

## GENETIC STRUCTURE AND DEMOGRAPHY OF THE HUMAN POPULATION OF ÓBIDOS, IN THE BRAZILIAN AMAZON

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### ABSTRACT

Migratory parameters and the genetics of thirteen blood systems were studied in a sample of 250 individuals from the trihybrid population of Óbidos, State of Pará, Brazil. The dispersion indices indicate a low population mobility; the locally born individuals account for 80% of the sample studied, and 88% of the immigrants were born in the State of Pará. The phenotype distribution presented some differences when compared to those reported for other Amazonian populations (Oriximiná, Parintins, Coari, Belém and Manaus). The average heterozygosity (H) was estimated as 0.200 (S.E. 0.055), the mean number of alleles per locus at 2.000 (S.E. 0.260), and the percentage of polymorphic *loci* at 84.6%. In terms of racial admixture (38% White, 52% Indian and 10% Black), Óbidos presents values similar to those observed for the population of Parintins, State of Amazonas, with a low Black and a high Indian contribution.

### INTRODUCTION

Previous genetic-demographic studies performed in hybrid communities from the Brazilian Amazon region have demonstrated the influence of racial admixture and of internal immigrants on the genetic variability of these populations (review in Santos *et al.*, 1987). The relative contribution of Caucasians, Blacks and native Indians in the formation of the Amazonian communities was found to be heterogenous, especially for the Black element, whose contribution in the admixture process occurred later than the

White-Indian crossbreeding. In addition, the contribution of the internal immigrants was not uniform. In the past, the immigrants, predominantly represented by Northeasterners, were concentrated in the capitals, except in Pará State, where the distribution was more diffuse (Carneiro, 1980). More recently, especially in the seventies, the implementation of governmental projects for the development of the region introduced a large contingent of immigrants, which in the State of Pará have been mainly concentrated in the South, at the right margin of the Amazon river. Here we present demographic and genetic data on 13 blood systems, for a trihybrid population located at the left margin of the Amazon river.

## MATERIAL AND METHODS

Óbidos is located at the left margin of the Amazon river, at about  $1^{\circ}54'S$ ,  $55^{\circ}30'W$ , in the western region of the State of Pará, Brazil (Figure 1). In 1639, Portuguese Capuchin Priests reached the region and founded Óbidos, first named Pauxis, as a reference to the Indians of the area. The General Census of 1991 estimated the municipality population at 30,299 individuals.

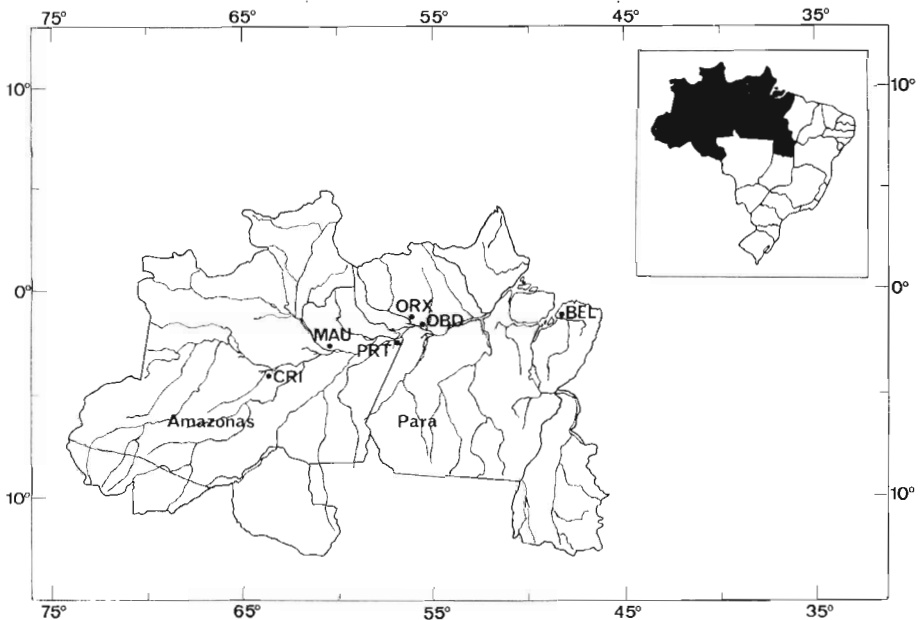


Figure 1 - Map of the northern region of Brazil, showing the location of Óbidos and other populations mentioned in the text. OBD - Óbidos, ORX - Oriximiná, BEL - Belém, MAU = Manaus, PRT = Pariutins, CRI = Coari.

The sample was composed of 250 individuals, and was collected in June, 1988. Demographic data and blood samples were obtained at the Hospital of the National Health Foundation, Hospital "Santa Casa de Misericórdia", São José School, and two community Health Centers (Santa Terezinha and Cidade Nova). The ages varied from 10 to 77 years, and 70% of the individuals were males. The apparent racial classification indicated 14% Whites, 84% of persons of mixed ancestry and 2% Blacks.

Blood samples were collected, with EDTA as an anticoagulant, and phenotypic determinations made of ABO and RH blood groups, ceruloplasmin, haptoglobin, transferrin, albumin, serum cholinesterase (CHE1 and CHE2), carbonic anhydrase, acid phosphatase, glyoxalase, esterase D, and hemoglobin. The methods employed are described for referenced in Guerreiro and Chautard-Freire-Maia (1984), Schneider *et al.* (1987) and Santos *et al.* (1987). Gene frequencies were estimated by the maximum likelihood method, using the MAXLIK computer program developed by Reed and Schull (1968), and *loci* heterozygosities were calculated by the unbiased estimate of Nei (1987). Comparisons between the gene frequencies found in Óbidos and those reported for other Amazonian populations were made with the Pearson chi-square statistic. The difference in single-locus heterozygosities estimated for Óbidos and other populations was tested using the variance related to this measure, according to Nei (1987). The quantitative estimates of racial admixture were obtained by the method devised by Krieger *et al.* (1965). The level of dispersion of the population was evaluated using the following parameters: a) mean individual migration in the sample studied (average migration distance from the person's birthplace to Óbidos, considering generation three); b) marital distance (average distance between the spouses' birthplaces) in generation three and in their ancestors (generations two and one); c) parent-offspring distance (average of the father-child and mother-child birthplace distances) in generation two - generation three and in generation one - generation two; d) exogamy coefficient (percent of marriages between people born in different localities), estimated for generations two and one. These parameters were analysed by the DIST computer program developed by J.R.S. Tavares (Human Genetics Laboratory, Federal University of Pará).

## RESULTS AND DISCUSSION

### *Migratory parameters*

The birthplace distribution of the individuals of generation three, as well as of their ancestors (generations two and one) is presented in Table I. Most of them were born in Óbidos. Among the immigrants, the major portion is represented by individuals from other places within the State of Pará. The percentage of Northeasterners in the sample was very low, but somewhat higher in their ancestors. The data were similar to those

observed in Parintins (Schüler *et al.*, 1982) and Oriximiná (Santos *et al.*, 1987), but significantly different from those found in Belém (Guerreiro and Chautard-Freire-Maia, 1988) and Manaus (Santos *et al.*, 1983), where the proportion of immigrants is higher.

Table I - Distribution of birthplaces of the individuals studied in Óbidos and of their ancestors (in %).

Birthplaces	Subjects tested (generation 3)	Their parents (generation 2)	Their grandparents (generation 1)
	N - 250	N - 463	N - 753
At Óbidos	80.4	72.4	72.3
Outside Óbidos			
In Pará	17.6	23.1	21.6
In the Northern region	0.8	0.9	1.2
In the Northeastern region	1.2	3.4	4.0
Abroad	0.0	0.0	1.9

Table II shows data about other mobility measures estimated for Óbidos and other Amazonian populations. In the sample studied, the mean individual migration was calculated as 80 km and the marital distance as 165 km. In generation two the marital distance was 102 km and in generation one, 80 km. The parent-offspring distance was estimated at 84 km in generation two - generation three, and 138 km in generation one - generation two. The exogamy coefficient was calculated at 12 for the subjects tested, 3.4 for their parents, and 1.1 for their grandparents. The comparison of these measures with those found in other populations of the Amazon region revealed that Óbidos presents dispersion indices similar to those observed for the population of Parintins (Schüler *et al.*, 1982). These observations are expected due to the town's geographical location, far away from large urban areas, though this is also true for Oriximiná.

### *Blood polymorphisms*

The phenotype and allele frequencies presented in Table III are expected for a trihybrid population (product of admixture between Caucasians, Blacks and native Indians). These data were compared to those reported for Oriximiná (Santos *et al.*, 1987),

Table II - Individual migration, marital distances and offspring distances observed in Óbidos and in other populations of the Brazilian Amazon (in km).

Parameter	Population			
	Óbidos	Oriximiná 1	Belém 2	Parintins 3
Individual migration				
Generation 3	80	255	245	116
Marital distance				
Generation 3	165	370	270	174
Generation 2	102	184	-	117
Generation 1	80	49	-	35
Parent-offspring distance				
Generation 2 - Generation 3	84	145	255	88
Generation 1 - Generation 2	138	52	-	157

1. Santos *et al.* (1987); 2. Guerreiro and Chautard-Freire-Maia (1988); 3. Schüler *et al.* (1982).

Parintins (Schüler *et al.*, 1982), Belém (Ayes *et al.*, 1976; Corvelo and Salzano, 1984; Guerreiro and Chautard-Freire-Maia, 1988), Manaus (Santos *et al.*, 1983) and Coari (Rosa *et al.*, 1984). The  $RH^*D$ - frequency was higher than that observed in Parintins (12%) and Coari (14%), but lower than that found in Oriximiná (33%). The frequency of  $ESD^*2$  was higher than in Oriximiná (15%) and Parintins (22%). The  $ACP^*B$  frequency was higher than that found in Oriximiná (79%) and that of  $CA2^*2$  higher than that observed in Parintins (0.2%). Another interesting observation is the absence of  $HBBS^*S$  and  $HP^*2M$  in Óbidos, since they have been found in all Amazonian populations thus far studied, except in Parintins, where  $HP^*2M$  was not found. Finally, although the frequency of  $TF^*D$  was higher than that described for most Amazonian populations, the precise identification of this allele (whether it is  $TF^*D1$  or  $TF^*D Chi$ ) was not made here.

Estimates of heterozygosity per locus ( $h$ ) and average heterozygosity ( $H$ ), using the thirteen loci studied are also shown in Table III. The values of  $h$  varied from zero in albumin and hemoglobin to 50% in haptoglobin and glyoxalase, and the average heterozygosity was 20%. This value of 20% can be considered as an underestimate of the average heterozygosity of the loci studied, as the phenotyping methods used revealed only part of the phenotypic variation. The mean number of alleles per locus was estimated

Table III - Phenotype distribution, gene frequencies and heterozygosity for 13 loci investigated in Óbidos.

Loci and phenotypes	Number	Alleles	Frequency	Heterozygosity per locus
<b>Haptoglobin</b>				
1-1	61	<i>HP*1</i>	0.513	0.501
1-2	121	<i>IIP*2</i>	0.487	
2-2	55			
<b>Ceruloplasmin</b>				
AB	4	<i>CP*A</i>	0.010	0.024
B	235	<i>CP*B</i>	0.988	
AC	1	<i>CP*C</i>	0.002	
<b>Transferrin</b>				
C	222	<i>TC*C</i>	0.968	0.062
CD	15	<i>TF*D</i>	0.032	
<b>Albumin</b>				
A	241	<i>ALB*A</i>	1.000	0.000
<b>Serum cholinesterase (CHE1)</b>				
U	227	<i>CHE1*U</i>	0.987	0.026
UA	6	<i>CHE1*A</i>	0.013	
<b>Serum cholinesterase (CHE2)</b>				
C5-	203	<i>CHE2*C5-</i>	0.930	0.130
C5+	32	<i>CHE2*C5+</i>	0.070	
<b>Carbonic anhydrase 2</b>				
1-1	236	<i>CA2*1</i>	0.988	0.024
1-2	6	<i>CA2*2</i>	0.012	
<b>RH</b>				
RH+	231	<i>RH*D+</i>	0.745	0.381
RH-	16	<i>RII*D-</i>	0.255	
<b>ABO</b>				
O	161	<i>ABO*O</i>	0.809	0.320
A	68	<i>ABO*A</i>	0.154	
B	16	<i>ABO*B</i>	0.037	
AB	2			

Continued

Table III - Continued

Loci and phenotypes	Number	Alleles	Frequency	Heterozygosity per locus
Esterase D				
1-1	122	<i>ESD*1</i>	0.706	0.416
1-2	95	<i>ESD*2</i>	0.294	
2-2	23			
Acid phosphatase				
B	192	<i>ACP*B</i>	0.874	0.221
AB	39	<i>ACP*A</i>	0.126	
A	11			
Glyoxalase				
1-1	44	<i>GLO*1</i>	0.448	0.496
1-2	129	<i>GLO*2</i>	0.552	
2-2	69			
Hemoglobin				
A	242	<i>HBB*A</i>	1.000	0.000

Average heterozygosity (H) = 0.200 (S.E. 0.055).

Mean number of alleles per locus = 2.000 (S.E. 0.160).

Percentage of polymorphic loci = 84.6%.

as two, and the percentage of polymorphic *loci* as 85%. Table IV shows the locus heterozygosity estimated for the systems simultaneously studied in Óbidos, Oriximiná, Coari Parintins, and Manaus (seven *loci*), and in Belém (six *loci*). The average heterozygosity calculate for Óbidos did not differ significantly from those obtained for the other populations, but the heterozygosities per locus demonstrated several differences, especially for HBB, TF and RH. The mean number of alleles per locus did not present marked differences, and the proportion of polymorphic *loci* varied from 43% in Parintins to 86% in Oriximiná.

### Racial admixture

The best estimate of racial admixture in the population of Óbidos was obtained using the ABO, RH, CP, HP, TF, CHE1, CHE2, CA2, ACP, GLO1 and ESD systems.

Table IV - Estimates of heterozygosity per locus and standard error (in parentheses) in trihybrid populations of the Amazon region. (H) average heterozygosity; (N) mean number of alleles per locus; (P) percentage of polymorphic loci.

Locus	Obidos	Oriximiná <sup>1</sup>	Belém <sup>2</sup>	Coari <sup>3</sup>	Parintins <sup>4</sup>	Manaus <sup>5</sup>
HP	0.501 (0.002)	0.501 (0.002)	0.503 (0.002)	0.507* (0.002)	0.500 (0.001)	0.507 (0.003)
CP	0.024 (0.010)	0.041 (0.014)	- -	0.016 (0.005)	0.006 (0.003)	0.000
TF	0.062 (0.015)	0.020* (0.010)	0.022* (0.004)	0.022* (0.005)	0.010* (0.004)	0.020* (0.007)
ALB	0.000	0.010 (0.007)	0.002* (0.001)	0.004* (0.002)	- -	- -
ABO	0.320 (0.024)	0.367 (0.025)	0.375* (0.012)	0.326 (0.013)	0.286 (0.016)	0.386* (0.018)
RH	0.381 (0.019)	0.443* (0.016)	0.365 (0.010)	0.246* (0.012)	0.216* (0.015)	0.340 (0.016)
IIBB	0.000	0.020* (0.006)	0.022* (0.005)	0.022* (0.004)	0.008* (0.008)	0.024* (0.008)
<i>H</i>	0.184 (0.080)	0.200 (0.085)	0.215 (0.092)	0.163 (0.076)	0.147 (0.074)	0.183 (0.083)
<i>N</i>	2.000	2.439	2.570	2.570	2.000	2.290
<i>P</i>	71.43	85.71	83.33	71.43	42.86	57.14

Sources: 1. Santos *et al.* (1987); 2. Ayres *et al.* (1976); Corvelo and Salzano (1984); Guerreiro and Chantard-Freire-Maia (1988); 3. Rosa *et al.* (1984); 4. Schüller *et al.* (1982); 5. Santos *et al.* (1983).

\*Values that differ significantly from those of Óbidos ( $P < 0.05$ ).

The proportion of Caucasian admixture was estimated at  $0.378 + 0.088$ , native Indian admixture at  $0.524 + 0.086$  and Black admixture at  $0.098 + 0.080$ . Several estimates of racial admixture in populations of the Northern Region have been made, however valid comparisons among results are difficult due to the variability of methods and genetic markers employed. However, the estimates of racial admixture obtained for Óbidos were most similar to those obtained for the population of Parintins, where a high Indian and a low Black contribution are observed (Table V). The racial admixture values for Óbidos suggest a greater Indian and a lower White contribution than in Oriximiná, Belém and Manaus. The proportion of Black admixture in the population of Óbidos was somewhat similar to most of those calculated for other Amazonian trihybrid populations, but lower than that reported for Belém (27%). These data corroborate historical information about the distribution of Black slaves in the Amazonian region, which tended to remain in the State of Pará, and mainly in Belém.

Table V - Estimates of racial admixture in some Amazonian trihybrid populations.

Populations	Proportion of admixture			References
	Black	Indian	White	
Óbidos	10	52	38	Present study
Oriximiná	15	28	57	Santos <i>et al.</i> (1987)
Parintins	13	51	36	Hamel <i>et al.</i> (1984)
Coari	14	43	43	Hamel <i>et al.</i> (1984)
Belém	27	20	53	Schneider <i>et al.</i> (1979)
Manaus	13	29	58	Hamel <i>et al.</i> (1984)

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## RESUMO

Foram estudados parâmetros demográficos e 13 sistemas genéticos em uma amostra de 250 indivíduos da população tri-híbrida de Óbidos, Estado do Pará, Brasil. Os índices de dispersão indicaram uma baixa mobilidade da população; 80% dos indivíduos estudados nasceram em Óbidos, e 88% dos imigrantes nasceram no Estado do Pará. A distribuição de fenótipos apresenta algumas diferenças quando comparada com as descritas para outras populações amazônicas (Oriximiná, Parintins, Coari, Belém e Manaus). A heterozigosidade média foi estimada em 0,200 (E.P. 0,055), o número médio de alelos em 2,000 (E.P. 0,260), e a percentagem de locos polimórficos em 84,6%. Em termos de mistura racial (38% de brancos, 52% de índios e 10% de negros). Óbidos apresenta valores mais similares aos obtidos para a população de Parintins, Estado do Amazonas, com reduzida contribuição negróide e elevada contribuição indígena.

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