ANTHROPOMETRICAL OROFACIAL MEASUREMENT IN CHILDREN FROM THREE TO FIVE YEARS OLD

Medidas antropométricas orofaciais em crianças de três a cinco anos de idade

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ABSTRACT

Purpose: to obtain the orofacial anthropometric measurements in preschool children from three to five years old and realize the connection of these data with chronological age, gender, race, and oral habits. **Methods:** a transversal study with 93 children selected through consecutive convenience sample. Parents answered a questionnaire about the oral habits and children underwent odontological evaluation and orofacial anthropometric. The significance level was p <0.05. **Results:** the averages of orofacial anthropometric measurements were described. There were statistical differences in measures of midface (p<0.001), lower face (p<0.001), face height (p<0.001) and lower lip (p=0.015) in the age groups. The male gender showed higher mesures in height of the face (p=0.003), lower face (p<0.001), upper lip (p=0.001) and lower lip (p<0.001). There was no statistically significant difference in the height of the upper lip in non-caucasian subjects (p=0.03). The presence of oral habits didn't influence the outcomes. The exclusive breastfeeding for six months influenced the rise of the middle third (p=0.022) and height of the face (p=0.037). **Conclusion:** the measurements described in this study were higher than those found in other studies. The orofacial measurement increased with age. There were higher on measures for masculine gender and for non-white children, but not for the presence of oral habits.

KEYWORDS: Anthropometry; Face; Measures; Child; Child, Preschool

INTRODUCTION

Anthropometry is defined as the science that studies the measures of size, weight and proportions of the human body [1]. It has been used in several fields such as health, ergonomics, sports and engineering. In health sciences, the use by Speech-Language Pathology is one of the methods of morphological evaluation of the face that has increased in the last decade [2-14].

The orofacial anthropometric assessment is based on the location of specific points on the face of the subject and on the performance of noninvasive measurements [3,15]. It is a technique of low cost and it is non-hazardous to the health of the subject [3,4,14]. Because orofacial anthropometric assessment results in objective data, it can be compared across subjects once the normal pattern for the population has been established [3]. The digital caliper, an instrument used in orofacial anthropometry, is easy to handle and transport and provides no clinically significant difference for having 0.01 mm graduation [5].

In the field of orofacial myofunctional, area of expertise of Speech-Language Pathology, the caliper is used for quantitative evaluation of the face, specifically on evaluations of the frenulum

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of the tongue, facial paralysis, facial aesthetics, study of masticatory predominance among others [16]. The procedures of anthropometry can help the Speech-Language Pathologist to complement the clinical examination, providing information on the characterization of the face as well as reproducible data [11,12,16].

References on orofacial anthropometric normality measures are found in the literature, however, the majority of studies refers to school-age children, adolescents and adults [1,3,4,6,9,16,17]. Data on measurements of the face of children under six years of age are only found in the international literature [1]. Thus, the objective of this study was to obtain anthropometric orofacial measurements in preschool children from three to five years of age and to correlate those measures with age, gender, race and oral habits.

METHODS

This consisted on a cross-sectional, observational and contemporary study. The research was conducted at the Clinic of Children and Youth of the institution from March, 2011 to March, 2013. The study was approved by the Ethics Committee of the Federal University of Rio Grande do Sul (UFRGS) under the number 19236.

The sample consisted of 93 children aged between three and five years who were selected through a convenience consecutive sample. Besides the age, the inclusion criterion for the study was to present primary dentition with complete eruption of the first four molars. The following exclusion criteria were adopted: children who have undertaken Speech-Language Therapy regardless of the area; children with a history of orthodontic treatment or facial orthopedic treatment; children with syndromes, craniofacial malformation or neurological disease; children whose guardians did not allow participation in the study; children who were not willing to perform the orofacial anthropometric measures proposed.

Initially, the children were evaluated by a Pediatric Dentist. The evaluation of the occlusion was performed in a dental unit under illumination. The absence or presence of malocclusions was observed (anterior and/or posterior open bite, overbite, anterior and/or posterior crossbite, unilateral or bilateral).

For the Speech-Language Pathology assessment, the subsection “Face” of item number two of MBGR Protocol [18] was used. The protocol records the anthropometric orofacial measurements at three time points and at the end, the arithmetic mean among the measures is calculated. The measures analyzed were: middle third of the face (glabella to sub-nasal (g-sn)); lower third of the face (sub-nasal to gnathion (sn-gn)); face height (glabella to gnathion (g-gn)) - sum of the middle third with the lower third; outer corner of the right eye to right commissure of the lip (ex-ch); outer corner of the left eye to the left commissure of the lip (ex-ch); upper lip (sub-nasal to the lowest point of the upper lip (sn-sto)) and lower lip (the uppermost point of the lower lip to gnathion (sto-gn) lip). The measure of the width of the face (zy-zy) was not performed because the measuring instrument used does not allow such measure.

All methodological steps for collection of anthropometric orofacial measurements as recommended in the literature were considered: precise location and palpation before marking the anthropometric points - which was performed with appropriate pencil; use of the caliper without pressing its tips on skin; examiner seating in front of the subject under direct artificial light; subject seating with his head in a natural position and with feet flat on the floor; subject with the teeth in occlusion in the usual position without maximum intercuspation [3-5,9,13].

Anthropometric measurements were always performed by the same Speech-Language Pathologist who had experience in the area of orofacial myofunctional and in the handling of the instrument. The caliper used was digital from DIGIMESS Pro-Fono/2006. Biosafety requirements were met.

Parents answered a questionnaire about oral habits (breastfeeding, use and frequency of use of pacifier and baby bottle, finger suction, nail biting, habit of breathing through the mouth). The administration of a questionnaire about oral habits was conducted by a different researcher who was previously trained in paused reading and constant intonation for the application of each question and response options.

Children who showed changes in dental and/or speech aspects were referred to the respective services at the same institution.

The results were correlated and analyzed according to oral habits, age, gender and race. Regarding age, the children were divided into three groups: three years to three years and 11 months; four years to four years and 11 months; five years to five years and 11 months. Subjects were considered as presenting oronasal breathing through questionnaire responses plus the observation of the Speech-Language Pathologist during the course of anthroposcopy and the data of a full orofacial myofunctional evaluation performed with the MBGR Protocol [18].

According to the Brazilian Institute of Geography and Statistics (IBGE), the classification by color or race of the population comprises five categories: white, black, yellow, brown and indigenous [19]. In this study, the children were divided into white and non-whites, the latter including the black, yellow, brown and indigenous categories. The analysis of race was conducted through photographic images of each subject, considering the correlation between two observers; when there was no agreement, a third party was asked to opine.

For statistical analysis of the data the Statistical Package for Social Science (SPSS) v.18.0 for Windows was used. For the analyzes for categorical variables the values of absolute frequency and relative frequency percentage were calculated; and for quantitative variables mean, standard deviation, minimum, maximum and confidence interval of 95% (95% CI) were calculated. For between-groups comparisons the Student t test and ANOVA - which in some cases was supplemented by Tukey's test - were used. Kappa test was used to check interrater reliability. The significance level was set at 5%.

RESULTS

The 93 children had a mean age of 4.5±0.9 years. The children were divided according to age groups: 29 (31.2%) children had between three years and three years and 11 months; 30 (32.3%) children had between four years and four years and 11 months; and 34 (36.6%) between five and five years and 11 months. Of the total, 75.3% were white and 52.7% were male. Breastfeeding was performed in 86 (92.5%) children, with a median of one year and two months (minimum of two months and a maximum of four years and one month), however only five children were exclusively breastfed for six months.

Eighty (86%) children had used the bottle at some stage of childhood and 62 (66.7%) used the bottle with a typical nipple. Pacifier use was reported in 45 (48.4%) children and 20 children still used pacifier at the moment of data collection. Similarly to the bottle, in 28 (62.2%) children the pacifier type was typical. In what regards the digital sucking, it was found only 10 (10.8%) of the subjects had this behavior, although this habit still remained in seven of these individuals at the time of data collection.

The average age of withdrawal from the bottle, pacifier and finger sucking was 3.7±1.3, 3.5±1.5 and 3.5 ± 1.9 years, respectively. It was found that 78 children (83.9%) still had oral habits.

Table 1 describes the orofacial measurements obtained.

Table 2 shows the mean anthropometric orofacial measurements distributed in three age groups. The data revealed an increase of orofacial measures with an increase in age.

Regarding the relationship between orofacial anthropometric measures and gender (Table 3), it was found that the measurements of the lower face (sn-gn) for males were higher than for females.

Table 4 presents data on the analysis of orofacial measurements according to race (white and non-white). The interater agreement for this item was almost perfect (k = 0.941).

Respiratory function was also correlated with orofacial anthropometric measures (Table 5) and the increase in measurements of oronasal breathing was not statistically significant.

Table 1 - Description of orofacial anthropometric measures

Measures	Mean ± SD	Minimum	Maximum	$CI_{95\%}$
Face height (*g-gn*)	99.4±5.6	90.1	118.1	98.2-100.5
Middle third of the face (*g-sn*)	45.2±3.5	36.5	56.7	44.5-45.9
Lower third of the face (*sn-gn*)	54.2±3.6	48.4	62.0	53.4-54.9
Outer corner of the right eye to right commissure of the lip (*ex-ch*)	58.3±3.2	51.8	66.9	57.6-58.9
Outer corner of the left eye to the left commissure of the lip (*ex-ch*)	57.9±3.2	51.2	67.1	57.3-58.6
Upper lip (*sn-sto*)	17.9±1.8	13.4	22.3	17.6-18.4
Lower lip (*sto-gn*)	35.9±2.9	27.3	42.9	35.4-36.5

Note: SD = standard deviation; CI = confidence interval; g = glabella; gn = gnathion; sn = subnasal; ex = outer corner of the eye; ch = cheilion; sto = estomion

Table 2 - Analysis of orofacial anthropometric measures by age range (mean ± standard deviation)

Measures	Age			p-value*
	3:0 – 3:11 years (n=29)	4:0 – 4:11 years (n=30)	5:0 – 5:11 years (n=34)	
Face height (*g-gn*)	96±4 [a]	100.5±6.1 [b]	101.2±5.2 [b]	<0.001
Middle third of the face (*g-sn*)	43±2.8 [a]	46.2±3.5 [b]	46.1±3.7 [b]	<0.001
Lower third of the face (*sn-gn*)	52.9±2.9	54.2±3.8	55.1±3.7	0.070
Outer corner of the right eye to right commissure of the lip (*ex-ch*)	56.5±2.6 [a]	58.3±3.0 [b]	59.8±3.0 [b]	<0.001
Outer corner of the left eye to the left commissure of the lip (*ex-ch*)	56.3±2.7 [a]	57.9±3.2 [ab]	59.4±2.9 [b]	<0.001
Upper lip (*sn-sto*)	17.9±1.9	18.1±1.5	18±1.9	0.885
Lower lip (*sto-gn*)	34.7±2.6 [a]	36.1±2.9 [ab]	36.8±2.8 [b]	0.015

Note: * p<0.05 by ANOVA; a,b – equal letters do not differ according to Tukey´s test; g = glabella; gn = gnathion; sn = subnasal; ex = outer corner of the eye; ch = cheilion; sto = estomion

Table 3 - Analysis of orofacial anthropometric measures by gender (mean ± standard deviation)

Measures	Male (n=49)	Females (n=44)	p-value*
Face height (*g-gn*)	100.9±5.7	97.6±5	0.003
Middle third of the face (*g-sn*)	45.3±3.7	45.1±3.4	0.742
Lower third of the face (*sn-gn*)	55.6±3.4	52.5±3.1	<0.001
Outer corner of the right eye to right commissure of the lip (*ex-ch*)	58.9±3	57.6±3.3	0.063
Outer corner of the left eye to the left commissure of the lip (*ex-ch*)	58.8±3.3	57.3±3	0.057
Upper lip (*sn-sto*)	18.9±1.9	17.3±1.6	0.001
Lower lip (*sto-gn*)	37.2±2.8	34.6±2.4	<0.001

Note: * p<0.05 by Student t test; g = glabella; gn = gnathion; sn = subnasal; ex = outer corner of the eye; ch = cheilion; sto = estomion

Table 4 - Analysis of orofacial anthropometric measures by race (mean ± standard deviation)

Measures	White (n=70)	Non-White (n=23)	p-value*
Face height (*g-gn*)	98.8±5.2	101±6.6	0.117
Middle third of the face (*g-sn*)	44.9±3.3	46±4.1	0.192
Lower third of the face (*sn-gn*)	53.9±3.4	54.9±3.9	0.241
Outer corner of the right eye to right commissure of the lip (*ex-ch*)	57.9±3.2	59.2±3.2	0.118
Outer corner of the left eye to the left commissure of the lip (*ex-ch*)	57.6±3.1	59±3.2	0.072
Upper lip (*sn-sto*)	17.8±1.9	18.7±1.5	0.030
Lower lip (*sto-gn*)	35.7±2.8	36.5±3	0.256

Note: * p<0.05 by Student t test; g = glabella; gn = gnathion; sn = subnasal; ex = outer corner of the eye; ch = cheilion; sto = estomion

Table 5 - Analysis of orofacial anthropometric measures by respiratory function (mean ± standard deviation)

Measures	Oronasal Breathing	Nasal Breathing	p-value*
Face height (*g-gn*)	100.1±6.6	98.8±5.0	0.172
Middle third of the face (*g-sn*)	45.4±4	45.1±3.3	0.739
Lower third of the face (*sn-gn*)	55.3±4.2	53.6±3.1	0.065
Outer corner of the right eye to right commissure of the lip (*ex-ch*)	58.7±3.9	58.1±2.8	0.446
Outer corner of the left eye to the left commissure of the lip (*ex-ch*)	58.1±3.8	57.9±2.9	0.830
Upper lip (*sn-sto*)	18.4±2.2	17.8±1.6	0.135
Lower lip (*sto-gn*)	36.1±2.8	35.8±2.9	0.649

Note: * p<0.05 by Student t test; g = glabella; gn = gnathion; sn = subnasal; ex = outer corner of the eye; ch = cheilion; sto = estomion

Breastfeeding itself resulted in no difference between the means of orofacial measurements (p > 0.05), but breastfeeding exclusively for six months appears to significantly influence the extent of the middle third of the face (g-sn) (p = 0.022) by increasing approximately 5 mm and also the height of the face (gn-g) (p = 0.037) by an increase in approximately 7 mm.

In relation to dental aspects, 40 (43%) children had some type of altered occlusion, being the most prevalent ones the open bite, the overbite and the cross bite.

The presence of habits other than those described above as well as occlusal changes did not significantly influence the measures proposed in this study for the established age criteria.

DISCUSSION

Only one international study that investigated anthropometric measures in pre-school children was found [1]. However, that study consisted on analyzing anthropometric measures at different points of the face than those used in the present study. National studies that used the same measures have established the normal range for orofacial measurements of children above six years of age, adolescents and adults [3-5].

Below, comparisons with the international study will be conducted; it is not possible to carry out a direct comparison of the present data with data of the national studies, however hypotheses were inferred.

The results of the values obtained in this sample to measure the height of face (g-gn) were on average 6.3 mm larger than those found in the international study [1] in all age groups. That study provided reference for the height of face (g-gn) at three years of age at an average of 87.7 mm; the average at four years was 94.5 mm, and the average at five was 96.6 mm. For the measure of lower lip (sto-gn), the author reports means at three years of 35.5 mm, 40.6 mm at four and 41.7 mm at five [1]. The results obtained for the latter measure are similar to the ones at three years of age, however, vary on average 4.7 mm when compared to four and five years of age.

The literature data reports the normality of the measures for children from seven to 11 years of age. The mean measure of the middle third of the face (g-sn) is 51.4 mm, ranging between 43.0 mm and 60.9 mm; the average of the lower third of the face (sn-gn) is 58.7 mm, ranging between 49.6 mm and 72.4 mm; the average of lower lip (sto-gn) is 39.7 mm, ranging between 31.0 mm and 50.2 mm; and the average of the upper lip (sn-sto) lip is 18.1 mm, ranging between 13.0 mm and 23.1 mm [4]. It is observed that the measure that less differed from those found in the current study was the upper lip (sn -sto) one and the one that most diverged was of the middle third of the face (g-sn), which extended 6.2 mm.

In a literature review [16] the references presented in international studies as normal parameters in adults were: middle third of the face (g-sn) (mean 65.2 mm) and lower third of the face (sn-gn) (average 69 mm) and lower lip (sto-gn) (mean 45.3 mm) and upper lip (sn-sto) (mean 21.6 mm). When establishing relationships between the above mentioned data and that of the present study, it is noticed that there is an increase in the heights of the middle third of the face (sn-g) (around 20 mm) and lower third of the face (sn-gn) (around 15 mm) and upper lip (sn-sto) (about 4 mm) when comparing preschool children and adults, though the extent of the lower lip (sto-gn) is similar. The literature suggests that

lower lip (sto-gn) is developed at an early age: at the age of five, male children already have 84.2% of adult size; for females, this percentage is 91.4% [1].

Considering the age of the children evaluated in this study, it is worth noting the relationship between the development of the dentition and facial growth and development, which is largely regulated by the teeth that are present [20]. Occlusion of the 20 primary teeth usually settles at three years of age, and is also around this age that the maxilla and mandible relationship is established and general jaw pattern does not change significantly [21]. In the age group investigated, the presence of altered occlusion did not influence the facial measurement.

The literature supports that the facial type is preserved from five to 25 years of age in 77% of the population and this regularity is maintained in 88% of subjects followed between five and 12 years of age [22]. The growth continues to cause changes in soft tissues, resulting from an increase in volume, but the trend is that the facial skeletal configuration remains constant during growth, since it is genetically determined. However, in the deciduous dentition, even though the face has not reached its final dimension, it is already possible to clinically evaluate and define the skeletal pattern [23].

In the present study there was an increase in measures between three and four years. However, the measurements showed a smaller increase in growth from four to five when compared to the growth from three to four years. In the literature no studies comparing craniofacial growth of children in these age groups was found. It is considered that there are two periods of high-speed craniofacial growth: the first two years of life and pubertal stage [22].

As for the gender gap, the present study obtained a 3.3 mm difference in height of face (g-gn) and 1.6 mm in the measure of upper lip (sn-sto) between boys and girls, while in the international research [1] the differences were 1.9 mm and 0.6 mm. Studies indicate the occurrence of sexual dimorphism [13,24-26] agreeing that, in general, the measurements obtained in the analysis are larger in males than in females. In the current study, this occurred in most of the measures, except in the middle third of the face (g-sn).

Differences in measures and facial proportions are demonstrated in studies with populations composed of different races [3,4,9,11-13,25,26]. Authors argue that the findings and the variation of measures in the studies may be related to the large Brazilian miscegenation [13].

Corroborating with our results, which showed lower facial measurements values (but only of the upper lip with significance) in white subjects than those obtained for the non-white subjects, a study infers that black individuals have a slight tendency to show a vertical pattern compared to whites, the same should be applied for anthropometric measurements [27].

In a different study[9] that aimed to compare the means of the dimensions of the face between the children from the city of São Paulo with the normal standards published for the North American population, lower averages were found in children from São Paulo in all age groups and both genders. In comparing the population of North Americans with children from Santiago, Chile, between five and eight years oge, there was no difference between the populations, but the author points out that the methodology differed [28].

The importance of conducting research in southern Brazil is highlighted when analyzing data from the above mentioned studies because facial measurements standards appear to be influenced by the geographical origin of migration. One must consider the influence of Italian and German colonization in this region, which could have determined the increased facial measurements in this study with respect to the upper vertical pattern when compared with the international one [1].

Considering the respiratory mode, some authors [5,8,29] found an association between oronasal breathing and morphologic facial changes. In one of these studies, the measures that were different between the groups were: upper lip (sn-sto), lower lip (sto-gn), lower third of the face (sn-gn) and sides of the face (ex-ch) beyond differences in proportions between the upper and lower lips, and between the middle third and lower third of the face [5].

In the current study, although the anthropometric orofacial measurements were higher in oronasal breathers, no statistical differences for anthropometric orofacial measurements between oronasal and nasal breathers were found. Corroborating the present study, a recent research [14] with oronasal and nasal breathing found that the orofacial measurements were similar between the two groups. The findings of that study were similar to those obtained in different studies [7,30], which, even when using different methodology, suggest that respiratory mode cannot be considered as a primary factor for orofacial changes. However, the respiratory mode diagnosis only through Speech-Language Pathology evaluation is considered a limitation of the current study.

Knowledge of orofacial anthropometric measures in children and their variations with respect to age, gender, race and oral habits can improve the evaluation of orofacial myofunctional and contribute to establish a functional diagnosis made by a

Speech-Language Pathologist, bringing objective data on facial morphology [9]. It is also important to note that the national literature had not yet provided data for this age group.

CONCLUSION

In view of the results presented and discussed, it can be concluded that the mean anthropometric orofacial measurements increase with age, but remains closer when groups of four and five years of age are compared. It has been found that the means described in this study were superior to those found in other studies for the same age range. Males had higher anthropometric measures, with statistical significance for the lower third of the face. Similarly, non-white children had higher averages in all measures, with statistical significance for the upper lip. The presence of oral habits did not significantly influence the results of this sample.

RESUMO

Objetivo: obter as medidas antropométricas orofaciais em crianças pré-escolares de três a cinco anos e realizar a correlação com idade cronológica, gênero, raça e hábitos orais. **Métodos:** estudo transversal com 93 crianças selecionadas por meio de amostra de conveniência consecutiva. Os responsáveis responderam a um questionário sobre os hábitos orais e as crianças foram submetidas a uma avaliação odontológica e antropométrica da face. O nível de significância utilizado foi p<0,05. **Resultados:** as médias das medidas antropométricas orofaciais foram descritas. Houve diferença estatística nas medidas de altura da face (p<0,001), terço médio da face (p<0,001), canto externo do olho até a comissura labial esquerda/direita (p<0,001) e lábio inferior (p=0,015) nas faixas etárias. O gênero masculino apresentou medidas superiores na altura de face (p=0,003), terço inferior da face (p<0,001), lábio superior (p=0,001) e lábio inferior (p<0,001). Não houve diferença estatisticamente significante na altura do lábio superior em sujeitos não brancos (p=0,03). A presença de hábitos orais não influenciou os resultados. O aleitamento materno exclusivo por seis meses influenciou o aumento da medida de terço médio (p=0,022) e da altura da face (p=0,037). **Conclusão:** as médias descritas neste estudo foram superiores aos padrões encontrados em outros estudos. As médias orofaciais aumentaram conforme a idade. Houve superioridade nas medidas para o gênero masculino e para as crianças não brancas, mas não para presença de hábitos orais.

DESCRITORES: Antropometria; Face; Medidas; Criança; Pré-Escolar

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