Effects of a traditional lifestyle on the cardiovascular risk profile: the Amondava population of the Brazilian Amazon. Comparison with matched African, Italian and Polish populations

Lucia Pavan[a], Edoardo Casiglia[a], Laura M. Carvalho Braga[b], Mikolaj Winnicki[c], Massimo Puato[a], Paolo Pauletto[a] and Achille C. Pessina[a]

Objective **To determine the relationships between lifestyle and cardiovascular risk factors among the Brazilian Amondava, one of the world's most isolated populations.**

Design **Cross-sectional, population-based study. Four age- and sex-matched samples from Brazil Africa, Italy and Poland, representing different levels of modernization, were compared. Body weight, height, blood pressure, serum cholesterol and glycaemia were measured, and a standard questionnaire administered. Data concerning dietary habits and physical activity were collected. A personal socio-economic score was calculated, on the basis of type of economy, level of formal education, type of occupation, type of habitat, availability of piped water and electricity, main source of income, housing conditions, availability of radio, television or personal computer, knowledge of a second language, and organized health facilities.**

Setting **Primary epidemiological screening, at an institution.**

Results **Among the Amondava blood pressure was always < 140/90 mmHg, it did not increase with age and was not correlated with any other variable; 46.6% of subjects had systolic blood pressure < 100 mmHg. Blood pressure among the Amondava (109.6 ± 11.1/69.5 ± 6.4 mmHg) was on average lower ($P < 0.0001$) than in all other samples. Among the Amondava, the concentration of total cholesterol was always < 200 mg/dl, i.e. similar to that of Africans whose diet included large amounts of vegetable foodstuffs; 90% had glycaemia (< 80 mg/dl), and their mean value was the lowest (55.1 ± 14.9 mg/dl) of all the groups.**

Conclusions **In addition to a possible genetic predisposition not analysed in this study, a traditional lifestyle (no contact with civilization, diet based on complex carbohydrates and vegetables, high energy expenditure) may protect against the development of hypertension, hypercholesterolaemia, and diabetes. *J Hypertens* 1999, 17:749–756 © Lippincott Williams & Wilkins.**

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[a]Department of Clinical and Experimental Medicine, University of Padova, Italy, [b]Hospital S. Lucas de Ouro Preto do Oeste, Rondonia, Brazil and [c]Department of Hypertension and Diabetology, University of Gdansk, Gdansk, Poland.

Correspondence and requests for reprints to E. Casiglia, MD, Department of Clinical and Experimental Medicine, University of Padova, Via Giustiniani 2, 35128 Padova, Italy.
Tel: +39 049 8212275; fax: +39 049 8754179; e-mail: casiglia@ux1.unipd.it

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Introduction

A number of epidemiological studies have demonstrated that lifestyle greatly influences the cardiovascular risk pattern of populations and that 'modernization' (however it is defined) is associated with an increased incidence of non-communicable diseases, such as hypertension, obesity, dyslipidaemia, and diabetes mellitus [1,2].

Low levels of blood pressure [3–7], serum total cholesterol [8–10], blood glucose [11], and body mass index (BMI) have been reported among unacculturated populations [3,10,12]. Furthermore, in many such populations, blood pressure and BMI show little or no increase with age [6], and the incidence of cardiovascular disease is extremely low [13]. Reports on people of similar ethnic origins but with different degrees of contact with modern societies [14], and on migrants moving from 'low' culture to modern societies [15,16], confirm the existence of a strong relationship between lifestyle and cardiovascular risk: the adoption of a Westernized lifestyle implies an immediate worsening of the risk pattern [17], with an increase in the prevalence of hypertension [18], hypercholesterolaemia [19], and diabetes mellitus [20]. All of these studies draw our attention to the process of Westernization as a possible triggering factor for non-communicable diseases, but only a few of them have been conducted close to the time of first contact with Westernized society.

Brazil, and particularly Amazonian native populations, offer the best opportunity for studying the impact of modernization [21], such as in the Amazon basin where 175 indigenous groups still survive. However, in the past two decades the Indian reservations have been extensively taken over by Brazilian colonists or agropastoral projects. Many of these indigenous groups have now disappeared, as a result of epidemics or war [22]. The health status of the survivors is undergoing an exponential change because of the increasing contact with non-Indian cultures and social reorganization. As a result, currently very few Indians maintain their identity and can be considered segregated.

Until recent years, the Yanomano were the main Southern American people with aboriginal traditions. Their contact with Western society dates back to the first years of the 20th century, and important differences between tribes can now be highlighted according to the degree of acculturation [23]. Many Yanomano are today able to understand Portuguese, and show higher blood pressure values than uncultured native subjects [24–26]. Of course, they can no longer be considered primitive.

Few other traditional South American populations have been studied [27,28]. In the Rondonia state, situated at the Bolivian border of North-West Brazil (Amazon region), about 20 indigenous groups still exist, many of them still completely segregated. The present study examined the Amondava people living in the Uru-Eu-Uau-Uau area (Fig. 1). They speak a language classified as being part of the Tupi family and, in contrast to other Brazilian Indians, their first official contact with the Brazilian National Indian Foundation came only in 1987. They therefore represent one of the world's most segregated populations.

The present study aimed to sketch out their cardiovascular risk pattern and compare it with that of age- and sex-matched groups living in geographic areas with very different lifestyles and levels of modernization.

Materials and methods

Study population

The entire Amondava population is composed of 30 adult subjects (age range 15–58 years) and 35 children. The Amondava reservation is about 8 h from the Rondonia capital, Porto Velho, and covers an area of 1 821 300 hectares. The climate is that of the tropical rain forest of the Amazon, with a rainy season spanning from November to April, and a relatively dry season from May to September.

No member of the population is able to read or write; there is no piped water, electricity, telephone or television; competitiveness is not a typical trait; and the level of physical activity is high. Their only means of transportation is on foot. No health aid is provided. Diet is very poor in animal fat and rich in dietary fibres and complex carbohydrates (80–85% of energy intake). Alcoholic beverages, cigarettes and canned food are unknown, and salt intake is estimated to be less than 3 g/day. The major components of their diet are rice and beans, maize (xixa), manioc, potatoes and wild vegetables. Meat and fish are eaten rarely.

Control groups

Amondava were compared with age- and sex-matched samples from North-East Italy, Northern Poland, and South East Africa (the Bantu of Madilu village).

The Italian sample consisted of 30 normotensive individuals from the general population of Mirano (Venice) [29]. The lifestyle and diet of these subjects are similar to those of the general Italian population [30,31].

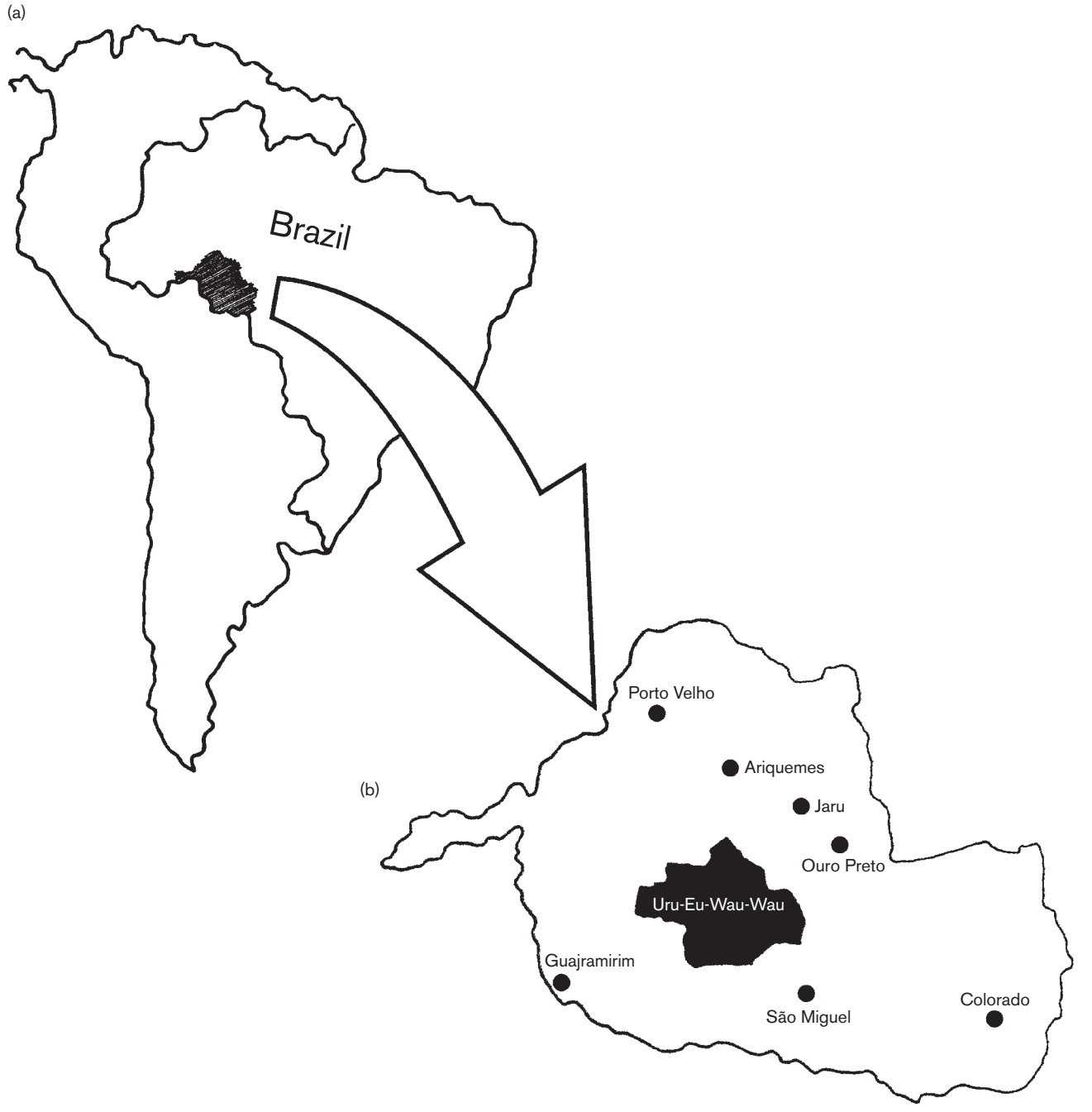
The Polish sample consisted of 30 normotensive individuals from the general population of Gdansk, whose diet was mainly based on red meat and sausages (40–45% of energy intake is from animal sources), with a low intake of vegetables (15–20% of energy intake), and included more than 9 g/day salt. The cardiovascular risk of this sample is known to be representative of that of the general Polish population [32,33].

The African sample consists of 30 Tanzanian Bantu normotensive individuals [34], living by farming and maintaining a primitive lifestyle. Cigarettes and canned food are rare. Average daily consumption of 4–6% alcoholic beverages is frequent. The Madilu diet includes large amounts of vegetable foods (80–82% of energy intake), and it is very low in animal fat. Salt intake is estimated at 4 g/day. Their first contact with Western culture occurred in about 1930. All inhabitants have a basic education and can speak English in addition to Kiswahili. First-level health aid is available.

Data collection

Data from the Amondava population were collected in December 1997. Only the 30 adults above the age of 15 years, representing 46% of the total number of individuals in the Amondava tribe, were taken into account. The age distribution (50% adults, and 50% children) is typical of all Indian populations [27]. Gaps in age- and sex-specific categories reflect actual mortality experience rather than out-migration or absenteeism [22]. All subjects and all procedures were conducted in accordance with ethical standards for human experiments outlined by the Brazilian government. Since none of the Amondava Indians spoke Portuguese, all interviews were conducted by an interpreter. Age was

Fig. 1



Map of Rondonia. The black region in B indicates the Uru-Eu-Wau-Wau reserve, where the study was conducted.

calculated by asking the subject and their relatives. When age was unknown, which was frequently the case, an estimate was made by chronological relationship to other subjects of known age in the family, physical characteristics, marital status, and the number of children. The personal knowledge of the interpreter, who knew this village very well, was also used for estimating age and for collecting information on dietary habits, smoking habits, ethanol consumption, physical activity and lifestyle. Since no method was available for validating age, this item should be interpreted as approximate. Two of the investigators resided periodically with the Amondava in order to observe their habits. Dietary constituents were calculated from international

standard food tables, a method previously validated under analogous experimental conditions [31].

In all samples, BMI was calculated from the weight (kg) divided by height $(m)^2$. Subjects with BMI below 20 kg/m^2 were regarded as being underweight, and those with BMI values over 25 kg/m^2 as being overweight. Blood pressure (diastolic phase 5) was measured twice, by trained doctors, with the subject resting for 5 min in a sitting posture, using a standard sphygmomanometer, and averaged. Hypertension was diagnosed when the systolic blood pressure was > 140 mmHg or diastolic blood pressure was > 90 mmHg.

Laboratory specimens were obtained after subjects had fasted for at least 12 h. Because of the impossibility of keeping and storing blood samples in the Amazon forest, plasma cholesterol was measured using the Accumeter system (Menarini, Firenze, Italy), whose reliability was tested against the enzymatic colorimetric method that was used in Africa, Italy and Poland. Hypercholesterolaemia was diagnosed when total cholesterol was > 200 mg/dl. Blood glucose levels were measured in Brazil using the Glucostik method (Boehringer Mannheim, Mannheim, Germany), which gave results similar to those obtained with the esokinase method used in the other samples.

A personal socio-economic score (Table 1) was calculated using type of economy (subsistence or non-subsistence), level of formal education (years of school), type of occupation, type of habitat (rural, urban), availability of piped water and of electricity, main source of income, housing conditions, availability of radio, television or personal computer, knowledge of a second language, and organized health facilities.

Table 1 **Calculation of socio-economic score**

		Partial score
A. Type of economy	Subsistence	0
	Non-subsistence	1
	0	0
B. Years of education	1–10	1
	> 10	2
C. Type of occupation	Employee, technician, worker	0
	Professional, manager	1
D. Type of habitat	Rural	0
	Urban	1
E. Piped water, electricity	Not provided	0
	Provided	1
F. Main source of income	Family	0
	Business	1
G. Housing	Absent	0
	Present	1
H. Radio, television, personal	Not provided	0
computer	Provided	1
I. Knowledge of a second language	No	0
	Yes	1
J. Health services	Absent	0
	First level only	1
	Modern	2

The final score has been calculated as the sum of the partial scores (A + B + C + D + E + F + G + H + I + J).

Since data collection was performed in different countries, a method of standardizing procedures was conceived in order to ensure comparability of data. Preliminary stages of Italian researchers in Africa and South America, and of Polish researchers in Italy, helped to establish this method. The comparability of blood examinations was preliminarily checked by blinded cross-controls, which demonstrated no systematic bias.

Statistical analysis

Mean values (means ± SD) were compared by analysis of covariance and the Tukey post-hoc test after adjusting for confounders; the correlations between continuous variables were evaluated with the Pearson coefficient and the Bonferroni's correction, and prevalence of categorical variables with two-way contingency tables and the Pearson χ^2 test.

Classes of age (< 24, 25–35 and > 35 years), BMI (< 20, 20–25 and > 25 kg/m^2), intake of salt (< 3, 3–5 or > 5 g/day), diet (weekly vegetables/meat ratio), and physical activity (> 14, 2–14, < 2 h/week) were created and used as grouping variables. The association of blood pressure with age, sex, BMI, total cholesterol, and blood glucose was assessed with multivariate regression analysis performed for each population.

Results

The general characteristics of the Amondava Indians and of the three samples are summarized in Table 2. The socio-economic score was 0.1 ± 0.2 among Amondava, 2.1 ± 0.3 among Africans, 11.8 ± 1.2 among Italians and 11.6 ± 1.6 among Polish subjects ($P < 0.0001$).

When all subjects were considered together, mean blood pressure progressively increased with decreasing physical activity and vegetable intake, and with increasing salt intake (Fig. 2). BMI (23.5 kg/m^2 versus 20.9 kg/m^2, $P < 0.0001$), total cholesterol (182.2 mg/dl versus 128.6 mg/dl, $P < 0.0001$) and blood glucose (93.2 mg/dl versus 63.9 mg/dl, $P < 0.0001$) were significantly higher in the sedentary than in those who were physically active (> 14 h/week).

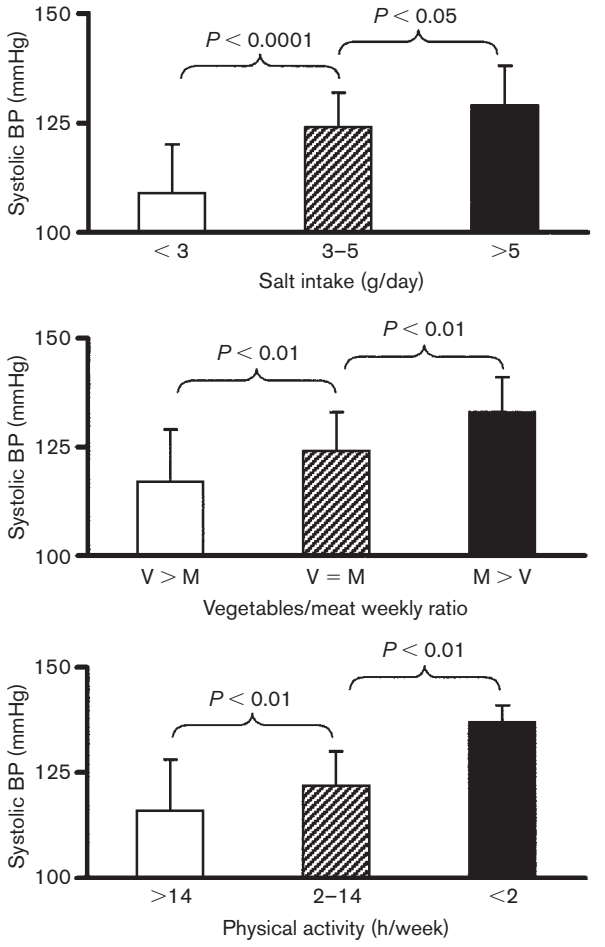
Blood pressure was significantly lower in the Amondava than in all other groups, and also lower in the Italian than in the Polish sample (Fig. 3). None of the Amondava were found to be hypertensive, and their blood pressure did not increase either with age (Fig. 4) or with BMI. In addition, 50% of Amondava subjects

Table 2 **General characteristics of the Amondava Indians and of the three age-matched and sex-matched samples**

	Amondava Population	Madilu sample	Italian sample	Polish sample	ANOVA *P* value
Socio-economic score	0.1 ± 0.2	2.1 ± 0.3**††	11.8 ± 1.2**	11.6 ± 1.6**	< 0.0001
SBP (mmHg)	109.6 ± 11.1	124.9 ± 8.5**	124.7 ± 9.2**‡‡	133.1 ± 7.9**	< 0.0001
DBP (mmHg)	69.5 ± 6.4	74.6 ± 6.4*	74.9 ± 7.7*‡	85.2 ± 5.7**	< 0.0001
BMI (kg/m^2)	20.9 ± 1.7	21.1 ± 1.4	22.1 ± 3.2§	25.1 ± 4.7**	< 0.0001
Total cholesterol (mg/dl)	129 ± 13.7	129 ± 24.1††	176.8 ± 33.4**§§	199.3 ± 42.5**	< 0.0001
Glycaemia (mg/dl)	55.1 ± 14.9	77.4 ± 17.8**†††	92.4 ± 12.8**	95.6 ± 21.7**	< 0.0001

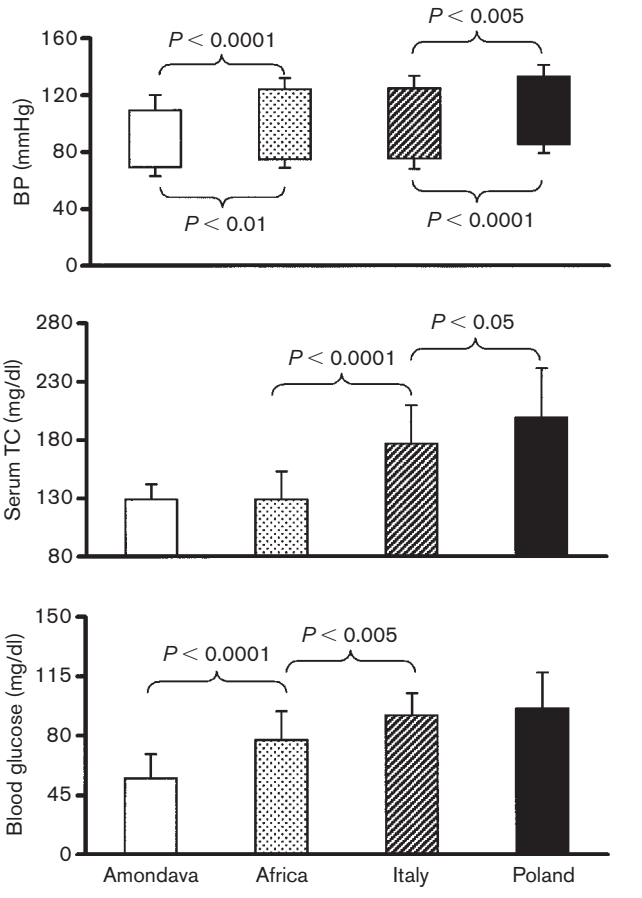
Data are presented as means ± SD. Subjects were aged 25.3 ± 11.4 years (range 15–58 years), 17 women and 13 men in each group. SBP, systolic blood pressure; DBP, diastolic blood pressure; BMI, body mass index. $^{*}P < 0.01$; $^{**}P < 0.0001$, versus Amondava; $^{\dagger\dagger}P < 0.0001$; $^{\dagger\dagger\dagger}P < 0.005$, versus Italians; $^{\ddagger\ddagger}P < 0.0001$; $^{\ddagger\ddagger\ddagger}P < 0.005$; $^{\S}P < 0.001$; $^{\S\S}P < 0.05$, versus Poles.

Fig. 2



Systolic blood pressure (BP) in relation to dietary habits and physical activity in the four study groups pooled together. V, vegetables; M, meat.

Fig. 3

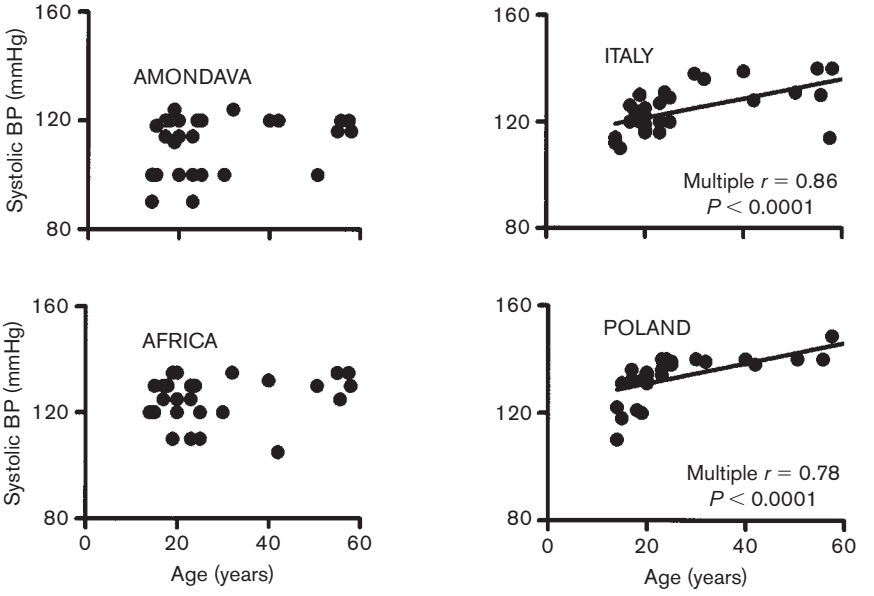


Blood pressure (BP), total serum cholesterol (TC) and blood glucose in the Amondava population and in the three control samples. Values of Amondava subjects were always significantly lower than those in Italian and Polish groups.

had systolic blood pressures < 100 mmHg and diastolic blood pressures < 70 mmHg, independently of sex. By contrast, in the Polish and Italian samples, blood pressure did correlate positively with age (Fig. 4) and BMI.

None of the Amondava Indians had serum levels of total cholesterol > 200 mg/dl (mean total cholesterol 129 ± 13.7 mg/dl). Africans had comparable values (Table 2), and in neither population was there was an increase in serum total cholesterol with age or BMI. The prevalence of hypercholesterolaemia was 16% in

Fig. 4



Relationship between systolic blood pressure (BP) and age in the Amondava population and in the three control samples. Regression lines and multiple coefficients are indicated when significant.

Italy and 44% in Poland ($\chi^2 = 57.13$, $P < 0.0001$), and total cholesterol increased with age in both groups (Fig. 5). Serum total cholesterol correlated with systolic blood pressure only in the Polish group (multiple $r = 0.81$, $P < 0.0001$).

Obesity was unknown both in the Amondava Indians and in the Africans, in whom BMI did not increase with age (which was the case for Western subjects, with a multiple r value of 0.83, $P < 0.0001$), with blood pressure or with concentration of total cholesterol. The prevalence of overweight was 20% among Italians and 46% among the Poles ($\chi^2 = 44.7$, $P < 0.0001$).

Among the Amondava, the concentration of blood glucose was on average 55.1 ± 14.9 mg/dl (the lowest of all the samples, Table 2).

Discussion

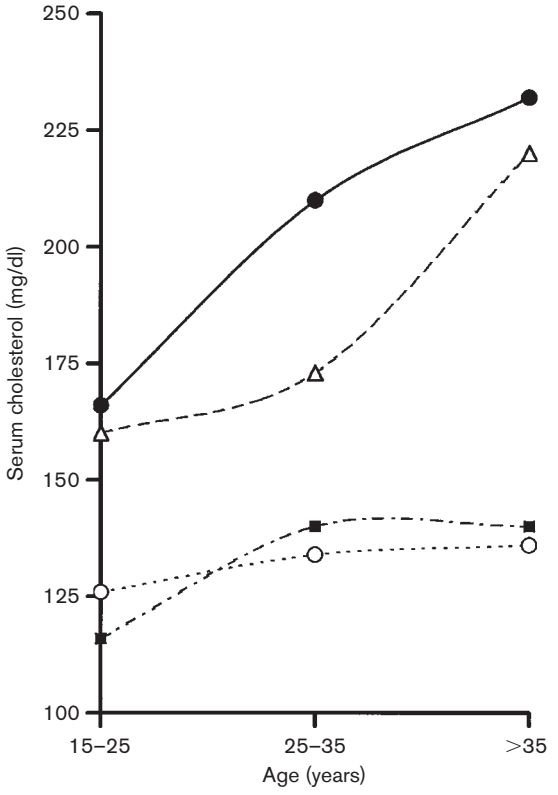
The results of this study show that the cardiovascular risk pattern of the Amondava, a population living in a remote area of the Amazon forest, is characterized by lower levels of blood pressure, BMI, total cholesterol and glycaemia than those found in modern control groups.

Similar data have been reported previously in a limited number of other tribal groups [1,35]. This is also the case of the Xavante in Mato Grosso [13] and of part of the Yanomami [26]. Furthermore, similarly to other tribal people [9,36], these items do not show any increase with increasing age. The general belief is that this type of risk pattern is 'favourable'.

Segregation is the main reason for these findings. In fact, it has been shown that shortly after a primitive population comes into contact with the Western culture, its cardiovascular risk pattern changes dramatically [2,23]. More recently this has been observed in the Chimbu (New Guinea), in subjects from the Cook Island (Melanesia) [37], in the Tarahumara (Mexico) [19] and in the Pima Indians (Arizona) [20]. Therefore, environmental factors, and not a particular genetic predisposition, seem to represent the main determinants of levels of blood pressure, total cholesterol and glycaemia among these populations.

The Amondava diet is a rather simple and monotonous one, and is characterized by low salt intake, low animal fats, and high fibre content. Physical activity is high and social stress very low. This is the opposite to what is found in affluent societies where in fact hypertension, obesity, dyslipidaemia, and diabetes mellitus have a very high prevalence and are considered as diseases of urbanization [17,38]. Indeed, the Polish sample with the worst dietary habits presented the highest levels of blood pressure, total cholesterol and glycaemia, while the Italians presented intermediate values probably because of a diet less rich in animal fats, and the Africans scored even better with a cardio-

Fig. 5



Trend of serum total cholesterol with age in the Amondava (open circles) and in the three control samples from Africa (squares), Italy (triangles), and Poland (filled circles). Between groups statistics were as follows: Amondava versus Africans, NS; Italians versus both Africans and Amondava, $P < 0.0001$ for class 15–25 and $P < 0.001$ for classes 25–35 and > 35; Poles versus both Africans and Amondava, $P < 0.0001$; Poles versus Italians, NS. Within-groups statistics was as follows: Africans 15–25 versus 25–35, $P < 0.01$; both Italians and Poles 15–25 versus > 35, $P < 0.0001$; Italians 25–35 versus > 35, $P < 0.01$.

vascular risk pattern similar to that of the Amondava, although less favourable.

In conclusion, the present findings confirm the hypothesis that the pattern of cardiovascular risk is strongly related to modernization and that a traditional lifestyle grants a good risk profile. Thi good risk profile. This is why any unfavourable modification of traditional lifestyle in primitive native populations should be avoided. For the same reasons a low caloric diet and physical activity should be included in all programmes aimed at improving health in affluent societies.

References

1 Taylor R. Non-communicable diseases in the tropics. *Med J Aust* 1993; **159**:266–270.

2 Patrick RC, Prior IAM, Smith JC, Smith AH. Relationship between blood pressure and modernity among Ponapeans. *Int J Epidemiol* 1983; **12**:36–44.

3 Swai AB, McLarty DG, Kitange HM, Kilima HM, Tatalla S, Keen N, *et al*. Low prevalence of risk factor for coronary heart disease in rural Tanzania. *Int J Epidemiol* 1993; **22**:651–659.

4 Poulter N, Khaw KT, Hopwood BE, Mugambi M, Peart WS, Rose G, *et al*. Blood pressure and associated factors in a rural Kenyan community. *Hypertension* 1984; **6**:810–813.

5 M'Buyamba-Kabangu JR, Fagard R, Lijnen P, Staessen J, Ditu M, Tshiani KA, *et al*. Epidemiological study of blood pressure and hypertension in a sample of urban Bantù of Zaire. *J Hypertens* 1986; **4**:485–491.

6 Carvalho Jairo JM, Baruzzi RG, Howard PF, Poulter N, Alpers MP, Franco LJ, *et al*. Blood pressure in four remote populations in the INTERSALT study. *Hypertension* 1989; **14**:238–246.

7 Oliver WJ, Cohen EL, Neel JV. Blood pressure, sodium intake and sodium related hormones in the Yanomamo Indians, a "no-salt" culture. *Circulation* 1975; **52**:146–151.

8 Mancilha-Carvalho JJ, Crews DE. Lipid profiles of Yanomamo Indians of Brazil. *Prev Med* 1990; **19**:66–75.

9 Connor WE, Cerqueira MT, Connor RW, Wallace RB. The plasma lipids, lipoproteins and diet of the Taraumara Indians of Mexico. *Am J Clin Nutr* 1978; **31**:1131–1142.

10 Knuiman JT, West CE, Burema J. Serum total and high density lipoprotein cholesterol concentrations and body mass index in adult men from 13 countries. *Am J Epidemiol* 1982; **116**:631–642.

11 McLarty DG, Swai ABM, Kitange HM, Masuki G, Mtinangi BL, Kilima PM, *et al*. Prevalence of diabetes and impaired glucose tolerance in rural Tanzania. *Lancet* 1989; **22**:871–875.

12 Jones DW, Kim JS, Andrew ME, Kim SJ, Hong YP. Body mass index and blood pressure in Korean man and woman: the Korean national blood pressure survey. *J Hypertens* 1994; **12**:1433–1437.

13 Carneiro O, Jardim PC. Blood pressure in the Xavante tribe. Comparison after fifteen years (in Portuguese: Pressao arterial em tribo Xavante. Comparacao 15 anos depois). *Arquivos Brasileiros de Cardiologia* 1993; **61**:279–282.

14 Grossman E, Rosenthal T. Effect of urbanisation on blood pressure in Ethiopian immigrants. *J Hum Hypertens* 1993; **7**:559–561.

15 Mufunda J, Chifamba J, Somova L, Sparks HV. Hypertension and cardiovascular disease in migrating populations. Migration within Africa. *High Blood Press* 1995; **4**:46–49.

16 He J, Klag MJ, Whelton PK, Chen JY, Mo JP, Qian M, *et al*. Migration blood pressure pattern, and hypertension: the Yi migrant study. *Am J Epidemiol* 1991; **134**:1085–1101.

17 Dressler WW, Dos Santos JE, Gallagher PN, Viteri FE. Arterial blood pressure and modernization in Brazil. *Am Anthropol* 1987; **89**:398–409.

18 Taylor R, Bennett P, Uili R, Joffres M, Germain R, Levy S, *et al*. Hypertension and indicators of coronary heart disease in Wallis Polynesians: an urban-rural comparison. *Eur J Epidemiol* 1987; **3**:247–256.

19 McMurry MP, Crqueira MT, Connor SL, Connor WE. Changes in lipid and lipoprotein levels and body weight in Tarahumara Indians after consumption of an affluent diet. *N Engl J Med* 1991; **325**:1704–1708.

20 Knowler WC, Pettitt DJ, Saad MF, Bennett PH. Diabetes mellitus in the Pima Indians: incidence, risk factors and pathogenesis. *Diabetes Metab Rev* 1990; **6**:1–27.

21 Fleming-Moran M, Coimbra CEA. Blood pressure studies among Amazonian native populations: a review from an epidemiological perspective. *Soc Sci Med* 1990; **31**:593–601.

22 Coimbra CEA. From shifting cultivation to coffee farming: the impact of change on health and ecology of the Suruí Indians of the Brazilian Amazon. PhD dissertation. Indiana University, Bloomington, USA.

23 Mancilha-Carvalho JJ, Carvalho JV, Lima JA, Souza e Silva NA. The absence of risk factors for coronary disease in Yanomami Indians and the influence of acculturation on arterial pressure (in Portuguese: Ausencia de fatores de risco de doenca coronaria em indios Yanomami e influencia da aculturacao na pressao arterial). *Arq Brasileiros de Cardiologia* 1992; **59**:275–283.

24 Carvalho JJM. Biomedical factors and blood pressure among Yanomami Indians in Brazil. *Am J Phys Anthropol* 1988; **75**:245.

25 Carvalho JJM, Lima JAC, Carvalho JV. Blood pressure is directly related to the degree of acculturation among primitive Yanomano Indians. *Circulation* 1985; **72 (suppl III)**:296.

26 Mancilha-Carvalho JJ, Souza e Silva NA, Carvalho JV, Lima JA. Blood pressure in six Yanomami. villages (in Portuguese: Pressao arterial em seis aldeias Yanomami). *Arq Brasileiros de Cardiologia* 1991; **56**:477–482.)

27 Fleming-Moran M, Santos RV, Coimbra CEA. Blood pressure levels of the Suruì and Zorò Indians of the Brazilian Amazon: group- and sex-specific effects resulting from body composition, health status, and age. *Hum Biol* 1991; **63**:835–861.

28 Lima PE. Blood pressure levels of Kalapalo and Kamaiurà Indians (in

Portuguese: Niveis tensionais dos Indios Kalapalo e Kamaiurá). *Rev Bras Med* 1950; **7**:787–788.
29 Casiglia E, D'Este D, Ginocchio G, Colangeli G, Onesto C, Tramontin P, *et al*. Lack of influence of menopause on blood pressure and cardiovascular risk profile: a 16-year longitudinal study concerning a cohort of 568 women. *J Hypertens* 1996; **14**:729–736.
30 Descovich GC, Dormi A, Gaddi A, Magri GL, Mannino G, Rimondi S, *et al*. The Brisighella study: a community survey. In: Lenzi S, Descovich GC (editors): *Atherosclerosis and cardiovascular disease*. Bologna, Italy: MPT Press; 1987. pp. 215–222.
31 Pavan L, Casiglia E, Pauletto P, Batista SL, Ginocchio G, Kwankam MMY, *et al*. Blood pressure, serum cholesterol and nutritional state in Tanzania and in Amazon: comparison with an Italian population. *J Hypertens* 1997; **15**:1083–1090.
32 Koziowska-Wojciechowska M, Uramowska-Zyto B. Animal or vegetable fat? Preferences of the Polish women according to consumer assays. (in Polish: Tluszcze roslinne czy zwierzece? Wybory polskich kobiet w swietle badan konsumenckich). *Czynniki Ryzyka* 1998; **2/3**:40–44.
33 Williams OD, Rywik S, Sznajd J, Aberbathy JR, Pajak A, Kupsc W, *et al*. Poland and US Collaborative Study on cardiovascular epidemiology. *Am J Epidemiol* 1989; **130**:457–468.
34 Pauletto P, Puato M, Caroli MG, Casiglia E, Munhambo AE, Cazzolato G, *et al*. Blood pressure and atherogenic lipoprotein profiles of fish-diet and vegetarian villagers in Tanzania: the Lugalawa study. *Lancet* 1996; **348**:784–788.
35 Akinkughe OO. Epidemiology of cardiovascular disease in developing countries. *J Hypertens* 1990; **8 (suppl 7)**:S233–S238.
36 Sinnet PF, Shyte HM. Epidemiological studies in a total highland population, Tukisenta, New Guinea. Cardiovascular disease and relevant clinical, electrocardiographic, radiological, and biochemical findings. *J Chron Dis* 1973; **26**:265–290.
37 Hodge AM, Dowse GK, Erasmus RT, Spark RA, Nathaniel K, Zimmet *PZ et al*. Serun lipids and modernization in coastal and highland Papua New Guinea. *Am J Epidemiol* 1996; **144**:1129–1142.
38 Lowell RR. Blood pressure and westernization: hypotheses bearing on the control of hypertension. *Contributions to Nephrology* 1982; **30**:19–25.