Published in final edited form as:

Ann Hum Biol. 2015 January ; 42(1): 84–90. doi:10.3109/03014460.2014.932008.

Indigenous populations in transition: An evaluation of metabolic syndrome and its risk factors among the Toba of northern Argentina

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Abstract

Background—The health problems associated with rapidly changing lifestyles in indigenous populations, e.g., cardiovascular disease, are becoming a public health concern.

Aim—The objective of this study was to evaluate the prevalence of metabolic syndrome and analyze the metabolic conditions that define this syndrome, in an indigenous Toba community of northern Argentina.

Subjects and Methods—A total of 275 adults participated in this study. Anthropometric (BMI, body fat percentage, waist circumference) and clinical measures (blood pressure, cholesterol, glucose, and triglycerides) were taken. Pearson and logistic regressions were used in the statistical analysis of risk factors for metabolic syndrome by sex and by reproductive status in women.

Results—The overall prevalence of metabolic syndrome was 38%. Nearly a third (31%) of the population was overweight and 45%, obese. Men had significantly higher blood pressure and levels of triglycerides than women, while women had higher percentages of body fat. BMI was significantly associated with most of the risk factors for metabolic syndrome. Menopausal women had a higher prevalence of metabolic syndrome than women of reproductive age.

Conclusion—Metabolic syndrome was highly prevalent in this indigenous community, which places them at an increased risk for cardiovascular disease

Keywords

nutritional transition; obesity; hypertension

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INTRODUCTION

Historically, overweight and obesity were characteristic of industrialized populations and considered diseases of affluence; however, the problems associated with excess body fat are becoming endemic in poor communities in developing countries (Popkin and Du, 2003). Moreover, not only obesity, but also insulin resistance and dyslipidemia are on the rise in these populations (Aballay et al., 2013). Together, these changes in metabolism are known as *Metabolic Syndrome* and are considered risk factors for cardiovascular disease and diabetes (Aballay et al., 2013; Schnell et al., 2007). Consequently, there is great concern in the public health field over the growing prevalence of metabolic syndrome (MS) in populations that, until recently, struggled primarily with malnutrition.

Numerous indigenous Latin American populations fit in this category (Orden and Oyhenart, 2006; Tavares et al., 2003). During the last century, the majority of indigenous communities in Latin America have suffered from major changes to their traditional lifestyle, all of which share a common denominator: a dramatic reduction in the level of physical activity combined with an increase in the consumption of processed foods. The vast majority of these peoples have lived through, to a greater or lesser degree, a process of *westernization*. This process is characterized by a change in traditional practices, from sustenance farming or foraging to participation in the market economy and an increase in urbanization (Popkin and Du, 2003). These rapid lifestyle changes have been associated with an increase in the prevalence of chronic diseases or “diseases of affluence” (Ezzati et al 2005; Snodgrass et al 2006) such as metabolic syndrome. Metabolic syndrome comprises an array of metabolic conditions that, in conjunction, predispose an individual to cardiovascular disease and diabetes. These metabolic conditions are defined by measures of abdominal obesity, triglycerides, HDL cholesterol, fasting glucose levels and blood pressure.

Recently, some studies have reported a high prevalence of overweight in various South American ethnic groups (Carrasco P et al., 2004; Orden and Oyhenart, 2006; Port Lourenço et al., 2008; Tavares et al., 2003). However, there is little published information about the prevalence of chronic metabolic diseases in Latin America and even less information about the prevalence of these diseases in indigenous populations. Our focus here is on one of the groups from the Argentine Chaco that, in the last fifty years, has undergone a rapid demographic, epidemiological, and nutritional transition. In this context, the objective of this study is to evaluate the prevalence of metabolic syndrome and analyze the metabolic conditions that define this syndrome, in an indigenous Toba community of northern Argentina.

METHODS

Population under study

The Toba are one of the original indigenous nations of the Gran Chaco region of Argentina, Paraguay and Bolivia. The Chacoans have traditionally been nomadic or semi-nomadic foragers (Miller 1999). Their subsistence relied on hunting, fishing, and gathering fruits and honey. The disintegration of their traditional lifestyle coupled with the degradation of their

original habitat forced the migration of some groups from the rural areas where they foraged to urban and peri-urban settlements, where they participate, with a varying degree of success, in market economies.

As with most indigenous populations around the world, this lifestyle change has brought about changes in diet composition and in physical activity levels. Until relatively recently (not more than 50-60 years ago), the traditional diet of these groups was characterized by being rich in proteins and fiber, but low in fat content (Mendoza 2002; Miller 1999). In addition, their subsistence pattern required a considerable energetic effort because they had to walk long distances in search of food, water, and shelter. This is in stark contrast to their current situation: a nutritionally poorer diet and low physical activity levels (Valeggia and Lanza 2005; Valeggia et al. 2010).

The present work was carried out in the village of Namqom, located 10 km west of the city of Formosa, in northern Argentina, where approximately 3,000 Toba live. The families of Namqom live off wages from the men's temporary work, government subsidies, and the sale of traditional arts and crafts and handiwork made by the women. Their diet is unvaried in nutritional content and predominantly made up of food items high in carbohydrates and saturated fat, which are more economically accessible than fruits, vegetables, and leaner meats (Valeggia & Lanza, 2005). In addition, the great majority of adults lead a sedentary lifestyle, with low levels of physical activity.

Study design and methods

A cross-sectional study was conducted between March and December of 2010. The optimal sample size was calculated using Raosoft (Raosoft, Inc. 2004, www.raosoft.com) with the following parameters: population size = 1600 adults, design effect (deff) = 1.0, error (alpha) of 5% and confidence interval of 95%. The estimated prevalence of risk factors was set to 30%, based on a pilot study conducted in 2006. The sample was made up of 275 individuals, 141 women and 134 men. In order to be included in the study, participants were restricted to Toba adults over the age of 20 residing in the village during 2010, who were randomly selected from a village-wide census conducted in 2006. Pregnant women, individuals with mental and/or physical disabilities were excluded from the study. Individuals who had been diagnosed with and currently being treated for dyslipidemia, hypertension, hyperglycemia, or diabetes (n = 6 adults) were also excluded from the sample because their metabolic and blood pressure measurements could affect the results of this study. Participants were visited in their homes between 07:00 am and noon. The investigation protocol was approved by the IRB of the University of Pennsylvania (Protocol #811348).

Body mass (weight), height, waist circumference (WC), and percent body fat (%BF), were collected to assess overweight and obesity status. Height and weight data were used to calculate body mass index (BMI) for each participant. Following the World Health Organization (WHO) guidelines, participants with BMI ≥ 25 kg/m² were considered to be overweight and participants with BMI ≥ 30 were considered to be obese (WHO, 2000). Anthropometric measures were collected using established protocols. Waist circumference (WC) was measured, in centimeters, between the last rib and the iliac crest with a measuring tape. Participants were considered to have abdominal obesity if WC ≥ 102 cm (in men) or

WC 88 cm (in women) (Panel, 1998). Percent body fat (%BF) was determined by bioelectrical impedance using the same digital scale (TANITA®) that was used to measure weight. Men with %BF>25 and women with %BF>32 were considered to be obese following standards set by Lohman (1992). All measurements were done following Frisancho (2008) protocols by the same researcher (ESL), who had been trained by one of the senior authors until an inter-observer reliability score of 90% was achieved.

Metabolic biomarkers, fasting blood glucose (GL), triglycerides (TGC), and high-density lipoprotein cholesterol (HDL), as well as blood pressure (BP) were evaluated. Capillary blood samples for metabolic biomarkers were taken from the finger using a lancing device with disposable lancets (Accucheck Softclick Pro). Measurements of HDL, TGC, and GL were obtained using a portable blood testing device (CardioChek® ST Analyzer). Previous studies indicated that results from capillary blood used with these portable devices are equivalent to those obtained from venous sampling (e.g., for cholesterol, within 1 and 1.7% variation, Warnick et al. 1994). The ChekMate™ Quality Control strips served as internal standards. Systolic blood pressure (SBP) and diastolic blood pressure (DBP) were measured with a digital blood pressure monitor (OMRON model HEM-433 INT). Blood pressure was measured with the subject seated and in repose. The average of two measurements was used to determine the presence of hypertension in subjects using internationally recommended criteria: SBP 140 mmHg and/or DBP 90 mmHg (Chobanian et al., 2003).

Risk for metabolic syndrome was established according to ATP III: low levels of HDL: HDL<40 mg/dl in men and <50 mg/dl in women, elevated triglycerides: TGC 150 mg/dl for both sexes, and GL 110 mg/dl for both sexes (ATP III, 2001). Metabolic syndrome was considered to be present when the participant presented with altered values of at least three of the following variables: GL, TGC, HDL, WC, SBP and/or DBP.

Demographic data (age, sex, parity and reproductive state in women, and tobacco use) were obtained at the beginning of participant interviews. Participants were classified as smokers (reported smoking at the time of the interview) or non-smokers (had never smoked or had not smoked in the last year as of the interview).

Statistical analyses

Data were analyzed using Pearson's Chi-squared test to compare the prevalence of different risk factors and Student's t-test to compare means of measured variables. Pearson correlations were used to evaluate the association between anthropometric variables and metabolic variables. Multivariate logistic regression was used to evaluate the association between altered body mass index, a common and easily obtained anthropometric value, and metabolic syndrome risk factors. There were no differences between overweight and obese individuals for the logistic regressions and, therefore, to increase the power of the test, BMI was dichotomized as either normal ($BMI < 25 \text{ kg/m}^2$) or altered ($BMI \geq 25 \text{ kg/m}^2$). This analysis controlled for age and used participants with normal BMI as the reference group. Logistic regression was also employed to assess the relationship between being menopausal and the different metabolic risk factors. This logistic regression analysis controlled for age and used women of childbearing age as the reference category. A 95% confidence interval

was used to establish the risk of metabolic syndrome. Analyses were carried out using SAS 9.3 for Windows (SAS Institute Inc, Cary, NC).

RESULTS

In general, average values were high for risk factors of metabolic syndrome in the study population. Overall, the prevalence of metabolic syndrome was 38 percent (37% in women and 39% in men, sex differences not significant ($\chi^2_{(275, 1)} = 0.11$, $p = 0.74$). Statistically significant differences were found between individuals with metabolic syndrome (MS+) and individuals without metabolic syndrome (MS-) for multiple variables (Table I). MS+ individuals presented significantly higher values for BMI, %BF, GL, SBP, and DBP. In addition, for both men and women, MS+ individuals were older than their MS-counterparts. There were no significant differences in tobacco use between MS+ and MS- individuals (Table I).

The prevalence of overweight and obesity, as indicated by BMI, was considerably high; 31.3% of participants were classified as overweight and 45.1% as obese (Figure 1). No significant differences were found between men and women in the categories of BMI ($\chi^2_{(275, 1)} = 3.97$, $p = 0.26$) nor in the distribution of individuals with altered or normal BMI ($\chi^2_{(275, 1)} = 0.14$, $p = 0.71$). There were, however, several other significant differences between sexes. The prevalence of tobacco use was significantly lower in women (8.5%, $n=12$) than in men (27.6%, $n = 37$, $\chi^2_{(275, 1)} = 17.1$, $p < 0.0001$). For men, there were no significant differences between smokers and non-smokers in the prevalence of metabolic syndrome, abdominal obesity, hypertension, altered glucose levels, triglycerides, or HDLs. However, male smokers tended to have a greater prevalence of altered BMI and %BF than male non-smokers ($\chi^2_{(134, 1)} = 6.97$, $p = 0.008$ and $\chi^2_{(134, 1)} = 6.25$, $p = 0.012$, respectively). None of the risk factors for metabolic syndrome were associated with smoking in women, but given the low number of female smokers in the sample, these findings should be taken with caution.

It was also of interest to evaluate the association between: (1) anthropometric measurements and blood pressure; and (2) anthropometric measurements and metabolic biomarkers of metabolic syndrome. Given that the three anthropometric measurements (BMI, WC, and %BF) were highly correlated --- coefficients of correlation (r) ranged between 0.72 and 0.91 ($p < 0.05$), we chose BMI as the anthropometric measure for analysis. In men, BMI was positively associated with both measures of blood pressure and triglyceride levels (Table II). In women, a significant, positive association was found between BMI and blood pressure (SBP and DBP). There was also a negative association between HDL cholesterol levels and BMI. No association was found between BMI and glucose levels in either sex (Table II). Multivariate logistic regression, controlling for age, revealed that, in both men and women, an altered BMI (defined as BMI ≥ 25) increased the odds of having altered levels of metabolic markers and altered blood pressure (Table III). Overweight and obese men had more than eight times the odds of having elevated TGC levels and almost four times the odds of having low levels of HDL than their leaner counterparts. Overweight and obese women, on the other hand, were six times more likely to have altered HDL levels.

It is well established that reproductive status is an important factor in the risk of metabolic syndrome. In our sample, 77.3% (n=109) of women were of childbearing age (as defined by the presence of menstrual periods); the remaining women were menopausal (the last menstrual period had occurred a year or more ago). The prevalence of metabolic syndrome was higher in menopausal women (62%) compared to childbearing age women (29%) ($\chi^2_{(140, 1)} = 11.67, p < 0.001$). Across both reproductive ages, women with metabolic syndrome had significantly higher values of BMI, %BF, TGC, GL, SBP, and DBP compared to women without metabolic syndrome (Table IV). Childbearing-age women with metabolic syndrome were significantly older than those without metabolic syndrome; no significant difference in age was found among menopausal women (Table IV). Multivariate logistic regressions using childbearing age women as the reference category and adjusting for age indicated no statistically significant increase in odds of metabolic syndrome among menopausal women (Table V).

DISCUSSION

This peri-urban Toba population presented a high prevalence of metabolic syndrome. Our results indicate that a high proportion of Toba adults presented altered levels for most of the metabolic conditions that define the metabolic syndrome. Overweight and obesity were highly prevalent, as was abdominal obesity measured by waist circumference. Obesity is the result of a complex interaction of genetic, nutritional, and sociocultural factors. Evidence exists of certain indigenous populations having a “thrifty genotype,” that is, genetic adaptations that augment their metabolic efficiency and facilitate energy storage in the form of fat (Neel, 1962). These adaptive genetic factors, combined with an abundance of calories and a decrease in energy expenditure, would make these groups more susceptible to obesity. This could be the case for the indigenous population of the Gran Chaco, who had lived for centuries as hunter-gatherers through alternate periods of abundance and scarcity. In this ecological context, a more efficient or *thrifty* metabolism would be an advantageous trait to have in order to be able to survive periods of famine. However, with the dramatic transformation of their way of life, this once protective trait is no longer beneficial, and has resulted in excessive accumulation of fat and changes in the metabolism that carry a major risk of developing cardiovascular disease (Álvarez, 2004). The health status of indigenous populations, as indicated by the high prevalence of obesity encountered in Namqom (45.1%), in the Native American population in the United States (34.3%, (Knowler et al., 1978), and in the Hispanic population of the United States (28.3%) (Wang and Beydoun, 2007), is a prime example of the consequences of this change in energy balance.

Most studies on the prevalence of overweight and obesity around the world have shown clear differences between men and women (Carrasco et al., 2004; Peña and Bacallao, 1997). However, this was not the case in Namqom, where we did not find significant sex differences in the proportion of overweight and obese adults. Among other factors, the high unemployment rate in this community could explain these results. Ethnographic observations suggest that unemployed men tend to stay at home, dramatically reducing their physical activity levels, in contrast to other communities where there is greater difference in activity levels between the sexes.

It is important to note that, while significant differences were not found in the proportion of overweight and obese adults between men and women, there were differences in body composition between the sexes. On average, women presented higher percentages of body fat and higher prevalence of abdominal obesity, suggesting an excess of intra-abdominal adipose tissue. Although differences in amount of body fat between men and women are characteristic of human biology, the high prevalence of central obesity in women is an important finding given the role that visceral adipose tissue plays in the etiology and diagnosis of metabolic syndrome and cardiovascular disease (Schnell et al., 2007). This difference between sexes could be linked to parity given that this population has a high fertility rate: 6.3 live births per woman (Valeggia and Ellison, 2004). It has been well established that, in Western populations, parity is associated with increased body mass, with weight gains estimated between 0.5 and 2.4 kg/birth (Riobó et al 2003). Furthermore, in a previous study, women in this population showed considerable postpartum weight retention (Valeggia and Ellison 2003).

Reproductive status, as a proxy for reproductive hormone levels in women, has an important impact on the risk profile for cardiovascular disease (Casado Pérez et al., 2001; Knowlton, 2012). After menopause, the cardioprotective effects of estrogen are lost, bringing about an apparent increase in the risk of cardiovascular problems. The hormonal changes that typically accompany menopause are associated with most of the metabolic conditions that define metabolic syndrome: a change in the distribution of body fat and an increased risk of hypertension, as well as elevated plasma lipids and insulin resistance (Knowlton, 2012).

The metabolic conditions that constitute the metabolic syndrome, which themselves are associated with higher risk for cardiovascular disease, are influenced by behavioral, cultural, and social variables. Acculturation, the adoption of cultural characteristics of a different group, seems to be an excellent predictor of cardiovascular health in indigenous communities around the world. For multiple indigenous communities, the greater the degree of acculturation (a more Westernized lifestyle), the greater the prevalence of obesity, diabetes, elevated glucose levels, alcoholism and smoking (Ulijaszek 2008, Rocha et al., 2011)

This study presents some limitations and possible sources of bias. First, although the sample size was statistically adequate to capture the study variables, our sample may not be representative of the adult population in the village. We have taken great precaution in recruiting participants at random. However, our sample may have been biased towards unemployed men because we recruited participants who were present in the home at the time of the initial visit. This would not be the case for women, who are very seldom away from their home. Second, this particular peri-urban village may not be representative of the entire Toba population in Argentina. However, studies conducted in other areas indicate that lifestyle in Namqom is very similar to other peri-urban and even more rural indigenous communities in northern Argentina (Valeggia & Lanza 2005). Third, as with any study of anthropometrics and metabolic markers, errors in measurements are a clear possibility. We have attempted to minimize those by having one well-trained researcher do all the measures. We also calculated the metabolic markers with the degree of error provided by the manufacturer of the Cardiochek® point-of-care device and found that it did not change the

results of our analysis. In spite of these limitations and constraints, we consider that the results of this study add considerably to the limited body of knowledge concerning the effects of nutritional and epidemiological transitions in indigenous populations and provide data important to the implementation of public health interventions.

In conclusion, the Toba population of Namqom shows an elevated prevalence of metabolic syndrome and, consequently, is at an increased risk for cardiovascular disease. This indigenous population, like many others in Latin America, has undergone a dramatic change in lifestyle and is now in the midst of a profound sociocultural, demographic, and epidemiological transformation that requires immediate attention. Future public health studies in these communities should focus on their eating habits, lifestyle, and cultural factors to design prevention strategies that are effective and culturally relevant.

ACKNOWLEDGEMENTS

We thank the Toba/Qom community of Namqom for their patience and cooperation. Dr. Maria Baía, the director of the Namqom Health Center, for her support, Irina Denisenko, Elaine Yang, and Cara McGuiness for assistance with data collection, and Amancio Lopez and Rosa Medina, for their help in the community. This study is part of the doctoral thesis of Elena Lagranja (Doctoral Program in Health Sciences, Facultad de Ciencias Médicas, Universidad Nacional de Córdoba, Argentina) and was funded in part by the Chaco Area Reproductive Ecology program (University of Pennsylvania, USA) and the National Institute of Aging (NIA P30 Demography of Aging (AG 012836-15) Pilot).

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Figure 1.

The adult population of Namqom classified by Body Mass Index following World Health Organization guidelines (WHO, 2000).

Table I

Anthropometric, metabolic, and clinical characteristics of adult Toba with (MS+) and without (MS-) metabolic syndrome. Values are expressed as the mean and standard deviation ($\bar{X} \pm DE$); Student's t-test used to for independent samples.

	MS+	MS-	<i>p</i>
Men			
n	52	82	
Age (years)	45.2 $\pm$ 11.7	33.5 $\pm$ 12.7	<0.0001
BMI (kg/m ²)	32.9 $\pm$ 4.5	26.3 $\pm$ 4.0	<0.0001
%BF	37.8 $\pm$ 9.0	29.0 $\pm$ 9.9	<0.0001
WC (cm)	108.4 $\pm$ 10.4	91.1 $\pm$ 9.2	<0.0001
HDL (mg/dl)	28.0 $\pm$ 9.3	31.9 $\pm$ 15.6	0.07
TGC (mg/dl)	192.6 $\pm$ 110.4	92.2 $\pm$ 75.3	<0.0001
GL (mg/dl)	100.8 $\pm$ 37.6	83.3 $\pm$ 17.7	<0.01
SBP (mm/Hg)	147.6 $\pm$ 16.3	131.1 $\pm$ 14.7	<0.0001
DBP (mm/Hg)	96.1 $\pm$ 18.1	83.3 $\pm$ 9.1	<0.0001
Smoking (yes)	23.1% (12)	30.5% (25)	0.35
Women			
n	52	89	
Age (years)	42.4 $\pm$ 12.3	34.1 $\pm$ 11.5	<0.0001
BMI (kg/m ²)	33.7 $\pm$ 6.7	29.2 $\pm$ 6.0	<0.0001
%BF	44.3 $\pm$ 5.3	37.3 $\pm$ 9.1	<0.0001
WC (cm)	104.8 $\pm$ 10.0	93.4 $\pm$ 12.9	<0.0001
HDL (mg/dl)	31.3 $\pm$ 8.9	34.1 $\pm$ 11.7	0.11
TGC (mg/dl)	134.3 $\pm$ 92.3	64.2 $\pm$ 43.1	<0.0001
GL (mg/dl)	104.7 $\pm$ 50.8	81.6 $\pm$ 15.0	<0.01
SBP (mm/Hg)	147.3 $\pm$ 27.9	119.0 $\pm$ 15.4	<0.0001
DBP (mm/Hg)	93.8 $\pm$ 12.1	78.2 $\pm$ 10.0	<0.0001
Smoking (yes)	3.9% (2)	11.2% (10)	0.14

BMI: body mass index; %BF: percent body fat; WC: waist circumference; HDL: high density lipoprotein cholesterol; TGC: triglycerides; GL: blood glucose; SBP: systolic blood pressure; DBP: diastolic blood pressure.

* Statistically significant differences ($p < 0.05$).

Table II

Pearson correlation between BMI, blood pressure, and metabolic markers of metabolic syndrome by sex.

Men (n=134)	BMI	SBP	DBP	GL	HDL
SBP	$r = 0.35$ $p < 0.001^*$				
DBP	$r = 0.31$ $p < 0.001^*$	$r = 0.58$ $p < 0.001^*$			
GL	$r = 0.10$ $p = 0.25$	$r = 0.16$ $p = 0.07$	$r = 0.10$ $p = 0.24$		
HDL	$r = -0.14$ $p = 0.12$	$r = 0.13$ $p = 0.13$	$r = 0.04$ $p = 0.64$	$r = 0.07$ $p = 0.44$	
TGC	$r = 0.38$ $p < 0.001^*$	$r = 0.16$ $p = 0.06$	$r = 0.21$ $p = 0.01$	$r = 0.15$ $p = 0.09$	$r = -0.04$ $p = 0.61$
Women (n=141)					
SBP	$r = 0.28$ $p = 0.001^*$				
DBP	$r = 0.30$ $p < 0.001^*$	$r = 0.79$ $p < 0.001^*$			
GL	$r = 0.09$ $p = 0.30$	$r = 0.09$ $p = 0.27$	$r = 0.13$ $p = 0.11$		
HDL	$r = -0.29$ $p < 0.001^*$	$r = -0.12$ $p = 0.14$	$r = -0.13$ $p = 0.12$	$r = 0.06$ $p = 0.50$	
TGC	$r = 0.29$ $p < 0.001^*$	$r = 0.27$ $p = 0.001^*$	$r = 0.27$ $p = 0.001^*$	$r = 0.30$ $p < 0.001^*$	$r = -0.02$ $p = 0.80$

BMI: body mass index; %BF: percent body fat; WC: waist circumference; HDL: high density lipoprotein cholesterol; TGC: triglycerides; GL: blood glucose; SBP: systolic blood pressure; DBP: diastolic blood pressure.

* Statistically significant differences ($p < 0.05$).

Table III

Odds ratios (OR) for metabolic syndrome risk factors in Toba adults presenting altered BMI (BMI ≥ 25 kg/m²).

Men			
	OR	95% CI	p-value
GL+	1.15	(0.22 – 6.11)	0.87
TGC+	8.59	(1.84 – 40.13)*	0.006
HDL+	3.88	(1.27 -11.88)*	0.02
HTA+	2.36	(0.95 – 5.85)	0.06
Women			
	OR	95% CI	p-value
GL+	3.74	(0.46 – 30.23)	0.22
TGC+	6.02	(0.75 – 48.63)	0.29
HDL+	5.94	(1.52 – 23.16)*	0.01
HTA+	2.41	(0.81 – 7.17)	0.11

Multivariate logistic regression controlling for age, using normal (BMI<25 kg/m²) as the reference category. GL+: blood glucose ≥ 110 mg/dl for both sexes; TGC+: triglycerides ≥ 150 mg/dl; HDL: high density lipoprotein cholesterol <40 mg/dl in men or <50 mg/dl in women; HTA: hypertension (SBP ≥ 140 mmHg or DBP ≥ 90 mmHg). CI: 95% confidence interval.

* Statistically significance $p < 0.05$.

Table IV

Mean values of anthropometric, metabolic markers and blood pressure in Toba women with (MS+) and without (MS–) metabolic syndrome by reproductive age.

	MS+	MS–	<i>p</i>
<i>Childbearing age</i>			
n	32	77	
Age (years)	35.5 ± 7.3	30.6 ± 7.2	<0.01
BMI (kg/m ²)	33.0 ± 6.9	28.4 ± 5.9	<0.01
%BF	43.5 ± 4.4	37.4 ± 9.1	<0.0001
WC (cm)	103.1 ± 9.9	93.7 ± 12.1	<0.01
HDL (mg/dl)	31.3 ± 8.8	34.8 ± 11.9	0.13
TGC (mg/dl)	126.9 ± 84.5	62.9 ± 43.9	<0.01
GL (mg/dl)	102.2 ± 56.1	80.7 ± 15.6	<0.05
SBP (mm/Hg)	142.4 ± 28.1	117.7 ± 14.4	<0.0001
DBP (mm/Hg)	95.5 ± 13.5	78.3 ± 10.2	<0.0001
Smoking (yes)	6.3% (2)	13.0% (10)	0.31
<i>Menopausal</i>			
n	20	12	
Age (years)	53.5 ± 10.6	56.8 ± 7.4	0.34
BMI (kg/m ²)	34.8 ± 6.4	27.1 ± 7.0	<0.01
%BF	45.5 ± 6.5	36.5 ± 9.4	<0.01
WC (cm)	107.6 ± 9.8	92.1 ± 17.4	<0.05
HDL (mg/dl)	31.2 ± 9.4	29.3 ± 8.5	0.58
TGC (mg/dl)	146.2 ± 104.8	72.8 ± 37.4	<0.01
GL (mg/dl)	108.7 ± 42.0	87.3 ± 8.7	<0.01
SBP (mm/Hg)	155.2 ± 26.4	127.1 ± 19.5	<0.01
DBP (mm/Hg)	91.1 ± 9.4	77.4 ± 8.9	<0.01
Smoking (yes)	0%(0)	0%(0)	N/A

BMI: body mass index; %BF: percent body fat; WC: waist circumference; HDL: high density lipoprotein cholesterol; TGC: triglycerides; GL: blood glucose; SBP: systolic blood pressure; DBP: diastolic blood pressure.

* Statistically significant differences ($p < 0.05$).

Table V

Odds ratio (OR) of metabolic syndrome risk factors in menopausal women.

	OR	95% CI	p-value
BMI+	0.54	(0.12-2.50)	0.43
HDL+	3.28	(0.44-24.41)	0.52
TGC+	0.88	(0.17-4.59)	0.88
GL+	2.53	(0.15-43.00)	0.25
SBP+	0.51	(0.12-2.22)	0.31
DBP+	0.25	(0.06-1.00)	0.32

Multivariate logistic regression using women of childbearing age as the reference category, controlling for age. BMI+: Body Mass Index ≥ 25 kg/m²; GL+: blood glucose ≥ 110 mg/dl; TGC+: triglycerides ≥ 150 mg/dl; HDL: high density lipoprotein cholesterol <50 mg/dl in women; HTA: hypertension (SBP ≥ 140 mmHg or DBP ≥ 90 mmHg). CI: 95% confidence interval.