# Blood Pressure Levels in Xavánte Adults from the Pimentel Barbosa Indian Reservation, Mato Grosso, Brazil

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*Objective:* To study blood pressure (BP) levels in the Xavánte Indians of Central Brazil.

*Methods:* 93 subjects ≥15 years old were included. Systolic (SBP) and diastolic (DBP) blood pressure readings were taken to the nearest mm Hg at Korotkoff phases 1 and 5 using a mercury sphygmomanometer. Height and weight measurements were taken, as well as general information on demographic, dietary, and social factors, including use of tobacco and alcohol.

*Results:* 5.3% of the adult men and 7.7% of the adult women (≥18 years old) were classified as hypertensive (SBP≥140 mm Hg and/or DBP≥90 mm Hg). No patients were classified as stage 3 hypertensive (SBP≥180 mm Hg or DBP≥110 mm Hg). Men had higher mean body weight and height than women. There was no major difference in mean BMI (body mass index) for men and women. SBP showed a positive and statistically significant correlation with age in both men ($P = .056$) and women ($P = .040$). Among men, DBP showed a negative correlation with height ($P = .032$). Among women, weight and BMI showed a positive correlation with DBP ($P = .013$ and $P = .005$, respectively). Diastolic pressure did not show statistically significant correlation with age for either sex ($P > .05$).

*Conclusion:* The prevalence of hypertension has increased among the Xavánte over the years, which is probably related to behavioral, social, and economic alterations deriving from increased interaction with Brazilian national society. (*Ethn Dis.* 2001;11:232–240)

*Key Words:* Anthropometry, Blood Pressure, Epidemiology, Hypertension, Social Change, South American Indians

## Introduction

For some time, indigenous populations from various parts of the world have attracted the attention of epidemiologists and anthropologists interested in the potential impacts of socioeconomic and environmental changes on human health and biology. For example, indigenous populations living on traditional subsistence regimens have awakened special interest due to their low blood pressure levels as compared to those of Western (or "Westernized") urban populations.[1–4] In general, indigenous peoples also lack the classic association between age and increased blood pressure, besides displaying a very low proportion of individuals with hypertension and/or other cardiovascular disease.[4–7] The most common explanation focuses on the absence of, or lower

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exposure to, risk factors for developing such diseases.

The profile of cardiovascular diseases in indigenous peoples tends to change quickly as such groups have increased their contact with Western cultural societies. They begin to adopt new eating habits, including the consumption of salt, saturated fat, and alcohol, begin to use tobacco and tend to reduce their levels of physical activity. Numerous studies of the literature indicate a rapid emergence of arterial hypertension associated with such lifestyle changes in these groups.[3–4,8–9] In addition, changes tend to occur in their broader psychosocial environment, often with negative impacts on their social support networks, a factor that has also been associated with hypertension and other cardiovascular disease.[10–11]

Despite the rapid socioeconomic, cultural, and ecological changes observed in the majority of indigenous groups in Brazil, little is known about the epidemiology of hypertension and other cardiovascular disease among them.[1] We should highlight that the majority of the available studies on blood pressure levels in indigenous peoples in Brazil have focused on groups that are still relatively isolated (or were, at the time of data collection) and whose lifestyles differ markedly from Western standards, especially since they consume no salt and only limited amounts of saturated fats.[2,12–15] To date, there have been few studies on the epidemiology of hypertension in indigenous peoples as associated with the changes they are experiencing.[16–18]

This article presents the results of a cross-sectional survey on blood pressure levels and anthropometric variables in a Xavánte indigenous community in the Pimentel Barbosa Indian Reserve in Mato Grosso State, Brazil. The data were collected as part of a larger project for the purpose of analyzing the impact of socioeconomic changes on health conditions in the community, whose permanent contact with Brazilian national society began in the 1940s.[19–20]

## Population and Methods

The Xavánte are distributed among seven indigenous areas in the eastern region of Mato Grosso State, Central Brazil. In 1997, the Xavánte population was approximately 10,000 and resided in some 70 villages. Their permanent contact with Brazilian national society began in the 1940s, resulting in a drastic population drop due mainly to epidemics of infectious diseases.[20–22]

This study was carried out in the Etéñitépa village, the largest village in the Pimentel Barbosa Indian Reserve. In 1990, when the data were collected, there were approximately 460 inhabitants in the village.[21]

Traditional Xavánte living subsistence included a combination of farming and hunting and gathering activities. Before their contact with national society, families spent a major portion of the year on long hunting and gathering expeditions, meeting in villages with hundreds of individuals during the dry season (May to August), when they enjoyed an intense social life. Corn and root crops were the main sources of carbohydrates in the Xavánte diet; thus, the pre-contact period was characterized by intense physical activity. The Xavánte did not produce fermented alcoholic beverages, did not consume salt (NaCl), and did not grow tobacco.[23–24]

By the 1990s, after half a century of permanent contact, the Xavánte had undergone great changes in various spheres of their lives. Even in Pimentel Barbosa, still identified as one of the most "traditional" among the dozens of Xavánte villages,[20,25] there was a large drop in the frequency of hunting and gathering treks. Rice is currently a mainstay of the villagers' diet, and salt is consumed daily, even on foodstuffs the Indians obtain from hunting, gathering, and fishing. A significant proportion of the men now smoke. Unlike many other indig-

enous communities, including some Xavánte villages, alcoholism is not present in Pimentel Barbosa. At the time of this study, alcoholic beverages were not consumed there.

Blood pressure (BP) and anthropometric measurements were taken from a group of 93 individuals, aged 15 years and older, which represented approximately 40% of the Pimentel Barbosa village population in this age bracket. BP readings were taken in early morning (7:00 AM–9:00 AM) or in late afternoon (5:00 PM–7:00 PM). The survey would have been broader if not for the mobile nature of the Xavánte lifestyle. Although no one refused to participate, subjects were often absent when researchers visited their homes to take BP readings.

Ages were obtained from various sources. Data taken during research conducted previously by other investigators were extremely helpful in determining the age of most adults.[21,24] For the few elderly individuals, aged 50 years or older, age was estimated on the basis of visual inspection.

Arterial blood pressure readings were taken using a mercury sphygmomanometer by one researcher (CEAC).[26,27] Two readings were performed on the left arm of a seated subject, with an interval of 10–15 minutes between readings.[28] Since Xavánte subjects were not accustomed to this kind of procedure, all readings were performed at each subject's home, after allowing enough time for the family to become familiar with the equipment and procedure. For the purposes of the analysis, the averages of two systolic (SBP) and two diastolic (DBP) blood pressure readings were used. SBP and DBP readings were taken to the nearest mm Hg at Korotkoff phases 1 and 5, respectively.[27,29] Most BP readings were taken in the morning, between 7:00 AM and 10:00 AM, before subjects began their daily tasks. Pregnant women were not included in the study.

In the adults (aged ≥18 years), BP levels were classified into five categories, according to the sixth report of the Joint National Committee on Prevention, Detection, Evaluation, and Treatment of High Blood Pressure (JNC-VI)[30]: optimal (SBP<120 mm Hg and DBP<80 mm Hg); normal (SBP<130 mm Hg and DBP<85 mm Hg); high-normal (SBP from 130–139 mm Hg or DBP from 85–89 mm Hg); hypertension stage 1 (SBP from 140–159 mm Hg or DBP from 90–99 mm Hg); hypertension stage 2 (SBP from 160–179 mm Hg or DBP from 100–109 mm Hg); hypertension stage 3 (SBP >180 mm Hg or DBP >110 mm Hg). For adolescents (15 to 17 years of age), we adopted the cutoff points recommended by the Fifth Report of the Joint National Committee on Prevention, Detection, Evaluation, and Treatment of High Blood Pressure (JNC-V)[31] for classification of arterial hypertension: for 15-year-olds, SBP≥136 mm Hg or DBP≥86 mm Hg and, for those 16 years of age or older, SBP≥142 mm Hg or DBP≥92 mm Hg.

All anthropometric measures were taken by one researcher (RVS). Height was measured to the nearest 0.1 cm using a GPM Swiss-made anthropometer on shoeless subjects standing on a flat surface. Weight was recorded on lightly clothed, shoeless subjects on a platform spring scale (Seca, Germany) to the nearest 100 g. Body mass index (BMI) was calculated using the standard formula: weight (in kilograms)/ height (in meters) squared.

## Results

Data on blood pressure in 1990 were available for 93 individuals. Among the men, SBP ranged from 106 mm Hg to 159 mm Hg, while among women, SBP ranged from 94 mm Hg to 159 mm Hg. DBP ranged from 65 mm Hg to 99 mm Hg among men and from 47 mm Hg to 101 mm Hg among women (Figures 1 and 2). No pattern of higher averages was observed when comparing men and women ($P>.05$) (Tables 1 and 2).

Seventy-four percent of the adults (aged

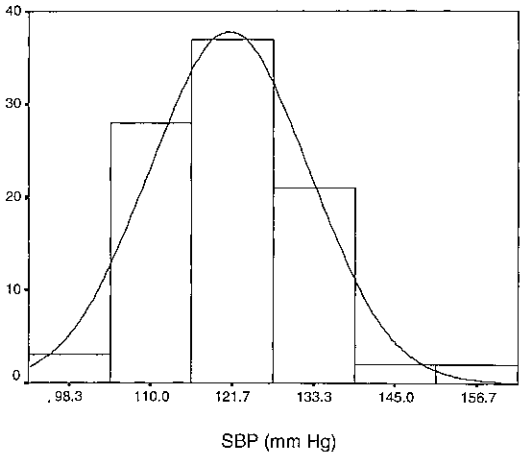


**Fig. 1.**—Distribution of systolic blood pressure (SBP) readings in the Xavánte Indians, age ≥15 years, sexes combined, 1990.

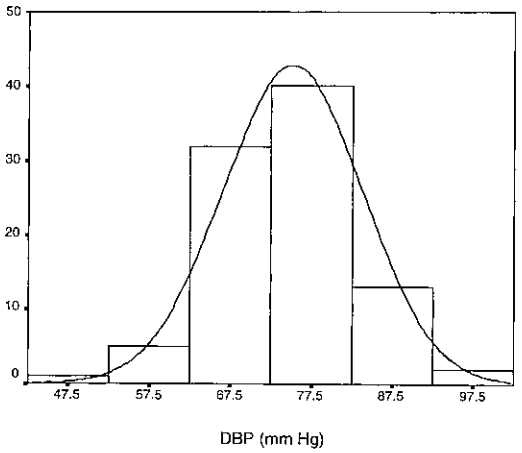


**Fig. 2.**—Distribution of diastolic blood pressure (DBP) readings in the Xavánte Indians, age ≥15 years, sexes combined, 1990.

≥18 years) showed excellent or normal blood pressure levels, with nearly 20% in the high-normal range. Only 5 individuals (5.3% of the men, and 7.7% of the women) were classified as hypertensive (two from the 28- to 37-year-age range and three older than 38 years of age). No one was classified as stage 3 hypertensive (Table 3).

Three adolescents, all male, were considered hypertensive, representing 19% of the 16 adolescent subjects. Their readings were: 122/99 mm Hg, 131/86 mm Hg, and 136/87 mm Hg.

Men had higher mean body weight and height than women in the three age brackets older than18 years of age (Table 4). There was no consistent pattern of difference in mean BMI when men and women were compared. Neither was there a significant variation in mean BMI based on age.

Blood pressure correlated with age and different anthropometric variables in adult men and women (Table 5). SBP showed a positive and statistically significant correlation with age in men (borderline significance of 0.056) and in women ($P = .040$). Among men, DBP showed a negative correlation with height ($P = .032$). Among women, weight and BMI showed a positive correlation with DBP ($P = .013$ and $P = .005$, respectively). DBP did not show a significant correlation with age.

## Discussion

The results of this study show that arterial hypertension is present among the Xavánte of the Pimentel Barbosa village. Although mean systolic and diastolic pressure is relatively low (around 121/75 mm Hg) as compared to levels for Western urban populations, we observed that some 5.3% of adult males and 7.7% of adult females (age ≥18 years), ie, 6.5% of the individuals examined, showed systolic and diastolic pressure readings over 140 mm Hg and 90 mm Hg, respectively.

Both mean blood pressure levels and the proportion of hypertensive individuals among the Xavánte in the Pimentel Barbosa village are consistently higher than those observed in various other studies of Brazilian indigenous peoples; it is important to note, however, that when these studies were performed, most groups still lived according to "traditional" subsistence regimens. Surveys conducted in the Upper Xingu,[2,13,32] and with the Yanomámi,[2,12,15] Karajá,[14] Kayapó,[33] and other groups showed mean sys-

**Table 1.**—Systolic blood pressure by sex and age group of Xavánte Indians, 1990—means, standard deviations (SD) and sample sizes (*N*)

| Age (years) | *P** | Men | | | Women | | |
|---|---|---|---|---|---|---|---|
| | | Mean (mm Hg) | SD | Total (*N*) | Mean (mm Hg) | SD | Total (*N*) |
| 15–17 | 0.763 | 121.10 | 10.98 | 10 | 122.67 | 7.53 | 6 |
| 18–27 | 0.378 | 117.00 | 7.82 | 10 | 112.70 | 12.84 | 10 |
| 28–37 | 0.312 | 118.77 | 4.68 | 13 | 123.56 | 12.05 | 8 |
| 38–66 | 0.946 | 125.07 | 11.70 | 15 | 124.76 | 13.99 | 21 |
| Total | 0.761 | 120.85 | 9.55 | 48 | 121.59 | 13.26 | 45 |

* *P* value of Student *t* tests.

tolic and diastolic pressure levels close to less than 100–105 mm Hg and 65–70 mm Hg, respectively. These surveys also recorded low proportions of hypertensive individuals (based on the criteria of SBP>140 mm Hg and DBP>90 mm Hg); in general, no more than 2% of all individuals examined were hypertensive.[2,13,32]

The Pimentel Barbosa Xavánte were surveyed by a team of physicians and bioanthropologists in 1962.[34] We compared the average values of the 1962 BP readings and anthropometric measurements with the data collected in 1990 (Table 6). There were increases in mean blood pressure and BMI from 1962 to 1990. While mean height remained virtually unchanged, men and women showed a mean weight increase of 5–7 kilograms in the 1990s. There was also an increase in mean systolic and diastolic pressure levels in both sexes. The increase in mean systolic pressure was particularly pronounced among women, and the increase in diastolic pressure was slightly higher among men. In the 1960s, systolic and diastolic pressure levels in adults aged 20 to 50 years were in the 94–126 mm Hg and 48–80 mm Hg ranges, respectively. In 1962, no hypertensive individuals were observed (SBP>140 mm Hg and DBP>90 mm Hg). In short, although the methodological procedures in the two studies were not identical, the overall results indicate the development of conditions favoring an increase in blood pressure levels (such as increased body mass), in addition to arterial hypertension.

The 1990 survey's findings indicate a moderately low but significant proportion of individuals with arterial hypertension among the Pimentel Barbosa Xavánte. It is plausible that this study may be documenting the emergence of cardiovascular diseases as a public health problem that may increase among the Xavánte in the future. Although the Pimentel Barbosa community

**Table 2.**—Diastolic blood pressure by sex and age group of Xavánte Indians, 1990—means, standard deviations (SD) and sample sizes (*N*)

| Age (years) | *P** | Men | | | Women | | |
|---|---|---|---|---|---|---|---|
| | | Mean (mm Hg) | SD | Total (*N*) | Mean (mm Hg) | SD | Total (*N*) |
| 15–17 | 0.051 | 79.60 | 9.22 | 10 | 67.33 | 13.92 | 6 |
| 18–27 | 0.086 | 76.00 | 7.51 | 10 | 69.20 | 9.16 | 10 |
| 28–37 | 0.510 | 75.69 | 7.86 | 13 | 78.50 | 11.38 | 8 |
| 38–66 | 0.804 | 75.93 | 6.28 | 15 | 75.43 | 5.73 | 21 |
| Total | 0.081 | 76.65 | 7.55 | 48 | 73.51 | 9.51 | 45 |

* *P* value of Student *t* tests.

**Table 3.**—Classification of blood pressure levels in Xavánte adults (age ≥18 years), 1990

| | Men | | Women | |
|---|---|---|---|---|
| | *N* | % | *N* | % |
| Optimal | 12 | 31.6 | 18 | 46.2 |
| Normal | 18 | 47.4 | 9 | 23.1 |
| High-normal | 6 | 15.8 | 9 | 23.1 |
| Hypertension (stage 1) | 2 | 5.3 | 2 | 5.1 |
| Hypertension (stage 2) | — | — | 1 | 2.6 |
| Hypertension (stage 3) | — | — | — | — |
| Total | 38 | 100.0 | 39 | 100.0 |

still maintains a lifestyle with many traditional Xavánte characteristics,[20] during their 50 years of contact with Brazilian national society, they have acquired habits (salt and alcohol consumption, smoking, etc) that predispose them to arterial hypertension and other cardiovascular diseases. Their average level of physical activity is lower than in the past, reflected in increased mean weight and BMI from the 1960s to date. Since the early 1970s the community has lived in one place, and most subsistence activities are carried out close to this village, with a substantial drop in the frequency of long hunting and gathering treks or camping expeditions away from the village.[20,23]

The results of this study on blood pressure levels among the Pimentel Barbosa Xavánte show a hybrid epidemiological profile. Mean systolic and diastolic pressure levels are still relatively low as compared to Western or "Westernized" urban populations. Men did not display blood pressure levels that were systematically higher than those of women. However, among the Pimentel Barbosa Xavánte there is already a positive correlation between systolic pressure and age, a pattern not commonly observed in indigenous peoples still adhering to traditional subsistence practices and engaging in intense physical activity.[2,4–8]

It is important to highlight that the data presented here for the Pimentel Barbosa community cannot be extrapolated to the larger Xavánte population. The historical experience of interaction between various Xavánte groups and Brazilian national society has been extremely heterogeneous, as reflected in changes in eating habits and lifestyle associated with the epidemiology of cardiovascular diseases. For example, in

**Table 4.**—Descriptive statistics of anthropometric parameters in Xavánte Indians according to sex and age groups, 1990

| | Men | | | Women | | |
|---|---|---|---|---|---|---|
| **Age Groups** | **Mean** | **SD** | **Total (*N*)** | **Mean** | **SD** | **Total (*N*)** |
| Weight (kg) | | | | | | |
| 15–17 | 59.39 | 3.98 | 9 | 60.50 | 8.36 | 9 |
| 18–27 | 71.19 | 6.93 | 20 | 56.21 | 6.25 | 17 |
| 28–37 | 67.32 | 7.07 | 19 | 65.28 | 7.47 | 9 |
| 38–66 | 70.78 | 7.61 | 23 | 60.04 | 9.02 | 26 |
| Height (cm) | | | | | | |
| 15–17 | 160.62 | 5.18 | 9 | 155.76 | 6.64 | 9 |
| 18–27 | 168.61 | 5.04 | 20 | 154.25 | 4.13 | 17 |
| 28–37 | 166.58 | 6.23 | 19 | 153.26 | 3.86 | 9 |
| 38–66 | 167.54 | 4.54 | 23 | 155.02 | 5.78 | 26 |
| BMI ($kg/m^2$) | | | | | | |
| 15–17 | 23.03 | 1.34 | 9 | 24.85 | 2.21 | 9 |
| 18–27 | 25.04 | 2.25 | 20 | 23.62 | 2.40 | 17 |
| 28–37 | 24.22 | 1.77 | 19 | 27.73 | 2.20 | 9 |
| 38–66 | 25.22 | 2.61 | 23 | 24.96 | 3.45 | 26 |

**Table 5.**—Bivariate correlation (Pearson's correlation coefficients and associated significances) of blood pressure with anthropometric and demographic variables in Xavánte adults (38 men and 39 women age ≥18 years), 1990

| | Men ($N$ = 38) | | Women ($N$ = 39) | |
|---|---|---|---|---|
| | Systolic | Diastolic | Systolic | Diastolic |
| Weight | 0.16 (=0.346) | 0.05 (=0.784) | 0.13 (=0.458) | 0.41 (=0.013)* |
| Height | −0.03 (=0.845) | −0.36 (=0.032)* | −0.16 (=0.346) | 0.03 (=0.883) |
| BMI (kg/m²) | 0.20 (=0.253) | 0.23 (=0.172) | 0.23 (=0.178) | 0.45 (=0.005)* |
| Age | 0.31 (=0.056) | −0.07 (=0.684) | 0.33 (=0.040)* | 0.17 (=0.317) |

* Indicates $P$ value <.05.

a study performed in another Xavánte community in 1990, Carneiro and Jardim[16] failed to observe any hypertensive individuals, using the same diagnostic criteria as in our study in Pimentel Barbosa. Although the findings from the Pimentel Barbosa survey cannot be generalized, they at least make it possible to question the situation in other Xavánte communities with respect to the magnitude of cardiovascular diseases. Considering that arterial hypertension is already present in Pimentel Barbosa, it is important to note that in various other Xavánte communities, the changes in diet and subsistence practices have been even more radical. For example, in Pimentel Barbosa some 3.6% of individuals had a BMI >30 (the cut point for obesity). In a recent study in the Sangradouro Xavánte reserve, some 26.6% of adults were found to be obese.[35] The magnitude of bioanthropological impacts on the Xavánte lifestyle has been so great in some areas, like Sangradouro and São Marcos, that in addition to the alarming obesity rates, there are reports of an increase in type 2 diabetes mellitus.[36] Preva-

**Table 6.**—Comparison of blood pressure levels and anthropometric parameters of the Xavánte Indians 20–50 years of age in 1962 and 1990

| | Men | | | Women | | |
|---|---|---|---|---|---|---|
| | Mean | SD | Total ($N$) | Mean | SD | Total ($N$) |
| Age (years) | | | | | | |
| 1962 | 26.69 | 7.12 | 13 | 30.75 | 11.12 | 12 |
| 1990 | 33.42 | 8.64 | 26 | 35.37 | 9.06 | 27 |
| Weight (kg) | | | | | | |
| 1962 | 68.31 | 5.94 | 13 | 53.25 | 5.65 | 12 |
| 1990 | 72.90 | 7.89 | 25 | 59.94 | 8.03 | 26 |
| Stature (cm) | | | | | | |
| 1962 | 169.31 | 5.44 | 13 | 155.25 | 5.14 | 12 |
| 1990 | 168.12 | 4.35 | 25 | 154.00 | 4.37 | 26 |
| BMI (kg/m²) | | | | | | |
| 1962 | 23.81 | 1.52 | 13 | 22.03 | 1.14 | 12 |
| 1990 | 25.79 | 2.69 | 25 | 25.23 | 2.92 | 26 |
| Systolic pressure (mm Hg) | | | | | | |
| 1962 | 114.00 | 8.83 | 13 | 106.67 | 9.04 | 12 |
| 1990 | 120.92 | 10.24 | 26 | 120.57 | 10.74 | 27 |
| Diastolic pressure (mm Hg) | | | | | | |
| 1962 | 63.54 | 8.05 | 13 | 66.17 | 9.28 | 12 |
| 1990 | 76.54 | 7.08 | 26 | 75.00 | 8.52 | 27 |

lence of arterial hypertension may well be higher in these areas than in Pimentel Barbosa.

In conclusion, this study focused on a Xavánte community, which to a major extent, still adheres to traditional subsistence patterns and diet, but with a 6.5% rate of arterial hypertension. While this result does not necessarily point to a huge problem from a quantitative point of view, qualitatively it signals the real potential for endemic development of arterial hypertension, reproducing the pattern characterizing urban groups. Brazilian indigenous peoples in general are undergoing rapid socioeconomic and environmental changes involving exposure to known risk factors for the development of cardiovascular diseases. It is extremely important that further research help elucidate the profile of chronic, non-transmissible diseases among indigenous peoples, including arterial hypertension, a topic that has still received only limited investigation in Brazil.

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