Incidence of metabolic syndrome and related diseases in the Khisêdjê indigenous people of the Xingu, Central Brazil, from 1999-2000 to 2010-2011

Incidência de síndrome metabólica e doenças associadas na população indígena Khisêdjê do Xingu, Brasil Central, no período de 1999-2000 a 2010-2011

Incidencia del síndrome metabólico y enfermedades relacionadas en la población indígena Khisêdjê del Xingú, Brasil Central, de 1999-2000 a 2010-2011

Abstract

The aim of this study was to identify the incidence of metabolic syndrome and related diseases in the Khisêdjê population living in the Xingu Indigenous Park, Mato Grosso State, Brazil, from 1999-2000 to 2010-2011. The study included 78 individuals aged ≥20 years. Data were analyzed using Student t test, linear regression, and Poisson regression. In 10 years of follow-up, cumulative incidence rates were 37.5% for metabolic syndrome, 47.4% for hypertriglyceridemia, 38.9% for arterial hypertension, 32% for central obesity, 30.4% for excess weight, 29.1% for hypercholesterolemia, 25% for low HDLc, 10.4% for high LDLc, and 2.9% for diabetes mellitus. Age proved to be a risk factor for incidence of hypertension, diabetes, and elevated LDLc, regardless of gender; male gender was a protective factor against incidence of central obesity, independently of age. The study showed deterioration of most target health indicators and exposure of the Khisêdjê to high cardiometabolic risk. These results may be related to changes in traditional lifestyle.

Metabolic Syndrome X; Chronic Disease; Indigenous Peoples; Incidence

Resumo

O objetivo deste estudo foi identificar a incidência de síndrome metabólica e doenças associadas na população Khisêdjê, residente no Parque Indígena do Xingu, Mato Grosso, Brasil, ao longo do período de 1999-2000 a 2010-2011. Foram incluídos 78 indivíduos com idades ≥20 anos. Os dados foram avaliados por meio do teste t de Student, regressão linear múltipla e regressão de Poisson. Em dez anos de seguimento verificou-se a incidência acumulada de 37,5% de síndrome metabólica, 47,4% de hipertigliceridemia, 38,9% de hipertensão arterial, 32% de obesidade central, 30,4% de excesso de peso, 29,1% de hipercolesterolemia, 25% de baixo HDLc, 10,4% de elevado LDLc, e 2,9% de diabetes mellitus. A idade foi identificada como um fator de risco para incidência de hipertensão arterial, diabetes mellitus e elevado LDLc, independentemente do sexo; ser do sexo masculino foi fator de proteção para incidência de obesidade central, não importando a idade. Identificou-se deterioração de grande parte dos indicadores de saúde avaliados, estando os Khisêdjê expostos a elevado risco cardiometabólico. Esse resultado pode estar relacionado a alterações no estilo de vida tradicional.

Síndrome X Metabólica; Doença Crônica; População Indígena; Incidência
Introduction

The health profile of Brazilian indigenous peoples has undergone important changes over the years. Alterations in the family and social economy and the incorporation of new eating habits and customs have predisposed to an increase in chronic non-communicable diseases (CNCD), thereby deteriorating the health status and thus the quality of life of these populations 1,2,3,4,5,6,7,8,9,10,11.

Metabolic syndrome is a CNCD that can be defined as the simultaneous presence of at least three altered metabolic parameters: central obesity, glucose intolerance, arterial hypertension, hypertriglyceridemia, or low HDL cholesterol 12. Its clinical relevance is due to the fact that affected individuals present 1.5 to 2.5 times the risk of death from all causes or from cardiovascular diseases when compared to those without the syndrome 13,14. Although not essential for the diagnosis, other disease conditions such as generalized obesity, hyperuricemia, hypercholesterolemia, and elevated LDLc are reported as associated or aggravating factors for metabolic syndrome.

Although the numerous health risks and problems resulting from metabolic syndrome are known, few related studies have been done in Brazilian indigenous peoples. The available publications report prevalence rates ranging from 11% to 65%, 7,8,10,11,15,16. Data on the incidence of this syndrome or its evolution over the years in a single indigenous people have not been found thus far.

Likewise, no information is available on the incidence of diseases related to metabolic syndrome in Brazilian indigenous peoples. It is only known that cases of excess weight and alterations in blood pressure, glucose tolerance, or serum lipid concentrations, which were all rare decades ago, now appear reported in the literature with similar or greater frequency when compared to rates observed in the non-indigenous Brazilian population 1,4,5,9,10,11,15,17,18,19,20.

Considering the high prevalence rates of CNCD reported in Brazilian indigenous peoples, the health problems resulting from these diseases, especially from metabolic syndrome, and the scarcity of scientific data on this subject, the current study aimed to estimate the incidence of metabolic syndrome and associated diseases in the Khisêdjê population living on the Middle Xingu River (Xingu Indigenous Park) over ten years of follow-up.

Material and methods

This was a cohort-type epidemiological study based on two cross-sectional studies among the Khisêdjê people in the years 1999-2000 and 2010-2011.

The Suyá, or Khisêdjê as they call themselves, are the only people of the Jê language that live in the Xingu Indigenous Park. According to the pattern in this linguistic family, their villages are arranged in a circular layout, with the “men’s house” in the center and the other huts facing toward it. They are currently distributed in five villages: the largest, Ngôjwêre, and Ngôsokô, Rop-tôtxi, Beira Rio, and Terra Indígena Wawé 21. The two stages of this study were done in the main village, Ngôjwêre.

In 1999-2000, 86 Khisêdjê individuals of both genders and 20 years or older were examined (91.5% of the total number of eligible individuals) 8, and of these, 78 (90.7%) were reevaluated in 2010-2011 and therefore included in this study. Among the subjects not examined in 2010-2011 (n = 8), six were not located (possibly having changed villages) and two were absent at the time of the data collection.

The data collection routines used in 1999-2000 have been published previously 8. Briefly, duplicate anthropometric data were obtained by properly trained professionals, and laboratory tests were performed after 10 hours of fasting. With the exception of blood glucose, which was measured by the capillary test, all the other tests were performed in venous blood samples.

In 2010-2011 the Khisêdjê were contacted and identified by the medical cards used by the health team from the Federal University of São Paulo (UNIFESP). A standard data collection form was used. Anthropometric measurements were taken according to procedures recommended by the World Health Organization (WHO). Body mass index (BMI) was calculated as weight (in kilograms) divided by height (in meters) squared. Excess weight was defined as BMI ≥ 25.0 kg/m² 22. Central obesity was defined according to the cutoff points set by the WHO (waist circumference ≥ 80.0cm for women or ≥ 94.0cm for men) 23. These measurements were taken with a portable scale, Líder brand, model P200m (Líder Balanças, Aracatuba, Brazil), with a capacity of 200kg and accurate to 50g; a portable platform stadiometer, WCS brand (Cardiomed, Curitiba, Brazil), with a scale from 20 to 220 cm; and a flexible fiberglass tape measure (TBW, China) with a scale from 0 to 150 cm.

Laboratory tests were taken in the morning after 12 hours of fasting. The biological material (blood) was collected, processed, and stored (in
a freezer at -20°C) in the village until sending to São Paulo. Transportation was done over land in a portable freezer for transporting heat-sensitive material (model FCW 20 EK; Domestic Medical Systems, UK). Samples were analyzed by the Central Laboratory of the São Paulo Hospital.

Systolic and diastolic blood pressure (SBP and DBP) were measured with an automatic arm-adjusted arterial blood pressure monitor (model HEM 742-INT; OMROM Healthcare, China), after resting for 10 minutes in the sitting position. Three measurements were taken, and the final value was taken as the mean of the latter two measurements. Classification of individuals used the consensus definition of metabolic syndrome proposed by the International Diabetes Federation (IDF), American Heart Association (AHA), National Heart, Lung and Blood Institute (NHLBI), World Heart Federation (WHF), International Atherosclerosis Society (IAS), and International Association for Study of Obesity (IASO) in the year 2009. Hypertension was defined as SBP ≥ 130.0 mmHg or DBP ≥ 85.0 mmHg.

The capillary blood glucose test used Kit One Touch Ultra 2 (Johnson & Johnson, São Paulo, Brazil) and the same brand of lancets and strips. Collection followed the manufacturer’s recommended procedures. Individual glucose tolerance was measured with the WHO for capillary blood glucose, with the corrections proposed by the WHO for capillary blood glucose. Thus, fasting blood glucose ≥ 100 mg/dL and < 110 mg/dL was classified as altered fasting blood glucose and ≥ 110 mg/dL as diabetes mellitus.

Total cholesterol, high-density lipoprotein (HDLc), and triglycerides were determined by the colorimetric enzymatic method (OLYMPUS AU 640; Tek Medical, London, UK). Low-density lipoprotein (LDLc) was measured according to the formula by Friedwald et al. Presence of dyslipidemia was defined according to the values proposed by the National Cholesterol Education Program Expert Panel, i.e., total cholesterol > 200 mg/dL or triglycerides > 150 mg/dL or LDLc > 130 mg/dL or HDLc < 40 mg/dL for men and < 50 mg/dL for women.

Determination of uric acid used the colorimetric enzymatic method (OLYMPUS AU 640). Hyperuricemia was defined as serum uric acid > 6 mg/dL for women and > 7 mg/dL for men.

Identification of metabolic syndrome used the consensus criteria proposed by various organizations in 2009. Diagnosis of the syndrome was defined as the presence of at least three of the following: increased waist circumference, elevated fasting blood glucose, arterial hypertension, reduced HDLc, and hypertriglyceridemia; use of medication to treat the above-mentioned diseases characterized their diagnosis. Important, the data presented here and referring to 1999-2000 were obtained from the file used in a PhD thesis. In order to allow comparison of the results from 1999-2000 and 2010-2011, the variables were reclassified. Thus, all the outcomes were classified using the same cutoffs in the two study phases (1999-2000 and 2010-2011).

The data description used measures of central tendency and dispersion for the quantitative variables. Comparison of mean values for the biological variables in the same individuals used the Student t test for dependent (matched) pairs. Multiple linear regression was used to analyze 11 distinct outcomes. Each model included an outcome variable (anthropometric, physical, or laboratory) and two exposure variables (gender and age in 1999-2000, in years (continuous)). Each outcome was measured by the following equation: value obtained in 2010-2011 minus value obtained in 1999-2000, divided by value obtained in 1999-2000. This stage of the data analysis included all the individuals with or without the target outcomes in 1999-2000.

Cumulative incidence was calculated considering only the individuals without the nutritional condition or chronic disease in 1999-2000 and that were thus at risk of becoming cases over the 10 years between the two evaluations. The study design did not allow calculating the incidence rates, due to the lack of information on person-years of exposure.

Poisson regression with robust variance was used to analyze nine distinct outcomes (number of new cases). Each model consisted of an outcome variable (nutritional condition or chronic disease) and two exposure variables (gender and age in 1999-2000, in years (continuous)). This analysis only included individuals that did not present the target outcomes in 1999-2000. All stages of the analysis used Stata (Stata Corp., College Station, USA).

The current study is part of a larger project entitled *Nutritional and Metabolic Profile of the Khisêdjê Indigenous People*, approved by the Brazilian National Commission on Research Ethics (CONEP) and the Ethics Research Committee of UNIFESP (case review 760/10). In order to further comply with ethical guidelines, this specific study was submitted to and approved by the Ethics Research Committee of UNIFESP (case review 319/11).

In order to obtain approval by the Khisêdjê people, they were provided with an explanation of the study’s objectives and procedures. Indig-
enous translators helped explain the study to the community in the native language. Signatures were collected simultaneously with a statement by the indigenous leaders who expressed their agreement with the study. Considering Resolution 196/96 of the Brazilian National Health Council, item IV.3 line "e", providing that "in culturally differentiated communities, including indigenous peoples, advance agreement by the community should be obtained through their own leaders, but without ruling out efforts to obtain individual consent," and given the particular characteristics of these research subjects, whenever possible a free and informed consent form was obtained with signatures by the participants.

The study was funded by the São Paulo State Research Foundation (FAPESP; grant 2010/52263-7).

Results

Of the 78 individuals included in the study, 36 (46.2%) were females and 42 (53.8%) males. Mean age in 1999–2000 was 36.3 years (SD = 13.4). There was no significant age difference between the genders in either study phase.

Table 1 shows the mean values for the anthropometric, physical, and laboratory variables for the Khisêdjê according to gender in both periods. Comparison of the mean values shows that in females, only arm circumference and DBP failed to show statistically significant alterations over the years; the increase in mean HDLc and decrease in LDLc can be considered beneficial. In males, only LDLc failed to show a significant change; the reduction in DBP and increase in HDLc can also be considered beneficial.

Table 2 shows the outcomes for women the outcomes SBP (β = 0.0046mmHg; 95%CI: -0.003; 0.0089), total cholesterol (β = 0.0073mg/dL; 95%CI: 0.0011; 0.0136), HDLc (β = 0.0218mg/dL; 95%CI: 0.0143; 0.0294), and LDLc (β = 0.0080mg/dL; 95%CI: 0.0011; 0.0148) increased with age. In males, while BMI (β = -0.0019kg/m²; 95%CI: -0.0034; -0.0005) decreased with age (in years), SBP (β = 0.0083mmHg; 95%CI: 0.0043; 0.0123) and DBP (β = 0.0057mmHg; 95%CI: 0.0027; 0.0088) increased.

Table 3 shows the number of new cases of nutritional conditions or chronic diseases over the course of 10 years. Females showed higher cumulative incidence than males for metabolic syndrome (48.1% vs. 27.6%), central obesity (60% vs. 20%), and elevated LDLc (19% vs. 3.7%). Meanwhile, males showed higher incidence than females for arterial hypertension (41.7% vs. 36.2%), hypercholesterolemia (33.3% vs. 24%), and hyperuricemia (21.9% vs. 5.9%).

Table 4 shows the incidence ratios for nutritional conditions or chronic diseases, adjusted
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The current study showed that in the ten years between the two evaluations, 21 (37.5%) new cases of metabolic syndrome occurred, and that incidence was higher in females, with a total of 13 (48.1%) new cases. Incidence of metabolic syndrome was not significantly associated simultaneously for age (in years) and gender. Independently of gender, relative risk was 1.03 (95%CI: 1.01; 1.05) for arterial hypertension, 1.04 (95%CI: 1.01; 1.07) for diabetes mellitus, and 1.10 (95%CI: 1.04; 1.17) for elevated LDLc. Meanwhile, the analysis in males identified a reduction in the incidence of central obesity (RR = 0.33; 95%CI: 0.15; 0.72), independently of age. Due to the small number of new cases, low HDLc (n = 1) was excluded from the analysis.

Discussion

Ever since the Khisêdjê people first came to the Xingu Indigenous Park, they have maintained good relations with the neighboring towns and have thus intensified their contact with adjacent society. Over the years they have achieved important victories such a population comeback, influenced by moderate birth rates, a drop in mortality, and a negative migratory coefficient, but they have also been exposed to high CNCD rates, identified by cross-sectional studies in 1999-2000 and 2010-2011 8,16,31,32.

The current study showed that in the ten years between the two evaluations, 21 (37.5%) new cases of metabolic syndrome occurred, and that incidence was higher in females, with a total of 13 (48.1%) new cases. Incidence of metabolic syndrome was not significantly associated with gender or age. No studies have been identified thus far that have evaluated the incidence of metabolic syndrome in Brazilian indigenous peoples, to serve as a source of comparison.

Metabolic syndrome is an important CNCD which is related to increased risk of cardiovascular diseases, diabetes mellitus, and all-cause mortality, among numerous other harms. Early detection thus allows the possibility of treatment and consequently a reduction in health problems 12,14,25,27,33,34,35,36,37,38,39.

Mean BMI values increased in both genders over the course of ten years (Table 1), but mean BMI in females remained below that found in the 1st National Health and Nutritional Survey of Brazilian Indigenous Peoples, a study that used a probabilistic sample of women 14 to 49 years of age and children under 60 months, living in villages in four major geographic regions of the country (BMI = 25.2kg/m²; 95%CI: 24.7; 25.8) 40. When adjusted for age, in males there was a reduction in BMI with age, that is, older individuals showed lower mean body mass index. These results may be related to older males' non-adherence to the new living and eating habits that have occurred in the villages, or to the aging process itself. The 1st National Health and Nutritional Survey of Brazilian Indigenous Peoples showed the opposite in women, an increase in BMI with age; however, the age range in the sample was lower than in the current study 40.
Table 3

Number and percentage of Khisêdjê indigenous individuals evaluated in 1999-2000 and 2010-2011 according to occurrence of new cases of altered metabolic or nutritional profile during the period, according to gender. Xingu Indigenous Park, Central Brazil, 2013.

<table>
<thead>
<tr>
<th>Variables/Categories</th>
<th>Females</th>
<th>Males</th>
<th>p-value *</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>n</td>
<td>%</td>
<td>n</td>
<td>%</td>
</tr>
<tr>
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<td></td>
<td></td>
</tr>
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<td>68.4</td>
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</tr>
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<td>9</td>
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<td>20.0</td>
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<td></td>
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<td>21</td>
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</tr>
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<td>13</td>
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<tr>
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<td>12</td>
<td>48.0</td>
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</tr>
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<td></td>
</tr>
<tr>
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<td>32</td>
<td>94.1</td>
<td>25</td>
<td>78.1</td>
</tr>
<tr>
<td>Yes</td>
<td>2</td>
<td>5.9</td>
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<td>21.9</td>
</tr>
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</table>

HDLc: high-density lipoprotein; LDLc: low-density lipoprotein.

* Refers to χ² test.

As identified with the excess weight variable, cumulative incidence of central obesity in the Khisêdjê was around 30%, and was even more alarming in women (60%). The protection against incidence of central obesity in males (RR = 0.33), independently of age, highlights the relevance of this outcome, which is associated with increased risk of cardiovascular diseases and other CNCD for females. An important hypothesis (but not investigated in the current study) is the high number of pregnancies among indigenous women over the course of their childbearing years. Data from the National Demographic and Health Survey of Brazilian Women and Children in 2006 showed that the highest prevalence rates of elevated waist circumference occurred precisely in women with the most children. Another relevant limiting factor relates to the diagnostic criteria used to identify nutritional status and some metabolic conditions, which may not be appropriate for indigenous individuals.

Among the other target components, the study identified an increase in SBP in both genders and DBP in males, with increasing age
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Table 2. These data contrast with the information published in 1988 by the Intersalt Study, which showed that in a sample of indigenous individuals from the Xingu (N = 198) there was only a minor increase in SBP (0.6mmHg) and a decrease in DBP (0.4mmHg) with increasing age 41,42. However, they partially corroborate the findings from the 1st National Health and Nutritional Survey of Brazilian Indigenous Peoples 40 showing that SBP and DBP in females, increased statistically with age. Similar to the current study, another study among indigenous people from the Suruí ethnic group in the State of Rondônia, Brazil, showed a minor increase in mean SBP and DBP in both genders between 1988 and 2005, which only reached statistical significance for SBP in females 44. Hypertension was the second most frequent incident disease (39.8%) over the ten years of follow-up, and there was an increase of 3% for each year of life, independently of gender. These results may relate to changes in eating habits and lifestyle among the population. Mean SBP and DBP levels in the Khisêdjê, especially in 2010-2011, were higher than those reported in the Intersalt Study 42,43.

Despite the low cumulative incidence (2.9%) of diabetes mellitus over the ten years, these results are higher than the findings by Baruzzi 3, who reported that as of 2002 only two cases of diabetes had been identified in the Xingu Indigenous Park, both in women from other ethnic groups. On the other hand, these findings are lower than those reported by other authors reporting high incidence rates for diabetes mellitus (> 17%) among different indigenous peoples around the world. Obesity, family history of diabetes, and genetic and environmental factors are related to the etiology of this disease 34,45,46,47,48,49,50,51. A study of North American indigenous peoples from 13 different ethnic groups showed lower diabetes incidence among participants who reported any type of physical activity when compared to physically inactive individuals 49. Based on these findings, the low incidence of diabetes found in the current study may be explained by the same factor, since recent data show that the Khisêdjê are physically active and in good shape 16,52.

Low HDLc is considered a strong independent predictor of coronary disease 27. Among the Khisêdjê this was the most frequent condition (39.8%) over the ten years of follow-up, and there was an increase of 3% for each year of life, independently of gender. These results may relate to changes in eating habits and lifestyle among the population. Mean SBP and DBP levels in the Khisêdjê, especially in 2010-2011, were higher than those observed in indigenous peoples of the Xingu as reported in the Intersalt Study 42,43.

A study in 2010 found that low HDLc may be related to genetic alterations in the metabolism of Native American peoples as a form of adaptive response to the environment 53.

Although high LDLc was not the main lipid disorder found in the Khisêdjê in 1999-2000 or 2010-2011, the increase in its levels with increas-

Table 4

Cumulative incidence ratios (CIR) by point and 95% confidence intervals (95%CI), adjusted simultaneously according to gender and age, for alterations in metabolic and nutritional profile in Khisêdjê indigenous individuals evaluated in 1999-2000 and 2010-2011. Xingu Indigenous Park, Central Brazil, 2013.

<table>
<thead>
<tr>
<th>Variables (new cases of)</th>
<th>CIR * (95%CI)</th>
<th>CIR * (95%CI)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age (in years)</td>
<td></td>
<td>Gender (male vs. female) **</td>
</tr>
<tr>
<td>Metabolic syndrome</td>
<td>1.01 (0.98; 1.03)</td>
<td>0.57 (0.28; 1.16)</td>
</tr>
<tr>
<td>Excess weight</td>
<td>0.98 (0.94; 1.01)</td>
<td>0.96 (0.41; 2.25)</td>
</tr>
<tr>
<td>Central obesity</td>
<td>0.99 (0.96; 1.02)</td>
<td><strong>0.33 (0.15; 0.72)</strong></td>
</tr>
<tr>
<td>Arterial hypertension</td>
<td>1.03 (1.01; 1.05)</td>
<td>1.19 (0.68; 2.07)</td>
</tr>
<tr>
<td>Diabetes mellitus</td>
<td>1.04 (1.01; 1.07)</td>
<td>0.99 (0.07; 15.02)</td>
</tr>
<tr>
<td>Hypercholesterolemia</td>
<td>1.02 (0.99; 1.05)</td>
<td>1.37 (0.58; 3.21)</td>
</tr>
<tr>
<td>High LDLc</td>
<td>1.10 (1.04; 1.17)</td>
<td>0.18 (0.02; 1.89)</td>
</tr>
<tr>
<td>Hypertriglyceridemia</td>
<td>0.98 (0.95; 1.01)</td>
<td>1.03 (0.52; 2.06)</td>
</tr>
<tr>
<td>Hyperuricemia</td>
<td>1.04 (0.99; 1.08)</td>
<td>3.84 (0.99; 14.95)</td>
</tr>
</tbody>
</table>

aging age emphasize the need for surveillance of this and other cardiovascular risk factors among these individuals. Likewise, the high cumulative incidence of hypertriglyceridemia (47.4%) and high prevalence rates in this population expose the individuals to high cardiovascular and metabolic risks.

In general, the adoption of non-traditional foods, changes in patterns of physical activity and customs (such as the use of new technologies) and the increase in the family economy based especially on paid work and social position (socioeconomic status) are factors commonly related to the appearance of metabolic syndrome and other CNCD among indigenous and non-indigenous peoples.

The study’s potential limitations include the possible variation (under or overestimation) of cumulative incidence rates resulting from loss of follow-up of eight indigenous individuals from the beginning of the study (9.3% of total eligible subjects). As an example, if the eight individuals had become cases of metabolic syndrome, the cumulative incidence would have been 45.3% (95%CI: 32.8; 57.8), but if they had remained free of the syndrome, the incidence would have been 32.8% (95%CI: 21.0; 44.6), while the figure found in the study was 37.5% (95%CI: 24.4; 50.6). Meanwhile, the exclusion of cases of diabetes mellitus identified in 2010-2011 via the oral glucose tolerance test and the fact that the test was not performed in 1999-2000 may have contributed to underestimation of the observed diabetes incidence.

The current study showed deterioration in many of the target health indicators. The high cumulative incidence rates for metabolic syndrome, hypertriglyceridemia, hypertension, central obesity, and excess weight among the Khisêdjê are alarming and predispose them to high risk of cardiovascular diseases. Although these results are not necessarily representative for identification of the deterioration of health indicators for all Brazilian indigenous peoples, they raise an alert concerning the need to implement effective interventions to protect these peoples from the acculturation that has encroached unfortunately on their daily lives over the years.

Resumen

El objetivo del estudio fue identificar la incidencia del síndrome metabólico y de enfermedades asociadas en la población Khisêdjê, que reside en el Reserva Indígena de Xingú, Mato Grosso, Brasil, durante los años de 1999-2000 a 2010-2011. Fueron incluidos 78 individuos con edad ≥ 20 años. Los datos fueron evaluados a través de las pruebas estadísticas t de Student, regresión lineal múltiple y regresión de Poisson. La incidencia acumulada en los 10 años de seguimiento fue de 37.5% de síndrome metabólico, 47.4% de hipertrigliceridemia, 38.9% de hipertensión arterial y 32% de obesidad central. Independientemente del sexo, la edad está relacionada como factor de riesgo para la incidencia de hipertensión arterial, diabetes mellitus, y LDLc elevado. Ser de sexo masculino se constituye en un factor de protección para la incidencia de obesidad central, independientemente de la edad. Fueron identificados deterioros significativos en gran parte de los indicadores de salud evaluados en los Khisêdjê expuestos a riesgo cardiometabólico elevado. Este resultado puede estar relacionado con la alteración del estilo de vida tradicional de la población estudiada.

Síndrome X Metabólico; Enfermedad Crónica; Población Indígena; Incidencia
Contributors

L. Mazzucchetti participated in the study planning, data collection, elaboration of the databank, statistical analysis, and writing of the manuscript. P. P. O. Galvão, M. L. S. Tsutsui, and K. M. Santos contributed to the study planning, data collection, elaboration of the database for 2010-2011, revision, and writing of the manuscript. D. A. Rodrigues and S. B. Mendonça collaborated in the study planning, data collection, revision, and writing of the manuscript. S. G. A. Gimeno, the project coordinator, participated in the study planning, data collection (2010-2011), statistical analysis (1999-2000 and 2010-2011), and writing and revision of the manuscript.

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