid interaction pattern between them.

The behavior between the racial groups was very similar. Positive correlations were observed between LPFH/LAFH with TPFH/TAFH and LPFH/TPFH. A negative correlation was observed between LPFH/LAFH with LAFH/TAFH. All these correlations were significant and classified as moderate. The other correlations proved weak and non-significant.

CONCLUSIONS

According to the methodology used and the results obtained, we concluded that:

1) Comparing the groups Afro and white Brazilians, no significant differences between them were identified in any of the measured facial proportions.
2) There were moderate correlations between LPFH/LAFH with TPFH/TAFH and LPFH/ LAFH with LPFH/TPFH in the white children group.
3) There were moderate correlations between LPFH/LAFH with TPFH/TAFH and a stronger correlation between LPFH/ LAFH with LPFH/TPFH in the black children group. These correlations were slightly higher than those presented by the white children group.

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