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Familial resemblance of facial measurements in Florianópolis, South-Brazil

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ABSTRACT

With the aim of evaluating facial similarity within families, seven face measurements were taken from 146 young adults (17.51 ± 0.90 years old) attending the last year of high school in Florianópolis, Brazil. The analysis included 80 families of these youngsters. The following measurements of odontological relevance were taken: bizygomatic and bigonial diameters, mandible depth, tragion-nasion and tragion-prosthion diameters, morphological face height and chin height, most of them following Martin (apud Knussmann, *Anthropologie-Handbuch der Vergleichender Biologie des Menschen. Band I. 1. Teil.*, 245-248, 1988). All of these measurements were significantly larger for male probands, the same being true for fathers when compared to mothers. The calculated index of prognathism showed greater values for female students.

Correlation analysis of the parents measurements in relation to those of the youngsters showed significant values only for bizygomatic, bigonial and tragion-prosthion diameters. Between spouses as well as between sibs the only significant correlation was for tragion-prosthion diameter. The values of heritability estimated from midparent-offspring regression were: 0.65; 0.91 and 0.85, respectively for bizygomatic, bigonial and tragion-prosthion diameters.

INTRODUCTION

Body measurements are affected by hereditary as well as by environmental factors. Face measurements follow this rule. The consequent facial similarity within a family, expressed as correlation and regression coefficients for face measurements can be quantified and is useful for odontological treatment purposes (see for instance Harris, 1975).

MATERIAL AND METHODS

The total sample consisted of 146 young adults (94 females and 52 males) attending the third (and last) year of two public and one private high schools in Florianópolis. As high school students these youngsters, as well as their families, could be more easily investigated, since in most cases the family still shared a common household in town. In spite of not having reached full maturity, their mean age (17.51 ± 0.90 years old) led us to expect that the most significant period of growth had already been completed. Data collection took place between September, 1992 and March, 1993.

Socioeconomically the sample included subjects who could afford getting through either public or private high school. By Brazilian standards this would, in most cases, exclude the poorest population strata.

Among the 146 students measured, only 82 (49 females and 33 males) had their families investigated, due to difficulties in visiting them. Absence of one of the parents occured in eight of them (seven fathers and one mother). A total of 38 siblings were also measured, belonging to 31 families.

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Seven face measurements of odontological relevance were taken using the Martin anthropometer and standardized measurement techniques: bizygomatic (BZD) and bigonial (BGD) diameters, mandible depth (MD), morphological face (MFH) and chin (CH) heights, according to Martin (apud Knussmann, 1988); and tragion-nasion (TND) and tragion-prosthion (TPD) diameters, according to Salzano (1982). Index of prognathism (IP) was calculated as follows, according to Martin (apud Knussmannm, 1988): [tragion-nasion diameter x 100]/tragion-prosthion diameter.

All subjects were measured by one of the authors (I.C.-A.). To avoid hurting young children with the instruments, only siblings older than five years were measured, whenever at home at the time of the visit.

For statistical analysis (means ± SD, variance, correlation and regression) the SAS (1985) program was employed. For correlation and regression analyses measurements were adjusted as described by Sharma and Sharma (1984) as follows: $SM = (Xi - \bar{X})/SD$, where SM = standardized score; $\bar{X}i$ = absolute measurement of the ith individual; and $\bar{X}$ and SD = mean value and standard deviation in the sample.

RESULTS

Females were more represented than males in the subjects sample whose families were visited, though, the difference was not quite significant (n = 82; $\chi^2 = 3.12$; $0.05 < P < 0.10$). Mean age among sexes was similar (Table I).

Mean values and standard deviations, calculated for all measurements, as well as for prognathism index, indicated in all cases a significant difference between sexes. All measurements were greater for the male group, while the prognathism index was greater in females (Table I).

Mean values and standard deviations for all measurements were also calculated for parents and were shown to be significantly greater for fathers than for mothers (Table II).

Correlation coefficients of the parents' measurements in relation to those of the youngsters were significant only for three adjusted variables: bizygomatic, bigonial and tragion-prosthion diameters (Table III). Most of these significant coefficients were in relation to father or to midparent values.

With measurements standardized for each sex, correlation coefficients were calculated between each parent or midparent and sons and daughters separately. Significant correlation coefficients were only found for bigonial and tragion-prosthion diameters, being respectively for BGD: 0.36 for father-daughter; 0.52 for mother-son; 0.39 for midparent-daughter and 0.51 for midparent-son; and for TPD, 0.39 for father-daughter and for father-son; 0.36 for midparent-daughter and 0.43 for midparent-son.

The sole significant correlation coefficient between spouses was for tragion-prosthion diameter (Table III), indicating possible assortative mating for this measurement.

Table I - Mean values and standard deviations of age (in years) and of facial measurements (in cm) and prognathism index for all subjects, for females and for males, and t-values comparing the sexes.

Variable	Mean ± SD			t
	All subjects n=146	Females n=94	Males n=52	
Age	17.51 ± 0.90	17.46 ± 0.97	17.62 ± 0.75	1.02
BZD	13.25 ± 0.56	13.01 ± 0.47	13.68 ± 0.45	8.35***
BGD	10.20 ± 0.53	10.02 ± 0.47	10.51 ± 0.50	5.85***
MD	7.62 ± 0.64	7.45 ± 0.60	7.93 ± 0.60	4.66***
TND	10.89 ± 0.50	10.68 ± 0.44	11.26 ± 0.36	8.11***
TPD	11.77 ± 0.60	11.48 ± 0.44	12.31 ± 0.47	10.64***
MFH	10.56 ± 0.71	10.26 ± 0.59	11.10 ± 0.57	8.30***
CH	3.55 ± 0.34	3.45 ± 0.29	3.73 ± 0.35	5.38***
IP	92.54 ± 3.38	93.10 ± 3.42	91.54 ± 3.09	2.72**

**0.001 < P ≤ 0.01; ***P ≤ 0.001.
BZD = bizygomatic diameter; BGD = bigonial diameter; MD = mandible depth; TND = tragion-nasion diameter; TPD = tragion-prosthion diameter; MFH = morphological face height; CH = chin height; IP = index of prognathism.

Table II - Mean values and standard deviations of age (in years) and of facial measurements (in cm) for the subjects' parents, and t-values comparing sexes.

Variable	Mean ± SD		t
	Mothers n=81	Fathers n=73	
Age	44.28 ± 5.37	48.35 ± 6.28	4.33***
BZD[1]	13.08 ± 0.49	13.99 ± 0.50	11.16***
BGD	10.02 ± 0.48	10.83 ± 0.72	8.18***
MD	7.15 ± 0.70	7.72 ± 0.85	4.53***
TND	10.79 ± 0.41	11.48 ± 0.42	10.36***
TPD	11.98 ± 0.51	12.48 ± 0.61	5.52***
MFH	10.32 ± 0.51	11.04 ± 0.72	7.07***
CH	3.65 ± 0.29	3.80 ± 0.27	3.26**

**0.001 < P ≤ 0.01; ***P ≤ 0.001.
[1]Definitions in Table I.

Table III - Pearson correlation coefficients between father, mother and midparent values and the age- and sex-standardized values for their offspring, as well as between mother and father.

	Father x offspring	Mother x offspring	Midparent x offspring	Mother x father
BZD[1]	0.24*	0.17	0.25*	0.23
	n=73	n=81	n=72	n=72
BGD	0.31**	0.27*	0.40***	0.01
	n=73	n=81	n=72	n=72
MD	0.17	0.09	0.20	0.09
	n=73	n=81	n=72	n=72
TND	0.16	-0.06	0.12	-0.04
	n=73	n=81	n=72	n=72
TPD	0.43***	0.14	0.37**	0.25*
	n=73	n=81	n=72	n=72
MFH	0.15	0.03	0.18	-0.08
	n=73	n=81	n=72	n=72
CH	0.18	0.12	0.20	0.10
	n=72	n=80	n=71	n=72

*0.01 < P ≤ 0.05; **0.001 < P ≤ 0.01; ***P ≤ 0.001.
[1]Definitions in Table I.

Since regression coefficients are not affected by parent selection (Falconer, 1960), they were also calculated for the three variables which showed significant correlation coefficients, being higher, in each variable, for offspring regression on midparent values (Table IV).

Correlation analyses between siblings were based on 31 sibling pairs. Each subject whose sib or sibs were also measured was compared to his or her oldest investigated sib. Mean ages were 17.55 ± 1.18 and 17.19 ± 5.13 years old for the subjects and their sibs, respectively. Only tragion-prosthion diameter showed a significant correlation coefficient between them (Table IV; r = 0.55).

Based on regression and correlation coefficients, heritability values were also estimated (Table V).

DISCUSSION

Mean values obtained for bizygomatic diameter place the investigated students, according to the Lebzelter-Saller classification (apud Knussmann, 1988), as having medium broad faces, on a scale from very narrow to very broad. According to morphological face height females could be classified as having low and males as having very low faces. As the same held true for parents' average values, the facial pattern of the whole sample reveals faces which are broader than high.

Along with Sharma and Sharma (1984) and contrary to the hypotheses of greater similarity of offspring to their mothers, higher correlation values were found between father-offspring and midparent-offspring. Also the hypothesis of higher resemblance of daughters to their parents, due to their more stable growth pattern (see, for instance, Marcondes and Setian, 1989) is not tenable for the present study, since correlation values for females and males were much the same.

The significant correlation coefficient between siblings for tragion-prosthion diameter might be due to parents' resemblance for this measurement.

Significant correlation values for breadth (bizygomatic and bigonial diameters) and depth measurements (tragion-prosthion diameter) do not support reports of greater heritability estimates for height measurements (see, for instance, Moyers, 1979 and Knussmann, 1980), although this discrepancy could be due to the ethnic differences between the populations studied. Heritability estimates for bizygomatic diameter based on regression coefficient on midparent (Table V) was nonetheless similar to the one found by Susanne (1977), using the same methodology (h^2 = 0.61). For bigonial diameter the same author obtained h^2 = 0.66.

Table IV - Pearson correlation coefficients (r) between parents and offspring, between couples and between siblings for three facial measurements and the respective regression coefficients (b) of offspring on parents, in cases showing significant values of r.

	BZD[1]				BGD				TPD			
Relationships	N	r	b	SDb	N	r	b	SDb	N	r	b	SDb
Midparent-offspring	72	0.25*	0.65*	0.30	72	0.40***	0.91***	0.25	72	0.37**	0.85**	0.26
Father-offspring	73	0.24*	0.48*	0.23	73	0.31**	0.44**	0.16	73	0.43***	0.72**	0.18
Mother-offspring	81	0.17			81	0.27*			81	0.14		
Father-mother	72	0.23			72	0.01			72	0.25*		
Siblings	31	0.30			31	0.34			31	0.55**		

*0.01 < P ≤ 0.05; ** 0.001 < P ≤ 0.01; ***P ≤ 0.001.
SDb = Standard deviation of b.
[1]Definitions in Table I.

Table V - Heritability estimates for facial measurements.

Relationships	Formula	BZD[1]	BGD	TPD
Midparent-offspring (MPO)	b	0.65	0.91	0.85
Father-offspring (FO)	2b	0.96	0.88	1.44*
Mother-offspring (MO)	2b	0.68	1.10*	0.56
Siblings	2r	0.60	0.68	1.10*
Combined estimate	∇	**0.78**	**0.95**	**1.03***

*Heritability estimates over 1 reflect *b* or *r* values greater than the expected maximum of 0.5 for the FO and siblings coefficients.
∇ according to Beiguelman (1977) as follows:
$[2b(FO).I(FO) + 2b(MO).I(MO) + b(MPO).I(MPO)]/[I(FO) + I(MO) + I(MPO)]$; where $I = 1/S^2(b)$.
[1]Definitions in Table I.

Twin studies report the following heritability values for bizygomatic and bigonial diameters and morphological face height, respectively: 0.60; 0.61 and 0.62 (Knussmann, 1969). When twins were separately considered, according to their sex, the following estimates were obtained for females and males respectively: for bizygomatic diameter - 0.63 and 0.71; for bigonial diameter - 0 and 0.45 and for morphological face height - 0.71 and 0.76 (Da Rocha *et al.*, 1972).

Heritability estimates already reported therefore vary from 0.60 to 0.71 for bizygomatic and from 0 to 0.66 for bigonial diameter. Estimates found in the present study are within this interval only in the first case. The values found for bigonial diameter are much greater than the ones reported in the literature. For tragion-prosthion diameter, a recently defined measurement, no comparable values were found.

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RESUMO

Com o objetivo geral de contribuir para a avaliação da semelhança familiar facial, foram analisadas sete medidas de face de 146 jovens (17,51 ± 0,90 anos de idade) da terceira série do segundo grau de escolas de Florianópolis. A análise estendeu-se a 80 famílias destes jovens. Foram estudadas as seguintes medidas de relevância odontológica: diâmetro bizigomático, diâmetro bigonial, profundidade da mandíbula, diâmetro tragion-nasion, diâmetro tragion-prosthion, altura morfológica da face e altura do queixo, tomadas na sua maioria segundo a técnica de Martin. Todas estas medidas são significativamente maiores nos probandos do sexo masculino, o mesmo acontecendo com o grupo dos pais em relação ao das mães. O índice de prognatismo calculado mostrou maiores valores para estudantes do sexo feminino.

A análise de correlação das medidas dos progenitores com as dos probandos teve valores significativos unicamente nos casos dos diâmetros bizigomático, bigonial e tragion-prosthion. Entre pais e mães está correlacionado somente o diâmetro tragion-prosthion, que também apresentou correlação positiva e significativa entre os irmãos. Os valores de herdabilidade calculados pela média dos progenitores são 0,65; 0,91 e 0,85, respectivamente para os diâmetros bizigomático, bigonial e tragion-prosthion.

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