Original Article

Artigo Original

Effect of gender, height and race on orofacial measurements

Efeito do gênero, da altura corporal e da etnia nas medidas antropométricas orofaciais

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Keywords

Anthropometry
Gender
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ABSTRACT

Purpose: The aim of this study was to assess the influence of gender, height and ethnicity on anthropometric orofacial measures in the adult population, and the possible correlation between these measures. **Methods:** Anthropometric orofacial measurements were performed in asymptomatic volunteers, being 56 women and 44 men, aged 19 to 53 years. The measure were: upper lip height (sn-sto); lower lip height (sto-gn); filter height (sn-ls); upper third of the face (tr-g); middle third of the face (g-sn); lower third of the face (sn-gn); and distance between the outer canthus (ex) and cheilion (ch). **Results:** All measurements were larger for men than for women. There was a positive correlation between most of the measures. There was no correlation between height and anthropometric orofacial measures, except for the middle third of the face (g-sn) of men, which had a weak positive correlation. Afro-Brazilian subjects presented larger measures for the lower third of the face (sn-gn) and for the distance between the outer canthus (ex) and the left cheilion (ch) than white subjects. **Conclusion:** Men have greater orofacial anthropometric measures than women. Height does not seem to have an influence on such measures.

Descritores

Antropometria
Gênero
Face
Estatura
Adulto

RESUMO

Objetivo: O objetivo desta investigação foi avaliar, em população adulta, a influência do gênero, da altura corporal, e da raça nas medidas antropométricas orofaciais, e a possibilidade de correlação entre as medidas. **Métodos:** Foram realizadas medidas antropométricas orofaciais em voluntários assintomáticos, 56 mulheres e 44 homens, com idades entre 19 e 53 anos. As medidas realizadas foram: altura do lábio superior (sn-sto); altura do lábio inferior (sto-gn); altura do filtro (sn-ls); terço superior da face (tr-g); terço médio da face (g-sn); terço inferior da face (sn-gn); distância entre o canto externo do olho (ex) e o cheilion (ch). **Resultados:** Todas as medidas realizadas foram maiores nos homens do que nas mulheres. Houve correlação positiva entre a maioria das medidas realizadas. Não houve correlação entre a altura corporal e as medidas antropométricas orofaciais, exceto para a medida do terço médio da face (g-sn) nos homens, quando houve correlação positiva fraca. Na comparação com indivíduos da raça branca os indivíduos da raça negra tiveram maiores medidas do terço inferior da face (sn-gn) e entre o canto externo do olho (ex) e o cheilion (ch) esquerdo. **Conclusão:** Homens têm maiores medidas antropométricas orofaciais do que as mulheres. A altura corporal dos indivíduos parece não influenciar estas medidas.

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Conflict of interests: nothing to declare.

INTRODUCTION

Many studies reveal anatomical and functional differences between men and women in relation to the mouth, pharynx, upper esophageal sphincter, esophagus and deglutition[1-5].

Anthropometry offers several advantages for the morphological study of the craniofacial complex[6] because it uses simple, non-invasive and no-risk techniques at low cost[7]. Literature describes the effects of gender on anthropometric orofacial measures, mentioning larger measures for men when compared to women[8,9-11]. Also, studies reveal differences between anthropometric orofacial measures in different ethnicities[6,8,12,13].

The proposal is that these measures are important to the speech therapy examination, being increasingly used for assessment, prognosis, planning[7] and therapeutic follow-up. It is known that the configuration of craniofacial structures, as well as orofacial musculature and dental occlusion, directly impact on chewing, deglutition, breathing, speech and voice functions[14].

A recent study about the degree of variability of orofacial measures among speech therapists specialized in orofacial motricity showed good reproducibility of the performed measurements, except for the opening of the mouth with the tongue in the papillae, indicating that data produced by different professionals are reliable[15].

The purpose of this study was to assess the differences between anthropometric orofacial measures of adult men and women, the correlation between these measures and the influence of height and ethnicity. The hypothesis was that gender and height influence anthropometric orofacial measures.

METHODS

The research project was approved by the Ethics Research Committee of the clinical hospital at the medical school of Ribeirão Preto, *Universidade de São Paulo*, process n. 5226/2008. All the volunteers signed the informed consent form.

Fifty-six females aged between 19 and 53 years, mean age of 31.5±10.2 years old, participated in the study, as well as 44 males aged between 19 and 53 years , mean age of 32.4±10,2 years. People living in the state of São Paulo belonging to all social classes were included. Among men, 33 were white and 11 were Afro-Brazilians, and among women, 39 were white and 17 were Afro-Brazilians.

People with craniofacial anomalies/alterations, with skeletal occlusion disorders or any anatomical change that could interfere with anthropometric measures were excluded. All subjects were measured and divided into two groups: those whose height ranged from 1.49 to 1.65 m, mean of 1.59±0.05 m, and those whose height ranged from 1.66 and 1.89 m, mean of 1.76±0.06 m.

In order to collect anthropometric orofacial measures, a Vonder® metallic caliper (Brazil) was used. Before the measurements were performed, volunteers were asked to remain seated, with their feet on the ground, head at rest position and occluded lips. They were also asked to remove their glasses, and afterwards the caliper and its function were shown to them. Then, the following measures were taken: upper lip height (sn-sto), which corresponds to the distance between the subnasal point (sn) and the lowest point of the upper lip (sto); lower lip height (sto-gn), which corresponds to the distance between the highest point of the lower lip (sto) and gnathion (gn); filter height (sn-ls), which corresponds to the distance between the subnasal point (sn) and the upper lip point; the upper third of the face (tr-g), which corresponds to the measure of the trichion (tr) to the glabella (g); the middle third of the face (g-sn), which corresponds to the measure of the glabella (g) to the subnasal point (sn); the lower third of the face (sn-gn), which corresponds to the measure of the subnasal point (sn) to the gnathion (gn); and the distance between the outer canthus (ex) and cheilion (ch), which corresponds to the distance between these facial points[7]. The orofacial proportions of the upper third of the face/lower third of the face (tr-g/g-sn) and the middle third of the face/lower third of the face (g-sn/sn-gn), were also analyzed. All measurements were taken at the same time.

Statistical analysis was conducted at the center of quantitative methods of the medical school of Ribeirão Preto (CEMEQ). The linear regression model with mixed effects (random and fixed effects)[16] was used. This model presupposes that the residue obtained from the difference between values predicted by the model and the observed values should have normal distribution with zero mean and constant variance. The model was adjusted by the SAS software, version 9.0. Also, the Wilcoxon non-parametric test was used. to compare two distributions. Therefore, it does not require assumptions as to data distribution. Correlations between the different measurements and between height and measurements were assessed and , the Pearson's correlation coefficient (r) was calculated. The analyses were carried out with the SAS® 9.0 software, with the PROC IML. Results are presented in mean, mean standard deviation, 95% confidence interval and Pearson's correlation coefficient (r).

RESULTS

The distribution of participants' height is presented in Table 1.

Concerning anthropometric orofacial measures, greater values were found for men in relation to women ($p \leq 0.02$) (Table 2).

Table 1. Distribution of the height of the participants in relation to gender

	Height from 1.49 to 1.65 m			Height from 1.66 to 1.89 m		
	Women	Men	Total	Women	Men	Total
Number	37	4	41	19	40	59
Height (mean±SD)	1.59±0.05	1.60±0.06	1.59±0.05	1.69±0.04	1.77±0.06	1.75±0.06

Legends: SD = standard deviation

Among subjects with heights between 1.66 and 1.89 m, there was a difference between men and women, with greater values found for men (p<0.03) (Table 2). There were no differences among women with heights between 1.49 and 1.65 m (n=37), and among subjects with heights between 1.66 and 1.89 m (n=19) (p>0.05) (Table 3).

There was a positive correlation between most of the performed measurements. Table 4 presents the measures with Pearson's correlation coefficient (r) higher than 0.715, considering all the 100 subjects, thus indicating a strong correlation between them (p<0,001).

There was no correlation (coefficient correlation between 0 and 0.183) between the measuresof the middle third of the face (g-sn): filter height (sn-ls); middle third of the face (g-sn): lower lip height (sto-gn); filter height (sn-sto): upper third of the face (tr-g); filter height (sn-sto): lower lip height (sto-gn); filter height (sn-sto): upper third of the face (tr-g) (p>0.07).

Among women, there was no correlation between height and orofacial measures, but among men there was a weak positive correlation between height and measures of the middle third of the face (g-sn), distance between the outer canthus (ex) and the left cheilion (ch), and the proportion between the middle third and the lower third of the face (g-sn/sn-gn) (p<0.04). With the multivariate regression analysis, it was observed that, among men the measures of the middle third of the face (g-sn) had a positive correlation with height (r=0.410, p<0.01), and the other correlations with significant results are a consequence of the measures of the middle third of the face (g-sn).

Afro-Brazilian subjects presented larger measurements of the lower third of the face (sn-gn) (Afro-Brazilian: men: 77.8 mm, women: 66.6 mm; white: men: 72.5 mm, women: 65.3 mm) and the distance between the outer canthus (ex) and the left cheilion (ch) (Afro-Brazilian: men: 73.6 mm, women 70.1 mm; white: men: 72.7 mm, women: 67.3 mm)

Table 2. Comparing anthropometric orofacial measurements according to gender

Measurements (mm)	Women		Men		p-value*
	Mean±SD	95%CI	Mean±SD	95%CI	
Upper third of the face (tr-g)	58.2±7.2	56.3–60.1	62.1±9.1	59.3–64.8	0.02
Middle third of the face (g-sn)	58.7±5.3	57.3–60.2	61.1±4.8	59.7–62.6	0.01
Lower third of the face (sn-gn)	65.9±5.7	64.4–67.4	73.8±6.3	71.8–75.7	<0.01
Filter height (sn-ls)	15.3±2.0	14.8–15.9	17.2±3.4	16.2–18.2	<0.01
Upper lip height (sn-sto)	22.5±4.2	21.4–23.7	24.7±3.5	23.6–25.8	<0.01
Lower lip height (sto-gn)	43.7±5.3	42.3–45.1	49.3±5.1	47.7–50.8	<0.01
Distance between the outer canthus (ex) and the right cheilion (ch) (ex-ch(D))	69.9±4.4	68.7–71.0	73.7±5.2	72.1–75.3	<0.01
Distance between the outer canthus (ex) and the left cheilion (ch) (ex-ch(E))	68.2±3.9	67.2–69.3	72.8±4.0	71.6–74.0	<0.01
Upper third of the face/lower third of the face (tr-g/g-sn)	58.5±5.4	57.0–59.9	61.6±6.0	59.8–63.4	0.01
Middle third of the face/lower third of the face (g-sn/sn-gn)	62.9±4.0	61.3–63.4	67.5±4.5	66.0–68.8	<0.01

*p-value refers to the comparison between men and women
Legends: SD = standard deviation; CI = confidence interval

Table 3. Comparison of anthropometric orofacial measurements according to gender and height

Measurements (mm)	Height between 1,49 and 1,65 m		Height between 1,66 and 1,89 m		p-value
	Women	Men	Women	Men	
Upper third of the face (tr-g)	58.3±7.4	57.0±11.8	58.0±7.2	62.6 ± 8.8	0.11
Middle third of the face (g-sn)	58.3±3.8	55.8±5.2	59.5±7.5	61.7 ± 4.5	0.01
Lower third of the face (sn-gn)	65.6±6.2	69.5±4.5	66.5±4.7	74.2 ± 6.3	<0.01
Filter height (sn-ls)	15.2±1.9	17.8±4.0	15.6±2.4	17.1 ± 3.4	0.03
Upper lip height (sn-sto)	22.9±4.7	24.0±2.5	21.8±3.0	24.8 ± 3.6	0.07
Lower lip height (sto-gn)	43.2±5.9	45.5±5.3	44.7±7.8	49.7 ± 4.9	<0.01
Distance between the outer canthus (ex) and the right cheilion (ex-ch (D))	70.0±4.1	71.5±5.6	69.5±4.9	73.9 ± 5.1	0.02
Distance between the outer canthus (ex) and the left cheilion (ex-c h (E))	68.1±4.1	70.5±4.2	68.4 ± 3.7	73.1 ± 3.9	<0.01
Upper third of the face/lower third of the face (tr-g/g-sn)	58.3±4.8	56.5±6.6	58.8 ± 6.5	62.1 ± 5.7	0.01
Middle third of the face/lower third of the face (g-sn/sn-gn)	62.1±3.8	62.6±3.6	63.0 ± 4.2	67.9 ± 4.3	<0.01

Mean±standard deviation; p-value refers to the comparison between men and women between 1.66 and 1.89 m tall

Table 4. Anthropometric orofacial measurements with correlation superior to 0.715 (Pearson's Correlation Coefficient – r), indicating strong correlation between them (p<0.001)

Measurements	Women	Men	Total	p-value
ex-ch E:ex-ch D	0.753	0.854	0.830	<0.001
sn-gn:sto-gn	0.666	0.821	0.800	<0.001
g-sn:g-sn sn-gn	0.700	0.748	0.716	<0.001
g-sn:tr-g g-sn	0.808	0.709	0.776	<0.001
g-sn sn-g:sn-g	0.739	0.861	0.856	<0.001
tr-g:tr-g g-sn	0.901	0.927	0.917	<0.001

Table 5. Correlation between anthropometric orofacial measurements and height (Pearson's Correlation Coefficient – r)

Measurements	Women		Men	
	r	p-value	r	p-value
Upper third of the face (tr-g)	0.048	0.724	-0.032	0.835
Middle third of the face (g-sn)	0.091	0.504	0.410	0.006
Lower third of the face (sn-gn)	0.121	0.375	0.169	0.271
Filter height (sn-ls)	0.157	0.249	-0.197	0.199
Upper lip height (sn-sto)	0.014	0.917	-0.116	0.452
Lower lip height (sto-gn)	0.040	0.769	0.270	0.076
Distance between the outer canthus (ex) and the right cheilion (ex-ch(D))	-0.003	0.984	0.234	0.126
Distance between the outer canthus (ex) and the left cheilion (ex-ch(E))	-0.043	0.754	0.322	0.033
Upper third of the face/lower third of the face (tr-g/g-sn)	0.077	0.573	0.140	0.366
Middle third of the face/lower third of the face (g-sn/sn-gn)	0.137	0.315	0.337	0.025

than white subjects (p<0.04), with the difference observed between men and women also observed between Afro-Brazilian and white people.

DISCUSSION

Results showed a tendency to greater measures for male faces in comparison to female faces. These data are in accordance with previous research[9-11]. Literature points out to differences in facial growth between genders from the age of ten[17]. It was observed that even when men and women had similar height, anthropometric orofacial measures were different; and that among women with different heights, taller or shorter than 1.65 m, results of anthropometric orofacial measures were the same. Results were consistent for women, once the number of assessed men shorter than 1.65 wassmall.

The obtained results were similar to those described for the upper lip height (sn-sto) (women: 17 to 23 mm, men: 21 to 26 mm)[9,10] and the lower lip height (sto-gn) (women: 38 to 55 mm, men: 42 to 58 mm)[10].We could not find studies in literature relating height with facial growth, but it is known that such growth is influenced by gender[17,18].

The observed differences can explain the behavior of men and women during deglutition[1,2,5]. Men swallow a greater volume of water in each deglutition, with larger flow, in relation to women[1,2], and women have longer oral and pharyngeal transit in comparison to men[5]. Larger orofacial measurements can also justify the observation that men are able to tolerate a larger volume of water in the oral cavity in comparison to women[19,20].

A previous study describes that height has no significant influence on deglutition[1], as it has no influence on orofacial measures, which reinforces the hypothesis that the differences described in deglutition of men and women should be a consequence of or be associated with different orofacial measures, and not related to height.

A study about morphology and changes in facial profile during growth reports that gender dimorphism starts to be noticed from ages of 10 to 12, when the male gender growth, especially in linear measures, is responsible for facial differentiation. It was also observed that the soft profile becomes more convex while the opposite happens with the skeletal profile[17].

The main difference of gender dimorphism is the size and configuration of the nose, which leads to collateral differences in other topographic structures of the face. The group of all regional topographic differences makes the female face flatter, proportionally wider and more delicate, unlike males, whose face is deeper, more irregular, protuberant and rustic[18].

Also, the differences found between ethnicities are in accordance with literature[6,8,12,13], with larger measurements of the lower third of the face in people with African backgound[13].

As to the correlation between anthropometric measures, we observed that there was a positive correlation between most of them, demonstrating that when one measure increases, the other also increases proportionally. Therefore, we can infer that such proportion between measures creates an harmonic facial pattern, which should interfere with stomatognathic functions. We should consider that, in order to this harmonic facial pattern to develop there is the influence of occlusion and orofacial musculature.

The anthropometric orofacial measures can influence not only deglutition, but chewing also. It has been demonstrated that men have stronger bites in relation to women, and that the total facial height is not correlated with bite strength. Transverse facial dimensions affect bite strength only for men, indicating

that men with long faces have weaker bites in relation to men with regular faces[21].

Anthropometric orofacial measures were taken once for each subject. There is a good correlation between the results obtained by different professionals[15]; so, repetitions of measurements taken by the same person should obtainsimilar results.

There was a natural limitation to determine ethnicity, once it was only conducted by skin color. Only this was possible, due to the frequent miscegenation of Brazilian population. Those who were clearly Afro-Brazilians were classified as Afro-Brazilians, and the others were classified as white.

The idea is that these results have clinical importance, since it is essential for the speech-language pathology examination concerning the assessment, prognosis, planning and therapeutic follow-up in orofacial motricity.

CONCLUSION

There are differences in anthropometric orofacial measures of men and women, and men present larger values when compared to women. There is a positive correlation between most anthropometric orofacial measures. The height of the subjects seems not to influence such measures. In comparison to white subjects, Afro-Brazilian people present larger measures of the lower third of the face and the distance between the outer canthus and the left cheilion.

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