Ethnic Admixture Composition of Two Western Amazonian Populations

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Abstract A small riverine community, Portuchuelo (8°37′S, 63°49′W), and a rural county, Monte Negro (10°15′S, 63°18′W), both in the state of Rondônia, Brazil, were studied for the purposes of ascertaining health conditions and the causes of the variability of some infectious diseases. The sample included 181 inhabitants of Portuchuelo and 924 of Monte Negro. Data on 11 blood polymorphisms (ABO, Rh, MNSs, Kell, Fy, haptoglobin, hemoglobin, ACP1, PGM1, GLO1, and CA2) were used to determine the ethnic composition of the inhabitants of Portuchuelo and Monte Negro. The contributions of Africans, Amerindians, and Europeans to the ethnic composition of the studied populations were, respectively, 0.21 ± 0.046, 0.44 ± 0.064, and 0.35 ± 0.069 in Portuchuelo; and 0.25 ± 0.032, 0.12 ± 0.046, and 0.63 ± 0.054 in Monte Negro.

Despite the obvious implications of demographic, ecological, and temporal influences on the epidemiological profile of infectious diseases in a population, studies on the ethnic origin of that population may give a new insight on disease causes and explain the possible heterogeneity of epidemiological patterns existing among populations. In fact, ethnic differences may reflect the assortment of favorable genetic mechanisms involved in the resistance/susceptibility to specific infectious/ecological diseases. The known contribution of European, African, and Amerindian genes to the present Amazonian populations is diverse (Schüller et al. 1982) and depends upon the type of population under study. Here, we present data on the ethnic admixture of two different western Amazonian populations, based on several blood genetic markers.

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Subjects and Methods

As part of a large research project on pure and applied research on infectious diseases in the state of Rondônia, Brazil (Camargo et al. 1994, 1996, 1999), data on two populations from the western Amazonian region were analyzed in order to estimate ethnic admixture proportions. These two populations were from Portuchuelo (8°37′S, 63°49′W), a riverine community, and Monte Negro (10°15′S, 63°18′W), a somewhat more recent, mostly rural settlement. The populations differ in several aspects, including population size, demographic density, and health care. More details on sampling as well as other characteristics of the population structure and dynamics are given elsewhere (Camargo et al. 1999, 2001).

A blood sample was collected from each studied individual (181 in Portuchuelo and 924 in Monte Negro) and tested within 24 hours for 14 antigens of five blood group systems using the classical immuno-hematological techniques. Blood groups ABO, Rh (CcDEe antigens), MNSs, Kell, and Duffy (Fya and Fyb antigens) were typed using a microtyping kit (DiaMed–ID Micro Typing System). The Coombs test was used in the last two systems. A horizontal starch gel electrophoresis was employed to type the haptoglobin (Hp) system (Smithies 1955). ACP1 (red cell acid phosphatase) was typed by isoelectric focusing (IEF), according to Kane et al. (1990). Typing of PGM1 (phosphoglucomutase 1), GLO1 (glyoxalase 1), CA2 (carbonic anhydrase 2), and hemoglobin (Hb) was conducted in the same starch–agarose gel electrophoresis, following the Wraxall and Stollorow (1978) method and the stain procedures described in Harris and Hopkinson (1976). Due to technical problems, the blood samples collected in Monte Negro were not typed for ACP1.

The maximum likelihood method of Krieger et al. (1965), using the program Mistura (Cabello and Krieger 1997), was employed to ascertain the ethnic proportions of these trihybrid populations.

Since the Africans brought to Brazil included many Bantu as well as various Sudanese groups (Freire-Maia 1963), it seemed reasonable to use weighted means based on several sources for estimating the ancestral contribution of Africans. Thus, the frequencies of various African populations summarized by Mourant et al. (1976) in Tables 2.11.2, 6.1, and 8.3.1 of their book were taken into account in calculating the gene frequencies of MNSs (Ghana and Nigeria, Tanzania and Uganda), Kell (Cabo Verde, Dahomey, Gambia, Ghana, Guinea, Ivory Coast, Liberia, and Nigeria), and Duffy (Ethiopia, Ghana and Nigeria, Moçambique, Rodesia, Tanzania, Uganda, and Zambia) systems, respectively. For the other analyzed systems the weighted means published by Franco et al. (1982) (ABO, Rh, haptoglobin, and hemoglobin) and Arpini-Sampaio et al. (1999) (ACP1, PGM1, GLO1, and CA2) were preferred. The gene frequencies of all these systems among Amerindians were drawn from Franco et al. (1982), Salzano et al. (1998), and Arpini-Sampaio et al. (1999), who have published weighted means of gene frequencies that were observed, sometimes in a very large number,

in South American Indian tribes (Salzano et al. 1998). Finally, the gene frequencies of the analyzed traits among Portuguese and/or Spaniards (Cunha and Morais 1966; Lessa 1970; Franco et al. 1982; Arpini-Sampaio et al. 1999) were used as European ancestral gene frequencies, since it is well known that the European contribution to the gene pool of Brazilian populations was predominantly of Iberian origin.

Results and Discussion

Estimates of gene frequencies for the ancestral populations are given in Table 1. The same table also shows the gene frequencies calculated for both samples according to the admixture model.

Table 2 gives the estimates of the admixture proportions and their respective standard errors for the two populations. As can be seen, the standard errors are relatively high, due largely to the heterogeneity between systems, which most likely reflects errors in estimation of ancestral gene frequencies.

The results show that the riverine population of Portuchuelo has an Amerindian ethnic proportion almost four times that of Monte Negro. This proportion reflects the fact that the Portuchuelo community is descended from settlers arriving in the 19th to the beginning of the 20th century, heavily admixed with the Mura Amerindian group, who lived in this part of the Madeira river region. In contrast, the Monte Negro population has a much more recent history and a conspicuous influence of southern Brazilian migrants. An interesting feature arising from the analyses is that the African contribution to the gene pool of these two populations is practically the same, indicating the persistence of a relatively small (around 20%) but significant proportion of African admixture, probably originating from the early migration of northeastern Brazilians during the "rubber boom" and the construction of the Madeira-Mamoré railroad.

Most of the data on the ethnic composition of the Amazonian populations refer to either urban populations or to small Amerindian tribes and former African slave isolates (cf. Sans 2000). There are virtually no reports on rural populations. The samples studied here differ from those of earlier studies in that they belong to predominantly rural populations and therefore may reflect a different genetic background.

Santos et al. (1999), analyzing the ethnic composition of several eastern and central Amazonian urban populations, concluded that there is an increased Amerindian admixture as one travels up the Amazon river, reaching around 40% in Manaus, state of Amazonas. The present data have shown, at least for rural populations, that the picture in western Amazonia is different in the sense that the Amerindian contribution is either equal to or smaller than that observed in Manaus, indicating a different pattern of colonization and migration.

The polymorphisms with reported effects on malaria resistance/susceptibility did not show significant discrepancies of ethnic admixture, as compared with the overall estimates, suggesting that either there are no noteworthy signs of se-

Table 1. Ancestral and Estimated Blood Group Gene Frequencies Used to Estimate the Ethnic Admixture of Two Western Amazonian Populations (AF = African, AM = Amerindian, E = European)

System	*Ethnic Group*	*Allele Frequencies*								*Reference*
		**A*	**B*	**O*						
ABO	AF	0.151	0.128	0.721						Franco et al. 1982
	AM	—	—	1						Franco et al. 1982
	E	0.298	0.057	0.645						Lessa 1970
	Portuchuelo	0.135	0.047	0.819						Present study
	Monte Negro	0.226	0.068	0.706						Arpini-Sampaio et al. 1999
		cDe	*CDe*	*cDE*	*CDE*	*cde*	*Cde*	*cdE*	*CdE*	
Rh	AF	0.555	0.096	0.070	0.001	0.270	0.005	0.003	—	Franco et al. 1982
	AM	0.052	0.542	0.341	0.056	0.006	—	0.001	0.002	Salzano et al.1998
	E	0.030	0.428	0.139	0.005	0.384	0.010	0.004	—	Franco et al. 1982
	Portuchuelo	0.150	0.409	0.214	0.027	0.192	0.005	0.002	0.001	Present study
	Monte Negro	0.166	0.358	0.145	0.010	0.311	0.007	0.003	0.000	Present study
		MS	*Ms*	*MSu*	*NS*	*Ns*	*NSu*			
MNSs	AF	0.159	0.328	0.066	0.088	0.265	0.093			Mourant et al.1976
	AM	0.244	0.510	—	0.073	0.173	—			Salzano et al. 1998
	E	0.214	0.300	—	0.071	0.374	—			Cunha and Morais 1966
	Portuchuelo	0.219	0.405	0.014	0.077	0.266	0.020			Present study
	Monte Negro	0.209	0.341	0.017	0.078	0.331	0.024			Present study
		K	*LK*							
Kell	AF	0.013	0.987							Mourant et al.1976
	AM	0.001	0.999							Salzano et al. 1998
	E	0.038	0.962							Cunha and Morais1966
	Portuchuelo	0.016	0.984							Present study
	Monte Negro	0.027	0.973							Present study

		*FY*A*	*FY*B*	*FY*	
Duffy	AF	0.020	0.020	0.960	Mourant et al. 1976
	AM	0.669	0.331	—	Salzano et al. 1998
	E	0.369	0.631	—	Cunha and Morais 1966
	Portuchuelo	0.429	0.370	0.201	Present study
	Monte Negro	0.315	0.440	0.245	Present study
		*HP*1*	*HP*2*	*HP*2M*	
Haptoglobin	AF	0.633	0.335	0.032	Franco et al. 1982
	AM	0.660	0.340	—	Franco et al. 1982
	E	0.403	0.597	—	Franco et al. 1982
	Portuchuelo	0.554	0.428	0.007	Present study
	Monte Negro	0.481	0.511	0.008	Present study
		*HBB*A*	*HBB*C*	*HBB*S*	
Hemoglobin	AF	0.900	0.016	0.084	Franco et al. 1982
	AM	1	—	—	Franco et al. 1982
	E	1	—	—	Franco et al. 1982
	Portuchuelo	0.979	0.003	0.018	Present study
	Monte Negro	0.975	0.004	0.021	Present study
		*ACP1*A*	*ACP1*B*	*ACP1*C*	
ACP1	AF	0.171	0.829	—	Arpini-Sampaio et al. 1999
	AM	0.152	0.848	—	Arpini-Sampaio et al. 1999
	E	0.358	0.522	0.121	Arpini-Sampaio et al. 1999
	Portuchuelo	0.227	0.731	0.042	Present study
		*PGM1*1*	*PGM1*2*		
PGM1	AF	0.837	0.163		Arpini-Sampaio et al. 1999
	AM	0.785	0.215		Arpini-Sampaio et al. 1999
	E	0.735	0.265		Arpini-Sampaio et al. 1999
	Portuchuelo	0.779	0.221		Present study
	Monte Negro	0.767	0.233		Present study

Table 1. (Continued)

System	*Ethnic Group*	*Allele Frequencies*		*Reference*
		*GLO1*1*	*GLO1*2*	
GLO1	AF	0.306	0.694	Arpini-Sampaio et al. 1999
	AM	0.273	0.727	Arpini-Sampaio et al. 1999
	E	0.426	0.574	Arpini-Sampaio et al. 1999
	Portuchuelo	0.333	0.667	Present study
	Monte Negro	0.378	0.622	Present study
		*CA2*1*	*CA2*2*	
CA2	AF	0.924	0.076	Arpini-Sampaio et al. 1999
	AM	1	—	Arpini-Sampaio et al. 1999
	E	1	—	Arpini-Sampaio et al. 1999
	Portuchuelo	0.984	0.016	Present study
	Monte Negro	0.981	0.019	Present study

Table 2. Ethnic Composition of Two Trihybrid Populations from Western Amazonia (State of Rondônia, Brazil)

Sample	*African*	*Amerindian*	*Caucasoid*
Portuchuelo	0.21 ± 0.046	0.44 ± 0.064	0.35 ± 0.069
Monte Negro	0.25 ± 0.032	0.12 ± 0.046	0.63 ± 0.054

lection (either by differential survival rate or migration), or the method is not sensitive enough to detect single polymorphism effects.

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