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Epidemiology of Renal and Cardiovascular Risk Factors in Toba Aborigines

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Objectives. To detect, educate, and control cardiovascular (CVD) risk factors, diabetes mellitus, hypertension, obesity, central obesity, and renal damage markers such as glomerular filtration rate (GFR) and proteinuria within a population of Toba aborigine people who live in the outskirts of Resistencia city, Chaco Province, Argentina. *Methods*. A sample was selected from four Toba communities. Blood and urine samples were drawn in their own homes. Proteinuria was considered positive when a urinary protein/urinary creatinine rate (uPr/uCr) ≥ 0.20. GFR was estimated by Levy formula, and the stages of chronic kidney disease (CKD) were as defined in the National Kidney Foundation Guidelines. *Results*. In all, 385 subjects were included, 36% males, mean age = 36.1 years old. The prevalence of CVD risk factors was as follows: hypertension in 97 (25.2%), proteinuria in 84 (21.8%), CKD in 93 (24.2%) [Stage 1 in 26 (6.8%), Stage 2 in 46 (12%), and Stage 3 in 21 (5.5%)]. No subjects showed CKD Stage 4 or 5. Being overweight was found in 129 (33.5%), obesity in 82 (21.3%), central obesity in 190 (49.4%), and diabetes in 8 (2.1%). The presence of CKD was associated with an increased prevalence in central obesity, hypertension, and diabetes, but not obesity. The adjusted relative risk for proteinuria was 2.79 ($p \leq 0.008$) in subjects of at least 45 years of age, compared to subjects under 25 years. *Conclusions*. This group of aborigines showed a high prevalence of proteinuria and CVD risk factors and CKD not related to diabetes.

Keywords kidney disease, hypertension, chronic non-communicable disease, Toba aborigines, high-risk populations, diabetes

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INTRODUCTION

Recent epidemiological studies indicate that many indigenous people have high prevalence of obesity, diabetes mellitus, arterial hypertension, proteinuria, and chronic kidney disease (CKD).[1–4] However, very few of these epidemiological studies have been carried out in the aborigines of the Argentine-Paraguayan region.

The Chaco province in Argentina was geopolitically established in 1875.[5] Prior to that time, this area and its people were part of the Great Chaco region of Paraguay and Bolivia. The last official census of the indigenous population of the Argentine Chaco was taken in 1968.[6] Recently, in July 2005, preliminary results were published by the National Institute of Statistics and Census from Argentina estimating 47,591 Toba aborigines for three provinces: Chaco, Formosa, and Santa Fe.[7]

During the past 100 years, the lifestyle of the aborigines of the Argentine Chaco has changed from hunter-gatherers to a more sedentary pattern of living and a more Western diet. The impact of this change in lifestyle[8] on the health of these people, particularly with regard to

obesity and diseases associated with a greater intake of calories and sodium chloride, is unknown.

In January 2003, a program was established for the Toba aborigines by the Northeastern Kidney Foundation of Argentina for the detection of non-communicable diseases, education concerning risk factors in their native language, detection, and treatment of hypertension.

The cardiovascular risk factors studied were arterial hypertension, diabetes, obesity, central obesity, the estimated glomerular filtration rate (GFR), and proteinuria. The program was limited to Toba aborigines older than 13 years of both sexes who lived in the slums of the city of Resistencia, the capital of the province of Chaco, Argentina. This report presents the preliminary results of the authors' assessment of a kidney disease, obesity, diabetes, and hypertension detection and treatment program that is being established for the Toba Aborigines. It also represents one of the first observational studies of the prevalence of these illnesses in an aborigine South American population.

METHODS

The report presented here is the result of an epidemiological, descriptive, cross-sectional surveillance study. The sample size required a minimum of 343 subjects to detect a prevalence of at least 3%. As there was no official census, four Toba Aborigines communities—Toba, Mapic, Chelliyi, and Fidelidad, which are each located within 180 km of the city of Resistencia—were selected. The inclusion criteria for participation in this survey was anyone who belonged to the Toba origin ethnic group, spoke the Toba language, defined themselves as Toba on their mother and/or father's side,[9] and lived permanently in one of the selected communities.

To achieve the objectives, the researchers worked with the leadership of the Toba community in a culturally and ethical sensitive manner to enlist their commitment and participation in this project. Several meetings were organized to identify the leaders in each of the four settlements of Toba Aborigines in the area. The researchers trained these individuals to take blood pressure and anthropometric measurements.

Arterial hypertension was defined according to the Seventh Report of the Joint National Committee on prevention, detection, evaluation, and treatment of high blood pressure.[10] Specifically, a subject was classified with arterial hypertension if systolic blood pressure was ≥140 mmHg or a diastolic blood pressure was ≥90 mgHg, measured by standard cuff manometer on two separate days (at least three blood pressure measurements each day) with no more than one week time interval between measurements. Diabetes mellitus was defined according to the American Society of Diabetes[11] as follows: two fasting blood glucose measurements ≥126 mg/dL or two random (non-fasting) blood sugar measurements ≥200 mg/dL. Blood glucose was tested using the glucose enzyme test GOD/PAD. Glomerular filtration rate was estimated using the simplified equation of Levy.[12] Protein was estimated by the complexometric test with pyrogallol red-molybdate (Wiener Laboratories SAIC, Rosario, Argentina). Creatinine was measured with the kinetic test of Jaffe (Roche Laboratories, Indianapolis, Indiana, USA). Proteinuria was considered to be present when the urinary protein: urinary creatinine ratio (uPr/uCr) was ≥0.20 in a morning urine specimen.[13]

Weight was estimated by a mechanical balance with altimeter, which registered a maximum weight of 150 kg and 2 m height. It was installed at the healthcare community center in each of the Toba communities. The individual's nutritional state was classified using the body mass index (BMI, kg/m^2) according to the WHO classification (i.e., overweight as $25 \geq BMI < 30$ and obesity as $30 \geq BMI$).[14] Abdominal circumference was measured with a metallic tape measure; central obesity was considered to be present when the waist circumference was >94 cm in men and >80 cm in women.[15] A physician obtained from the individual in his home a single 5 ml blood sample and a urine specimen in a sterile jar the morning after an eight-hour fast. Samples were labeled and kept in a refrigerated package until they arrived in the laboratory where they were processed; specimens were analyzed using a Hitachi 917 analyzer.

The population sample was divided into groups based on the calculated GFR, according to the National Kidney Foundation K/DOQI Clinical Practice Guidelines.[16]

The prevalence of CVD risk factors were compared between genders and between those with and without CKD using Fisher's exact test; also, the significance of trends in prevalence over age groups and over CKD stages were assessed using the Cochran-Armitage test.

Trends in the prevalence of proteinuria in combination with hypertension or without hypertension over CKD stages were assessed with the Cochran-Armitage test. The relative risks of proteinuria for each gender, age group, hypertension, obesity, and central obesity, adjusted by the other four factors, were obtained from a log-linear binomial regression model with proteinuria as the dependent variable and the five potential risk factors as independent variables.[17]

Both Epi Info 6 and SPSS, version 11.5 (2002) statistics packages were used.

RESULTS

Three hundred eighty-five subjects were enrolled. Demographic and clinical characteristics of the studied subjects are described in Table 1. Subjects had a mean age of 36.1 years,

Table 1
Subject characteristics

Number in study	385
Male	139 (36.1%)
Age, years	36.1 ± 16.5
Age, range	14–91
Hypertension	97 (25.2%)
Proteinuria	84 (21.8%)
CKD	93 (24.2%)
Stage 1	26 (6.8%)
Stage 2	46 (12%)
Stage 3	21 (5.5%)
BMI, kg/m^2	26.5 ± 5.5
Range	15.2–46.9
<20	32 (8.3%)
20–24	142 (36.9%)
25–29	129 (33.5%)
≥30	82 (21.3%)
Central obesity	190 (49.4%)
Diabetes mellitus	8 (2.1%)

Note. N in brackets indicates percentages. Variance is given as standard deviation unless other value is indicated.

36% were male, 25.2% had hypertension, 21.8% had proteinuria, and 24.2% had CKD (Stage 1: 6.8%, Stage 2: 12.0%, Stage 3: 5.5%, no Stage 4 or 5 were found). Being overweight was present in 129 (33.5%), obesity in 82 (21.3%), central obesity in 190 (49.4%), and diabetes in 8 (2.1%).

Prevalence (and a 95% confidence interval) for each CVD risk factor according to age, gender, and CKD stages are shown in Table 2.

All examined CVD risk factors showed a significantly ($p<0.01$) increasing prevalence with age except obesity for females ($p=0.80$) and diabetes mellitus for males ($p=0.15$). No significant difference was found by gender ($p>0.20$) except central obesity, with $p<0.0001$. All risk factors except obesity ($p>0.80$) had significantly greater ($p<0.01$) prevalence among subjects with CKD, compared to other subjects, and increased significantly ($p<0.01$) with increasing CKD stage.

The prevalence of concurrent proteinuria and hypertension and of proteinuria without hypertension in each stage of CKD is presented in Table 3. Concurrent hypertension and proteinuria is significantly more likely as CKD becomes more severe.

A multivariate model[17] was used to estimate risk of proteinuria from the potential risk factors of age, gender, hypertension, obesity, and central obesity. As there were only nine subjects with CKD who do not have proteinuria, none of the non-CKD subjects had proteinuria, and only 8 subjects with diabetes, those two factors could not be included in this analysis.

Table 4 displays the adjusted relative risks from this model. Increasing age was the dominant risk factor, with subjects 45 years or older having at least 2.79 times the risk of subjects younger than 25 years of age.

In all, 37 (9.6%) aborigines presented Stage 1 and 17 (4.4%) Stage 2 of hypertension. Only 23% of the detected hypertensive people were aware of their condition.

DISCUSSION

The special interest of studying this ethnic minority group is that "the Toba-Pilaga Indians remained isolated from the national society until the late 19th century. Anthropological reports considered that the change in eating habits began at that moment, when they began to work and were paid with sugar, and salt…."[18]

CVD prevalence found in obesity, central obesity, and hypertension (see Figure 1) was as high as in other non-aborigine groups of Latin America.[19–21] Women showed obesity in the four age groups studied (p=ns), and central obesity was more frequent in females than in males, which is probably related to a more sedentary pattern. CKD showed statistically significant association with hypertension, central obesity and proteinuria, while it showed no relation with obesity (see Table 2).

A remarkable finding is that diabetes mellitus was not as frequent as expected in our region. This may be explained by the relatively low mean age (36.1 years) of the population studied. In a white population in Corrientes city, 20 km far from Resistencia, the prevalence reported was 7% for non-obese individuals and 19% for obese.[22] In fact, diabetes mellitus in Alaskan Indians "was rare,"[23] as Bennet pointed out in 1971, whereas between 1990 and 1997, the incidence raised 76%.[24]

The prevalence and 95% of confidence intervals of CKD found was similar to that obtained by the Third National Health and Nutrition Examination Survey (NHANES III).[25] It is important to highlight that the sample size in this study was not calculated in order to detect a prevalence less than 3% (see Figure 2).

The prevalence of proteinuria of 20.8% is strikingly higher in comparison with the AusDiab Kidney Study,[26] which detected 2.4% with comparable methods. They also found increasing age as the dominant risk factor.

The population studied was divided into groups based on the calculated GFR, according to the National Kidney Foundation K/DOQI Clinical Practice Guidelines. The first stage includes those individuals with proteinuria and explains the 100% of proteinuria found within that Stage. When one distinguishes between the different stages of CKD, it is found that 85% of the proteinuria not related to arterial hypertension in Stage 1, 48% in Stage 2, or 14% in

Table 2
Cardiovascular disease (CVD) risk factors prevalence (95% CI) according to age, gender, and chronic kidney disease (CKD) stage

	N	Diabetes	Arterial hypertension	Obesity	Central obesity	Proteinuria	CKD
Women	246	2.4 (0.9–4.4)	23.6 (18.4–29.4)	32.1 (26.3–38.3)	63.4 (57.1–69.4)	23.2 (18.1–29.0)	25.6 (20.3–31.5)
< 25	73	0	0	28.7 (18.8–40.6)	35.6 (24.8–47.7)	11.0 (4.9–20.5)	11.0 (4.9–20.5)
25–44	110	0.9 (0.0– 5.0)	19.1 (12.2–27.7)	33.6 (24.9–43.3)	66.4 (56.7–75.1)	16.4 (10.0–24.6)	17.3 (10.7–25.7)
45–64	43	7.0 (1.5–19.1)	51.1 (35.5–66.7)	39.5 (25.0–55.6)	88.4 (74.9–96.1)	53.5 (37.7–68.8)	55.8 (39.9–70.9)
≥ 65	20	10.0 (1.2–37.7)	75.0 (50.9–91.3)	20.0 (5.7–43.7)	95.0 (75.1–99.9)	40.0 (19.1–64.0)	60.0 (36.1–80.9)
Men	139	1.4 (0.2– 5.1)	28.1 (20.8–36.3)	36.0 (28.0–44.5)	24.5 (17.6–32.5)	19.4 (13.2–27.0)	21.6 (15.1–29.4)
< 25	36	0	2.8 (0.1–14.5)	13.9 (4.7–29.5)	2.8 (0.1–14.5)	13.9 (4.7–29.5)	13.9 (4.7–29.5)
25–44	59	0	23.7 (13.6–36.6)	42.4 (29.6–55.9)	27.1 (16.4–40.3)	8.5 (2.8–18.7)	8.5 (2.8–18.7)
45–64	35	5.7 (0.7–19.2)	48.6 (31.4–66.0)	45.7 (28.8–63.4)	45.7 (28.8–63.4)	37.1 (21.5–55.1)	42.9 (26.3– 60.7)
≥ 65	9	0	77.8 (40.0–97.2)	44.4 (13.7–78.8)	11.1 (0.3–48.3)	44.4 (13.7–78.8)	55.6 (21.2–86.3)
All	385	2.1 0.9–4.1	25.2 20.9–29.8	33.5 28.8–38.5	49.4 44.3–54.5	21.8 17.8–26.3	24.2 20.0–28.8
< 25	109	0	0.9 0.0–5.0	23.9 16.2–33.0	24.8 17.0–34.0	11.9 6.5–19.5	11.9 6.5–19.5
25–44	169	0.6 0.0–3.3	20.7 14.9–27.6	36.7 29.4–44.4	52.7 44.9–60.4	13.6 8.8–19.7	14.2 9.3–20.4
45–64	78	6.4 2.1–14.3	50.0 38.5–61.5	42.3 31.2–54.0	69.2 57.8–79.2	46.2 34.8–57.8	50.0 38.5–61.5
≥ 65	29	6.9 0.9–22.8	75.9 56.5–89.7	27.6 12.7–47.2	69.0 49.2–84.7	41.4 23.5–61.6	58.6 38.9–76.5
CKD:							
No	292	0.3 0.0–1.9	18.2 13.9–23.1	33.9 28.5–39.7	45.6 39.7–51.5	0	
Yes	93	7.5 3.1–14.9	47.3 36.9–57.9	32.3 22.9–42.8	61.3 50.6–71.2	90.3 82.4–95.5	
Stage 1	26	3.9 0.1–19.6	15.4 4.4–34.9	23.1 9.0–43.7	30.8 14.3–51.8	100	
Stage 2	46	8.7 2.4–20.8	52.2 37.0–67.1	37.0 23.2–52.5	73.9 58.9–85.7	100	
Stage 3	21	9.5 1.2–30.4	76.2 52.8–91.8	33.3 14.6–57.0	71.4 47.8–88.7	57.1 34.0–78.2	

Age trends: all $p<0.01$ except obesity for females ($p=0.80$) and diabetes mellitus Type 2 for males ($p=0.15$), using Cochran-Armitage test for trend.

Gender: no significant differences ($p>0.20$) except central obesity, with $p<0.0001$, using Fisher's exact test.

CKD: all $p<0.01$ for Yes/No (Fisher's exact test) and for trend over stages (Cochran-Armitage test) except obesity ($p>0.80$).

Table 3
Prevalence of proteinuria with and without hypertension according to CKD stage

	All CKD	Stage1	Stage2	Stage3	Trend (*p* value)
Proteinuria without hypertension	50.4%	84.6%	47.8%	14.3%	<0.0001
Proteinuria and hypertension	39.8%	15.4%	52.2%	42.9%	0.04

Table 4
Adjusted relative risk of proteinuria for cardiovascular disease (CVD) risk factors

Risk factor	Adjusted relative risk (RR)*	95% CI for RR	*p* value
Female	1.37	0.89–2.11	0.15
Hypertension	1.46	0.97–2.20	0.07
Obesity	0.75	0.51–1.09	0.13
Central obesity	0.84	0.53–1.33	0.46
Age†			
25–44	1.14	0.60–2.19	0.69
45–64	3.84	2.04–7.23	<0.0001
≥65	2.79	1.30–5.97	0.008

*Adjusted mutually for other factors in this table.

†Relative to age < 25 years.

Stage 3 (see Table 3). An age older than 45 years showed higher adjusted relative risk of proteinuria for CVD risk factors. These results need further investigations under the hypothesis of a "multidimensional origin of kidney damage" stated by Hoy and co-workers,[27] or possibly the influence of hygiene and socioeconomic factors of Feng et al.[28] The studied Toba aborigines belong to urban groups who live in poverty and with poor sanitation. There are no published data that differentiate their health status from the white population of Chaco province. Demographic reports for the province of Chaco showed life expectancy of 65.6 yrs for men and 72.6 yrs for women, 33% of families with unsatisfied basic needs, and infant mortality rate in 2002 of 26.7 per thousand live birth.[29]

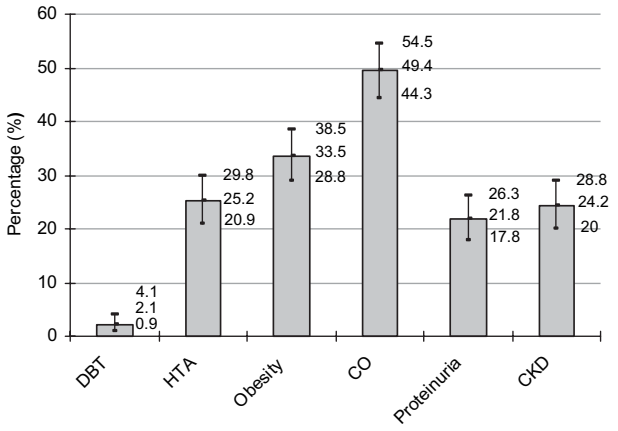

Figure 1. Prevalence of renal and cardiovascular disease (CVD) risk factors in Toba aborigines.

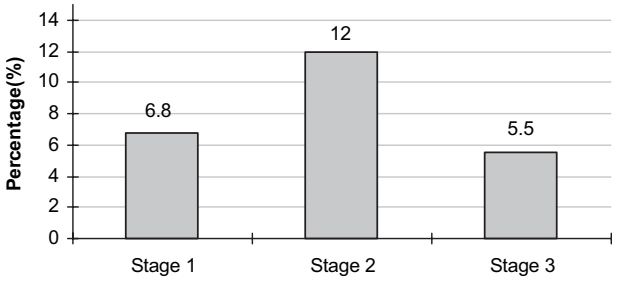

Figure 2. Prevalence of CKD in Toba aborigines.

The association of proteinuria and hypertension is more evident when GFR diminishes.[30] Fewer than 23% of hypertensive people were aware of that condition, which is possibly the reason for the high prevalence of hypertension with concurrent proteinuria in Stage 3 of CKD.

Since its design, the program promotes the "active involvement of indigenous people in primary health care and in the planning and implementation of health protection programs at the local level."[31]

The program showed its feasibility based on a very simple methodology and low costs to include a highly vulnerable population in a policy of prevention of non-communicable diseases. The treatment was supported by Chaco Province Ministry of Health.

Several screening and prevention programs proved their impact on slowing the progression of chronic kidney disease.[32,33] These results should be demonstrated in wide samples, and the follow-up of this group of people will show the program efficacy.

The limitations of this study include:

- The bias of selection with a greater proportion of females. The reason is males are out of their homes early in the morning.
- The sample was not truly random, as there was no official census as a sampling frame.

This group of Toba aborigines showed a high prevalence of proteinuria, CVD risk factors, and CKD not related to diabetes, with a high prevalence (42.9%) of people with concurrent hypertension and proteinuria in Stage 3 of CKD.

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