Prevalence of metabolic syndrome in the indigenous population, aged 19 to 69 years, from Jaguapiru Village, Dourados (MS), Brazil

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Prevalence of Metabolic Syndrome in the Indigenous Population, Aged 19 to 69 Years, from Jaguapiru Village, Dourados (MS), Brazil

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Objective: To evaluate the prevalence of metabolic syndrome in an indigenous Brazilian population.

Methods: Indigenous Brazilians aged 18-69 years from Jaguapiru Village, Dourados, MS were studied. Participants were selected by simple random sampling of 360 houses in the village. The abdominal circumference of the population was evaluated, and measurements <80 cm for females or <90 cm for males were considered normal. Capillary blood glucose levels by glucometer and oral glucose tolerance tests were measured, and, when necessary, total cholesterol, HDL cholesterol and triglyceride levels were assessed.

Results: Of the 632 indigenous Brazilians in the study, 281 were males. We observed that 287 (45.4%) presented abdominal circumference values greater than normal; of those, 199 were women (43.4% of all women in the study) and 88 were men (26.1% of all men in the study).

Conclusion: Metabolic syndrome is common in the Indian Jaguapiru Village. (*Ethn Dis.* 2011;21(3):301–306)

Key Words: Metabolic Syndrome, South American Indians, Diabetes Mellitus, Hypertension, Obesity

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Introduction

Global changes in lifestyle and dietary habits that have occurred in the second half of the 20th century have contributed to the increased incidence of several chronic diseases, altering the epidemiological profile of several populations. The Brazilian indigenous communities (ie, Indian tribal descendents, from the country's native inhabitants at the time of the European discovery of Brazil) may be in this situation.

Metabolic syndrome is a heterogeneous clinical entity that encompasses components such as abdominal obesity, insulin resistance, arterial hypertension, type 2 diabetes, and dyslipidemia, and increased risk of cardiovascular arteriosclerosis disease.[1] Adipose tissue, an important endocrine organ, plays a major role in the genesis of insulin resistance and is involved in metabolic syndrome.[2,3] Diabetes mellitus and impaired glucose tolerance cause decreased life expectancy. In adults, the risk of death from any cause is 40% higher in individuals with impaired glucose tolerance, compared to those with normal glucose levels.[4] Alterations in glucose metabolism, arterial hypertension, chronic inflammation and endothelial dysfunction, all of which interact in complex ways in the blood vessels,[5–7] are important in the genesis of arteriosclerosis. The control of these risk factors significantly reduces the mortality related with arteriosclerosis.[8]

The prevalence of metabolic syndrome worldwide is estimated to be around 25%, but it can reach 42% in individuals older than aged 60 years.[9] In the municipality of Vitoria (ES), a survey conducted between 1999 and 2000 found a prevalence of 29.8% in adults aged 25–64 years.[10]

Little epidemiological information is know about metabolic syndrome in indigenous Brazilian populations, however, reports from studies on the cardiometabolic risk of many indigenous communities suggest that this is a growing health problem.[11,12]

Our study establishes the prevalence of metabolic syndrome among an indigenous Brazilian population in Jaguapiru Village. With this information, appropriate measures to control cardiovascular disease risk factors can be implemented, thereby preventing its complications.

Methods

This cross-sectional study on the prevalence of metabolic syndrome in the Jaguapiru indigenous village, which is part of the Dourados indigenous reserve (MS), took place between April 2008 and October 2009.

The diagnosis of metabolic syndrome[13] was based on the presence of an abdominal circumference >80 cm

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in females or >90 cm in males in association with at least two of the following criteria: HDL cholesterol ≤50 mg/dL for females and ≤40 mg/dL for males; triglycerides ≥150 mg/dL; blood pressure ≥130/85 mm Hg; and fasting glucose ≥100 mg/dL, impaired glucose tolerance (glucose≥140 and <200 mg/dL 2 hours after 75g of dextrose overload) or diabetes mellitus.

The random samples were obtained by annotation of the official numbers of all 1,255 houses in Jaguapiru Village on pieces of paper that were folded and placed in an urn. The first 360 numbers taken from the urn became the selected households. Whenever one of the selected households had no participants that fulfilled the established inclusion criteria, a new house number was randomly taken from the urn.

Only males and females between the ages of 18 to 69 years who resided in the village met inclusion criteria. Exclusion criteria were non-indigenous individuals and their descendents living in Jaguapiru Village, pregnant women and chronic glucocorticoid users.

On the first visit, information on socioeconomic conditions, dietary habits, physical activity, alcohol consumption, smoking habits, sex, age, weight, occupation, personal and family history of hypertension and diabetes mellitus, education level and health conditions was collected. The age of the indigenous participants was based on identification records from the National Indian Foundation (Fundação Nacional do Índio-FUNAI).[14] Abdominal circumference was measured with a non-elastic measuring tape positioned at the midpoint between the bottom edge of the last rib and the top of the iliac crest while the subject was standing. Abdominal circumferences of up to 90 cm for males and 80 cm for females were considered normal.[13]

During the second visit, blood pressure was taken from the individual's right arm with an adult aneroid sphygmomanometer with a metal lock. Measurements were taken with the participant seated and after 10 minutes of resting. Two measurements were taken and averaged. Height was determined using a portable stadiometer capable of measuring heights of at least 0.80 m and up to 2.20 m. Weight was measured using a digital scale for adults with an LED screen, bi-volt battery, tubular structure, a non-slip rubber base and a capacity to measure up to 180 kg. The scale was levelled on a flat surface. The participant was positioned appropriately on the scale while wearing minimal clothing with empty pockets and no shoes. Body mass index (BMI) was calculated according to the formula: weight (kg)/height (m)^2

Capillary glycemia was measured using a glucometer (Accu-Chek®) with fast reading strip reagent (glucose-oxidase, Roche Diagnostics). Measurements of total cholesterol, HDL cholesterol and triglycerides were performed on a portable Reflotron Plus device run on a battery or electric current with automatic calibration using the photometry reflectance principle and using strip reagents for each individual parameter (Roche Diagnostics).

For statistical analysis, the Student *t* test, chi-square or exact Fisher tests were used.[15] Qualitative variables were represented by absolute (*n*) and relative (%) frequencies. Quantitative variables were represented by mean and standard deviation, and median, maximum and minimum values.

Correlation analysis among variables was performed by Pearson's correlation coefficient. The two-tailed test was used to determine the significance of the finding. The correlation was considered null when equal to zero, weak when >0 and <.3, regular when ≥.3 and <.6, strong when ≥.6 and <.9, very strong when ≥.9 and <1.0 and complete or perfect when =1.0.[15]

The project was approved by the Ethics in Research Committee from the Centro Universitário da Grande Dourados – UNIGRAN and by the National Commission of Ethics in Research (CONEP). The study participants signed an informed consent.

Table 1. Cardiometabolic risk factors among indigenous participants from Jaguapiru Village, Dourados, MS, Brazil, *n* (%)

Indicators	Male *n*= 268	Female *n*= 338	Total *n*= 606
Abdominal circumference	110 (41)*	259 (76.6)†	369 (60.9)
Hypertension	117 (43.6)	127(37.5)	244 (40.3)
Overweight	118 (44)	122 (45.5)	240 (39.6)
Obesity	38 (14.2)	104 (30.7)	142 (23.4)
Impaired fasting glucose	34 (12.7)	35 (10.4)	69 (11.4)
Diabetes mellitus	4 (1.5)	23 (8.6)	27 (4.5)
Decreased glucose tolerance	3 (1.1)	10 (3.0)	13 (2.1)

* >90 cm males.
† >80 cm females.

RESULTS

Study Participants

Initially, 632 indigenous Brazilians were evaluated, representing 24.5% of the adult population from the village. Later, we excluded: 19 pregnant women, 4 participants who moved, two who withdrew from the study and one who used glucocorticoid.

The final study group included 606 indigenous participants: 338 females (55.8%) and 268 males (44.2%) with a mean age of 36 ± 1 years. Table 1 shows the cardiometabolic risk factors found among study participants. Increased abdominal circumference was found to be the most prevalent risk factor in the sample (60.9%) and was more frequent in women (76.6%). This was followed by hypertension (40.3%) and being overweight (39.6%), with

Table 2. Prevalence of metabolic syndrome by age and sex among indigenous participants from Jaguapiru Village, Dourados, MS, Brazil, *n* (%)

Age, Years	Female *n* = 126	Male *n* = 61	Total *N*= 187
18–29	15 (11.9)	10 (16.4)	25 (13.4)
30–39	43 (34.1)	14 (22.9)	57 (30.5)
40–49	24 (19)	10 (16.4)	34 (18.2)
50–59	33 (26.2)	20 (32.8)	53 (28.3)
60–69	11 (8.7)	7 (11.5)	18 (9.6)

overweight being equally distributed between sexes. Obesity (23.4%) was more frequent in females than in males ($P<.05$). Impaired fasting glucose (11.4%) and decreased glucose tolerance (2.1%) had similar distributions between sexes. However, the incidence of diabetes mellitus (4.5%) was more frequent among women ($P<.05$).

The declared household monthly income was <148 Euros in 64.6% of the participating households, between 149 and 296 Euros in 24.5% of the households and >296 Euros in only 9.9% of the households.

Of the 369 participants with an abdominal circumference above normal, 82 (22.2%) individuals were excluded from the study for the following reasons: 31 withdrew, 17 were absent at the time of visits, 16 moved to other villages, 13 became pregnant, 3 were hospitalised and 2 died. Of the remaining total 287 indigenous participants (199 [69.3%] women), the mean age was aged 40 years and the majority of the participants (71%) were <50 years.

Metabolic Syndrome

After evaluation of the association of elevated abdominal circumference and the presence of two or more metabolic risk factors,[13] we found that 187 (35.7%) indigenous participants had metabolic syndrome, with a greater prevalence among females (43.4%) than males (26.1%). (Table 2) The frequencies were similar in all age groups.

Table 3 presents the total cholesterol, HDL cholesterol, triglycerides and glucose concentrations. No significant differences were observed between sexes. However, 47.3% of females had HDL cholesterol <50 mg/dL and 14.7% of the males <40 mg/dL. For serum triglycerides concentrations, 24.5% of women and 13.8% of men had levels above 149 mg/dL.

Table 4 presents the correlation coefficients between abdominal circumference and the laboratory and anthropometric variables in the indigenous participants, whether they had metabolic syndrome or not. In males with metabolic syndrome, no significant correlation was observed with any of the other parameters. In males without metabolic syndrome, a positive correlation was found between abdominal circumference and BMI and a negative correlation between abdominal circumference and systolic pressure. The correlation between the remaining parameters was weak. In women, both with and without metabolic syndrome, a strong positive correlation was observed between abdominal circumference and BMI and a weak correlation between abdominal circumference and the remaining parameters.

Table 3. Blood levels of total and HDL cholesterol, triglycerides and glucose of the 187 indigenous participants with metabolic syndrome, from Jaguapiru Village, Dourados, MS, Brazil

Indicators	Total Cholesterol (mg/dL)	HDL (mg/dL)	Triglycerides (mg/dL)	Glucose (mg/dL)
Female *n* = 126	161.6 ± 31.8	41.2 ± 12.5	173.8 ± 102.1	100.8 ± 42.6
Male *n* = 61	162.6 ± 36.9	37.6 ± 10.9	227.7 ± 170.9	99.9 ± 22.1
TOTAL *n* = 187	166.5 ± 34.3	36.6 ± 9.1	191.3 ± 130.5	106.5 ± 44.9

DISCUSSION

The criteria for metabolic syndrome diagnosis used in this study was based on the presence of abdominal circumference >80 cm for females and 90 cm for males.[13] According to the published consensus at 2005,[13] these parameters are used for South Asian men and women and should also be used for ethnic South and Central Americans, until more specific data are available. Using the Asian standard is justified on the basis that the American Indians are generally originated from people in Asia who crossed the Bering Strait.[14] Because the indigenous population of Jaguapiru Village has been mostly intermarried, theoretically, a similarity with ancestors' genes should be present. While the consensus suggests[13] using the same circumference for women as we used (80 cm), it suggested 94 cm for men. However, other studies[10,16] used the old references of the National Cholesterol Education Program (NCEP III) of waist circumference >102 cm for males and 88 cm for females,[17] which may have resulted in a reported decreased prevalence of metabolic syndrome in some populations, as found among the Japanese.[18]

Estimates for metabolic syndrome worldwide range between 20% and 25%, with greater predominance in males than in females.[9] These estimates are much lower than those found in Jaguapiru Village and also differ in regard to sex predominance. Previous studies in non-indigenous Brazilian populations found a prevalence of 30% and 21.6% in communities from the semiarid region of Bahia[19] and Minas Gerais,[16] respectively, and 29.8% in the population of Vitoria.[10]

Table 4. Correlations between abdominal circumference and cardio metabolic risk factors in indigenous participants with or without metabolic syndrome, from Jaguapiru Village, Dourados, MS, Brazil

	Abdominal Circumference with Metabolic Syndrome		Abdominal Circumference Without Metabolic Syndrome	
Indicators	Males	Females	Males	Females
BMI	.07	.87	.53	.80
Systolic pressure	.25	.18	−.41	.04
Diastolic pressure	.22	.30	−.14	.13
Glycaemia	.09	.08	.21	.17
Cholesterol	− .03	.17	.14	.15
HDL	− .2	− .13	−.17	.09
Triglycerides	.22	.15	−.03	.20

Analysis of a Japanese-Brazilian population found a prevalence of 55.4%,[18] which is higher than that found in the indigenous community from Jaguapiru.

Ethnicity-dependent prevalence differences were also observed in the US population, where the prevalence of metabolic syndrome among individuals aged 20 to 70 years was 24% in the Caucasian population and 30% among Indigenous Americans.[20] A different study of an indigenous community from northern California found a prevalence of 33.9%.[21] The prevalence levels observed in North American indigenous people were similar to those seen in the Jaguapiru indigenous community, suggesting a similarity between these indigenous American communities.

Differences between ethnic groups and lifestyles are evident with the low metabolic syndrome prevalence levels in the Chinese (9.5%) and South Korean (14.4%) populations aged 20 years and older as compared to the Jaguapiru Village indigenous population.[22] Lifestyle changes can affect the prevalence of metabolic syndrome in a given community, which was suggested by a study in Finland among young people of both sexes between 24 and 39 years old, in whom the prevalence increased from 1% to 7.5% from 1986 to 2001.[23]

There is a close relationship between central obesity, defined by abdominal circumference, and the occurrence of metabolic syndrome.[13,24–26] It has been suggested that the intra-abdominal adipose tissue is responsible for insulin resistance,[25,26] thereby leading to endothelial dysfunction and a proinflammatory state.[27] The intra-abdominal adipose tissue expresses higher levels of glucocorticoid receptors and has a greater sensitivity to catecholamines and is therefore more metabolically active.[3] The release of free fatty acids into the portal system plays a fundamental role in the genesis of insulin resistance in both peripheral tissue and liver.[28]

A high percentage of males (41%) and females (76.6%) with abdominal circumferences greater than those recommended were observed in Jaguapiru Village. This suggests that a high percentage of the village's adult population has increased cardio metabolic risk. A previous study with 151 Guarani-M'byá indians from the Rio de Janeiro state found similar levels for females but lower than those observed in males (6.5%).[11]

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Obesity is characterised by a BMI equal to or greater than 30 kg/m^2. Under this definition, 30.8% of the examined women from Jaguapiru Village were obese. This percentage is higher than that observed in previously analyzed indigenous Brazilian communities, ie, 12.5% of the indigenous population from the Alto Xingu[12] and the Parkatêjê (PA) village[29] and 18.7% of the females from the Buriti village.[30] The observed values were also greater than the 10.9% found for a rural community in Minas Gerais[31] and the 18.3% found in a study of an Australian indigenous population.[32] Yet, the observed levels were lower than the 41.3% found among women from the Xavante community of Sao José (MT).[33]

Among male participants, obesity was present in 14.2%. This level was similar to the 11.6% described for the Buriti terena community (MS),[30] the 15.5% for the Mapuchee tribe and the 13% for the Aymaras community in Chile.[34] Yet, these obesity levels were lower than the 18.2% for the Alto Xingu community[12] and the 24% for the São José Xavante community (MT),[33] but much higher than the 1.4% for the rural community in Minas Gerais[31] and the 1.7% of the indigenous Parkatêjê community (PA).[29]

The prevalence of diabetes mellitus in Jaguapiru Village (4.5%) was lower than the 7.6% observed in a multicentre Brazilian study[35] and similar to the 3.4% observed in a Brazilian rural community.[31] However, it was higher than the 2.2% reported for the Terena community of the Buriti village in Mato Grosso do Sul[30] and also higher than both the indigenous Xavante village of Sangradouro – Volta Grande (MT), where there were only 5 reported cases of type 2 diabetes among the 590 indigenous participants,[36] and the Yanomámi community, where only one case of the disease was observed.[37] Compared to foreign indigenous communities, the prevalence of diabetes mellitus found in our study population was similar to those reported for the indigenous Otomie community from Mexico (4.4%)[38] and the Australian Aboriginal communities (6.7%)[32] but well below the prevalence reported for several indigenous North American communities.[39,40] It is likely that genetic differences, physical activity intensity and dietary habits, such as lower caloric intake of the studied indigenous populations, explain these variations.

Arterial hypertension is another factor associated with metabolic syndrome[13] and is a disease with high prevalence and impact on morbidity and mortality worldwide.[41] It is estimated that in Brazil, 30 million people or around 30% of the adult population are hypertensive.[42] While high, these levels are lower than the 40.3% found in the residents of Jaguapiru Village. Regarding other studied indigenous communities, similar hypertension prevalence levels were observed in the communities of Alto Xingu (37.7%)[12] and lower levels were observed for both the Guarani-Mbyá from the coast of Rio de Janeiro (4.8%)[11] and the Terenas from Buriti Village (MS) (11.1%).[30] In non-indigenous populations, a lower prevalence was reported for a community from the semiarid region of Bahia (31.5%)[19] and a similar (38%) prevalence was reported for the population from the city of Vitoria (ES) in an observational study with 2268 participants between 25 and 64 years old.[10]

In our study, we observed that 47.3% of female participants had HDL cholesterol values <50 mg/dl and 14.7% of males had values <40 mg/dL. In the Aruak Indians from Alto Xingu, decreased HDL cholesterol serum concentrations 32.8 mg/dL for males and 41.3 mg/dL for females, were shown to be responsible for 82% of the cases of dyslipidemia.[12] These decreased HDL levels were similar to those seen in the males and females of Jaguapiru Village. In foreign indigenous communities, such as the one in northern California, decreased HDL cholesterol levels were found in 55% of males and 56% of females.[21] In indigenous communities from Chile, the prevalence of decreased HDL cholesterol, <35 mg/dL, was 14% in the Mapuches and 25% in the Aymaras[34], which were both lower than those seen in Jaguapiru Village. Other studies of non-indigenous Brazilian populations reported decreased HDL in 52% of males and 84.1% of females in the semiarid region of Bahia[19] both higher than those seen in the community of Jaguapiru Village, but in the semiarid region of Minas Gerais the prevalence of decreased HDL in females (49.3%) was similar and a bit higher (23.1%) in males.[16]

Regarding serum triglycerides levels, 24.5% of females and 13.8% of males of Jaguapiru Village had values >149 mg/dL. These levels were higher than those observed for male (9.5%) and female (12.6%) subjects studied in the Guarani-Mbyá community.[11] Studies of non-indigenous Brazilian populations reported either lower (8.3% in a rural Minas Gerais community),[31] or similar (21.6% in males and 18.1% in females of a rural community from the Bahia state),[19] prevalence of increased triglyceride levels than those found in this study. In Chilean[34] and Alto Xingu[12] indigenous populations and in the population of the city of Vitoria (ES),[10] hypertriglyceridemia was higher among males. It is likely that changes in traditional habits of the indigenous culture, such as fishing, hunting and family farming affected males more than females. Previously, the activities of hunting and fishing were restricted to the men while farming was a responsibility shared by both sexes. Today, a family's subsistence is generally provided by the manual labour of men in the region's farms and sugar and alcohol industries.

In this study, no correlation was observed between household income and metabolic syndrome. This is likely because living conditions and family income do not differ as much among the indigenous from the village compared to modern society communities. For example, only 9.9% received salaries that are equivalent to two or more times the Brazilian minimum wage, which is a reality shared by the indigenous people of the Buriti village.[30]

Among the factors that may contribute to the high prevalence of metabolic syndrome among the indigenous inhabitants of Jaguapiru Village are changes in the diet, degradation of their original environment and their traditional culture, poor socioeconomic conditions, physical inactivity and increasing obesity.

CONCLUSION

The results of this study suggest that specific actions should be implemented to control cardio metabolic risk factors. Notably, nutritional guidelines encouraging the consumption of whole grains, fruits and vegetables and encouragement of physical activity, all of which could greatly affect the prevention of metabolic syndrome of indigenous from Jaguapiru village, should be implemented.

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