

Family names and the length of the Y chromosome in Brazilian blacks

Ana A.L. Barbosa¹, Iglénir J. Cavalli², Kiyoko Abé¹, Maria G. Santos³
and Eliane S. Azevêdo⁴

ABSTRACT

The variability of the lengths of the heterochromatic and euchromatic segments of the human Y chromosome was studied by a quantitative method of densitometric measurement in 60 normal and unrelated black individuals (30 with and 30 without devotional surnames), living in Salvador, Bahia, northeastern Brazil. Thirty normal and unrelated Caucasian individuals of European origin, living in Curitiba, Paraná, south Brazil, were included as controls. The heterochromatic segment and total Y chromosome lengths were greater in caucasians than in blacks without devotional surnames, and these were greater than in blacks with devotional surnames. These findings are in agreement with previous reports of a higher percentage of black ancestry in blacks carrying devotional surnames than those carrying non-devotional ones.

INTRODUCTION

The population of northeastern Brazil is a triracial mixture of Europeans, who are mostly Portuguese, African Negroes and Native Indians. However, there are very few surnames of Indian origin and no surnames of African origin, as all Africans in Brazil acquired Portuguese surnames. In addition, the following findings are unique to this population: 38% of the population carries a devotional surname (name of saints, including the invocation of Our Lady, names of religious symbols, ceremonies or festivities in the Catholic Church such as Amor Divino, Bispo, Espírito Santo, etc); there is a strong association between

devotional surnames and black ancestries, the darker the group, the higher the frequency of devotional surnames (Krieger *et al.*, 1965; Tavares-Neto and Azevêdo, 1977, 1978; Azevêdo, 1980, Azevêdo *et al.*, 1981, 1982, 1983); the gene frequency distribution among whites carrying devotional surnames showed higher frequencies of the allele ABO*O and lower of the allele ABO*A than for whites carrying non-devotional surnames (Tavares-Neto and Azevêdo, 1978). Thus, surnames can be studied from genetic, cultural and historical points of view. Considering that it is also well known that the transmission of family names in patrilineal societies follows the inheritance pattern of the human Y chromosome (Mencken, 1936), we decided to investigate the variability of the Y chromosome in blacks and Caucasians in Brazil.

MATERIAL AND METHODS

A quantitative analysis of the Y chromosome and its heterochromatic and euchromatic segments was

¹ Departamento de Ciências Exatas e Naturais, Universidade Estadual do Sudoeste da Bahia, Jequié, BA, Brasil.

² Departamento de Genética, Universidade Federal do Paraná, Caixa Postal 19071, 81531-970 Curitiba, PR, Brasil. Send correspondence to I.J.C.

³ Faculdade de Formação de Professores, Universidade Estadual da Bahia, Alagoinhas, BA, Brasil.

⁴ Laboratório de Genética Médica, Hospital Universitário Prof. Edgard Santos, Universidade Federal da Bahia, 40150-121 Salvador, BA, Brasil.

performed in 90 normal and unrelated adults (range: 20-60 years), including 60 black individuals, 30 with devotional surnames and 30 without devotional surnames, living in Salvador, the capital city of the State of Bahia (population about three million), northeastern Brazil, and 30 Caucasian individuals of European origin (mainly Italians) living in Curitiba, the capital city of the State of Paraná (population about two million), south Brazil. All the samples were obtained at random and were made up of students of the Universidade Federal da Bahia (predominance of blacks) and Paraná (mostly of European origin).

Leukocytes were cultured by the technique of Moorhead *et al.* (1960), with modifications, and C bands were obtained by the CBG method (Sumner, 1972). Five cells were photographed, and the heterochromatic and euchromatic segments of chromosome Y and the euchromatic region of the long arm of both homologues of chromosome 1 were measured directly from the negatives of three selected metaphases, well stained and spread, using a Zeiss microscope equipped for densitometric analysis (MPM 01 photometer head, Servogor RE 541 recorder). The profiles thus obtained corresponded to $41,538 \pm 292$ magnification. The distal and proximal C-band boundaries and the distal boundary of the euchromatic region of the short arm of chromosome Y were determined visually and marked with the aid of the recording apparatus (Figure 1). The beginning of the euchromatic region of the long arm of chromosome 1 was marked in a position half-way between the base and the first deflection of the curve (Figure 2). All the measurements were made without previous knowledge of the origin of the metaphase. These points were later measured with a ruler and converted into micrometers. The heterochromatic and euchromatic segments of the Y chromosome were corrected for variable degrees of chromosome contraction using as reference the size of the euchromatic region of the long arm of chromosome 1 from the same cell (for complete details see Erdtmann *et al.*, 1981, 1982). The similarity of the empirical distributions and of the normal curve was determined by the Kolmogorov-Smirnov test. The regression and correlation coefficients were tested by the Student *t*-test. The differences between the means were analyzed by the F and Tukey tests.

RESULTS

The distribution of heterochromatic and euchromatic segment lengths of the Y chromosome among Caucasian and black individuals was within normal limits.

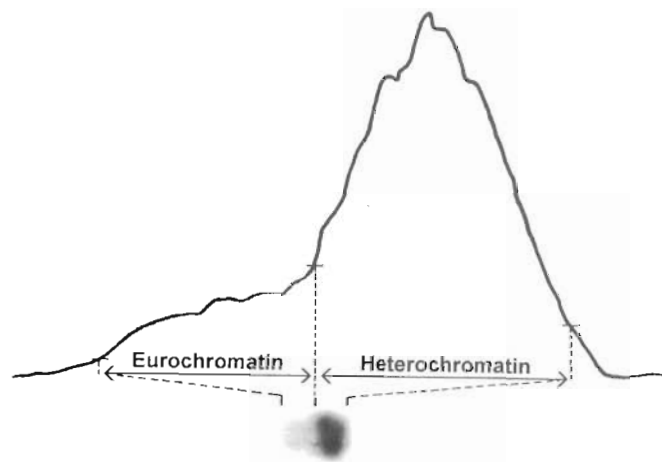


Figure 1 - Densitometric profile of the Y chromosome, with identification of how the heterochromatic and euchromatic regions were measured.

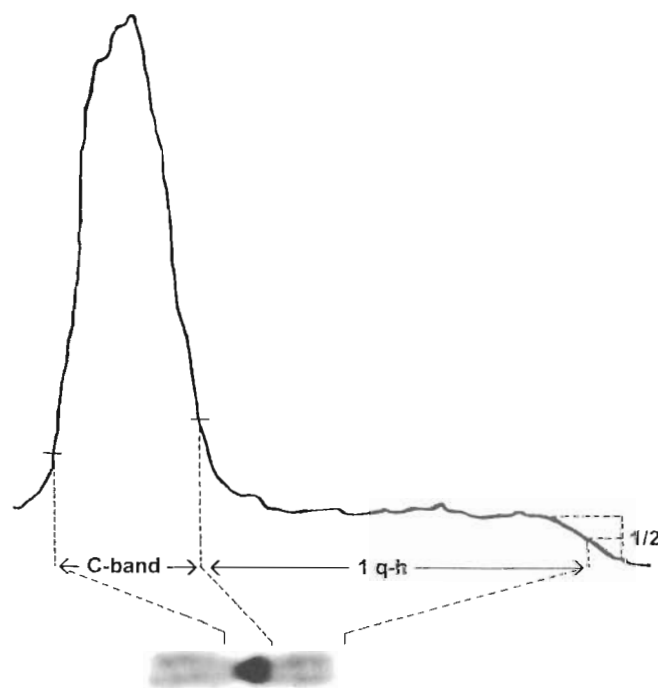


Figure 2 - Densitometric profile of the long arm of chromosome 1, with identification of how the euchromatic region was measured.

To determine whether the length of the Y chromosome is dependent on the variation of the heterochromatic and euchromatic segments, regression coefficients were calculated for the values obtained from 30 individuals of each sample (Table I). The length of the Y chromosome is, in all samples, significantly dependent on the length of heterochromatin and euchromatin. The correlation coefficients were significant, but the values obtained for the euchromatic segment were lower than those for the heterochromatic

segment. The regression and correlation coefficients between the length of the heterochromatic and euchromatic segments were not significant, showing that the heterochromatic and euchromatic segments vary independently.

Caucasians had longer hetero- and euchromatic segments and total Y chromosomes than blacks with and without devotional surnames (Table II). In the latter group the means observed were practically intermediate between those of Caucasians and blacks with devotional surnames. The differences between the means were analyzed by the F test. In all comparisons the value of F was significant at 0.05. Heterochromatin: $F = 11.193$; euchromatin: $F = 4.714$ and total absolute length of the Y chromosome: $F = 13.453$. The Tukey test (Δ) = at 0.05 indicated that Caucasians have a larger heterochromatic segment than blacks without devotional surnames ($\Delta = 0.105 < 0.106$) and with devotional surnames ($\Delta = 0.105 < 0.216$) and blacks without devotional surnames have a larger heterochromatic segments than blacks with devotional

surnames ($\Delta = 0.105 < 0.109$). Also, the mean value of the total length of the Y chromosome was larger among Caucasians than blacks without devotional surnames ($\Delta = 0.142 < 0.162$) and blacks with devotional surnames ($\Delta = 0.142 < 0.308$). The blacks without devotional surnames had a larger Y chromosome than blacks with devotional surnames ($\Delta = 0.142 < 0.146$). Finally, the means of the euchromatic segment showed only one statistically significant difference. The value observed in Caucasians was larger than that in the blacks with devotional surnames ($\Delta = 0.073 < 0.093$).

DISCUSSION

Reports comparing the size of the Y chromosome in blacks and in whites do not show consistent results: Cohen *et al.* (1966), in a sample from North America, showed that the size of the Y chromosome in blacks is significantly larger than that of Caucasian non-Jews. Lubs and Ruddle (1971) and Verma *et al.* (1983), studying samples from the same population, and Zanenga *et al.* (1984), studying blacks living in Brazil, did not show differences in the size of the Y chromosome between blacks and Caucasians. On the other hand, Ribeiro *et al.* (1981) found that the size of the Y chromosome in blacks was shorter than that of Caucasians in a sample from northeastern Brazil.

We found that the length of the heterochromatic segment and the total size of the Y chromosome in blacks without devotional surnames (those having less black ancestry) were intermediate between Caucasians and blacks with devotional surnames (those having more black ancestry). This finding is in agreement with the reported association between black ancestry and devotional surnames in the population of northeastern Brazil (Tavares-Neto and Azevêdo, 1978; Azevêdo, 1980). Thus, we went a step further in estimating a simple index for the total size of the Y chromosome (average size in blacks/average size in Caucasians) which, in the population of northeastern Brazil, may be indicative of the degree of black admixture. The index value for blacks with devotional surnames was calculated to be 0.85 ($1.792 \mu\text{m}/2.100 \mu\text{m}$), and 0.92 for blacks without devotional surnames ($1.938 \mu\text{m}/2.100 \mu\text{m}$).

Table I - Regression (b) and correlation (r) coefficients calculated among the lengths of the heterochromatic (x) and euchromatic (x) segments, and the entire Y chromosome (y).

Comparison	Racial group	b \pm s(b)	r
Between the length of the heterochromatin (x) and total length of the Y chromosome (y)	C	1.178 \pm 0.098*	0.916*
	BND	1.035 \pm 0.120*	0.852*
	BD	1.259 \pm 0.126*	0.884*
Between the length of the euchromatin (x) and total length of the Y chromosome (y)	C	1.544 \pm 0.297*	0.700*
	BND	0.984 \pm 0.271**	0.566**
	BD	1.522 \pm 0.237*	0.773*
Between the length of the heterochromatin (x) and the length of the euchromatin (y)	C	0.170 \pm 0.105 (ns)	0.290 (ns)
	BND	0.002 \pm 0.132 (ns)	0.003 (ns)
	BD	0.253 \pm 0.128 (ns)	0.350 (ns)

C = Caucasian; BND = black without devotional surname; BD = black with devotional surname. *,**Significant at 0.001 and 0.01, respectively; ns = non-significant. s(b) = Standard deviation of regression coefficient (b).

Table II - Absolute size (μm) of the heterochromatic and euchromatic segments of the Y chromosome and total absolute length of the same chromosome in 30 Caucasians, 30 blacks without devotional surnames and 30 blacks with devotional surnames (means \pm SE).

	Caucasian	Blacks without devotional surnames	Blacks with devotional surnames
Heterochromatin	1.170 \pm 0.031	1.064 \pm 0.032	0.955 \pm 0.033 a
Euchromatin	0.930 \pm 0.018	0.874 \pm 0.023	0.837 \pm 0.024 b
Y	2.100 \pm 0.040	1.938 \pm 0.039	1.792 \pm 0.047 a

a = The differences among the means were significant at 0.05; b = only the difference between the means of the Caucasians and blacks with devotional surnames was significant at 0.05.

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RESUMO

A variabilidade das regiões heterocromática e eucromática do cromossomo Y humano foi estudada, pelo emprego de uma metodologia da análise quantitativa e através de medidas densitométricas, em 60 negros normais e não aparentados (30 com sobrenomes de conotação religiosa e 30 sem sobrenome de conotação religiosa) de Salvador, Bahia. Trinta indivíduos caucásóides de origem européia, normais e não aparentados, de Curitiba, Paraná, constituíram o grupo controle. A região heterocromática e o tamanho total do cromossomo Y foram, em média, maiores nos caucásóides do que nos negros com e sem sobrenomes de conotação religiosa, sendo as médias observadas nestes últimos intermediárias entre as dos caucásóides e dos negros com sobrenome de conotação religiosa. Estes dados estão de acordo com os de publicações anteriores, que demonstram que nos negros com sobrenomes de conotação religiosa há mais ancestrais negros do que naqueles sem sobrenomes de conotação religiosa.

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