OR 1518

Prevalence of metabolic syndrome and its determinants in older Mexican non-diabetic adults

Prevalencia de síndrome metabólico y sus determinantes en adultos mayores mexicanos sin diabetes

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ABSTRACT

Introduction: the prevalence of metabolic syndrome (MetS) is high in older people, and several factors have been explored as main determinants. However, few data exist for older people from low- and middle-income countries. Therefore, our objective was to

estimate the prevalence of MetS. Secondly, to explore which of the cardio-metabolic, inflammatory and demographic risk factors were the main determinants of the high prevalence of MetS in a population of older Mexican adults.

Methods: data for this analysis were collected in subjects over 60 years of age from northwest Mexico. Fasting and two-hour glucose, fasting insulin, homeostasis model assessment of insulin resistance, lipid profiles, markers of adiposity and inflammation, and blood pressure were assessed. In addition, anthropometry and body composition data, levels of physical activity and demographic variables were also considered. MetS was diagnosed by three different criteria.

Results: total sample size was 369 subjects. The prevalence of MetS varied widely, from 36% to 52% depending on the criteria applied, but regardless of the criteria, all subjects with MetS were heavier and more overweight, and had higher triglyceride values and lower values of total HDL-cholesterol compared to those without MetS ($p < 0.0001$). Final models adjusted for age and gender showed that, regardless of the diagnostic criteria applied, gender and some cardio-metabolic variables were main determinants of MetS in this sample. Women were more severely affected than men.

Conclusions: the prevalence of MetS is relatively high in non-diabetic older adults and it was associated with gender, and a series of cardio-metabolic factors as the main determinants.

Key words: Demographic status. Inflammation markers. Insulin resistance. Metabolic syndrome. Older people. Risk factors.

RESUMEN

Introducción: la prevalencia de síndrome metabólico (SMet) es alta en los adultos mayores y se han explorado diversos factores como los principales determinantes. Sin embargo, existen pocos datos para los adultos mayores de países de ingresos bajos y medios. Por lo tanto, nuestro objetivo fue estimar la prevalencia de SMet. Segundo, se

exploró cuáles de los factores cardiometabólicos, inflamatorios y demográficos fueron los principales determinantes del SMet.

Métodos: se incluyeron 369 sujetos mayores de 60 años de edad del noroeste de México. Se determinaron la glucosa en ayuno y de dos horas y la insulina en ayuno, y se realizó la evaluación del modelo homeostático de resistencia a la insulina, perfil de lípidos, de los marcadores de adiposidad e inflamación y la presión sanguínea. También se consideraron los datos de antropometría y composición corporal, la actividad física y las variables demográficas. El SMet se diagnosticó por tres diferentes criterios.

Resultados: la prevalencia de SMet varió ampliamente de 36 a 52% y fue dependiente del criterio aplicado. Independientemente del criterio, todos los sujetos con SM presentaron sobrepeso y tenían valores más altos de triglicéridos y valores más bajos de colesterol HDL comparados con aquellos sin SMet ($p < 0,0001$). El género y algunas variables cardiovasculares fueron los principales determinantes del SMet en esta muestra y el de las mujeres fue el grupo más afectado por el SMet.

Conclusiones: la prevalencia de SMet es relativamente alta en adultos mayores no diabéticos y se asoció con el género y una serie de factores cardiometabólicos como los principales determinantes.

Palabras clave: Adultos mayores. Factores demográficos. Factores de riesgo. Marcadores de inflamación. Resistencia a la insulina. Síndrome metabólico.

INTRODUCTION

Metabolic syndrome (MetS) is characterized by a cluster of cardio-metabolic risk factors that includes abdominal obesity, high blood pressure, increased glucose concentrations, and dyslipidemia (1,2). MetS is highly-prevalent in geriatric populations, where it varies from 11-43%, 23-55%, and 37-41.9%, according to the World Health Organization, the National Cholesterol Education Program-Third Adult Treatment Panel (ATP III), and the International Diabetes Federation (IDF), respectively (3-7). The clinical impact of MetS in

older adult populations consists in its association with cardiovascular morbidity (4,7-10) and mortality (11-13).

The underlying causes of MetS are still being studied. Though insulin resistance and central obesity are currently considered as the most significant factors (1), other important contributing factors include inflammation, endothelial, renal and hepatic dysfunction, and oxidative stress (14). Also, recent studies had reported an association of MetS with such gender-specific risk factors as demographic variables (socioeconomic status, educational level and marital status, among others) in adult (15,16) and older adult subjects (17-21). To our knowledge, there are few specific studies of the association between socioeconomic status and MetS in older people, and even fewer of older people in developing countries. It is well-known that the prevalence of MetS increases with age, especially in individuals with high body-mass index (BMI) and low levels of physical activity (22).

In Mexico, the over-60 population has grown considerably. At the same time, obesity, central obesity, type 2 diabetes and hypertension, among other ailments, have become significant public health issues (23,24). In addition, an important segment of older Mexican people have low educational levels, a large proportion has neither formal jobs nor pensions, and others have extremely low incomes. Many are single; indeed, living alone is quite common in this age group (25). Unfortunately, few data exist on the prevalence and determinants of MetS in relation to cardio-metabolic and inflammatory profiles, or to demographic factors in older people from low- and middle-income countries. Therefore, the objective of the present study was to estimate the prevalence of MetS and, secondly, to explore which of the cardio-metabolic, inflammatory and demographic risk factors were the main determinants of the high prevalence of MetS in a population of older Mexican adults.

METHODS

A non-probabilistic, cross-sectional study was conducted with older people from the city of Hermosillo, Sonora, Mexico. During visits to homes and clubs, short interviews were

conducted to invite older people to participate, in order to gather information on their health and nutritional status. All potential participants then underwent a comprehensive medical examination, an oral glucose tolerance test (OGTT) and other biochemical determinations. Anthropometric measurements were taken and body composition was assessed. A series of demographic variables was also evaluated as part of the study protocols. The research protocol was carried out in the Laboratory of Body Composition and Functionality, Coordination of Nutrition, Research Center for Food and Development, and was approved by the Ethics Committee of CIAD, A.C. All volunteers were fully informed and signed the consent form before commencing the protocol.

Study population

The total sample comprised 369 participants, and included 195 women and 174 men over 60 years old (range: 60-83 years) who were physically independent according to the Katz scale (26) and in free-living conditions. Participants underwent a general medical examination and urine analyses and an oral glucose tolerance tests (OGTT). Subjects were free of type 2 diabetes as determined by the OGTT and were also free of other major chronic diseases, according to their clinical histories. Controlled hypertensive subjects and those with controlled endocrine disorders such as hypothyroidism were included.

Measures

Anthropometry and body composition assessments

Body weight and standing height were recorded, and BMI (kg/m^2) was determined. Waist circumference (WC) was measured to the nearest 0.1 cm at the umbilicus level using a fiberglass measuring tape. Body composition including total appendicular skeletal muscle mass (TASM) was measured by DXA using DPX-MD+™ (GE Lunar Madison, WI, USA), as previously published (27).

Cardio-metabolic and inflammatory biochemical determinations

After an 8-12 h overnight fast, whole blood samples (20 ml) were collected. Glucose levels were measured using the glucose oxidase method, while serum insulin was analyzed by radioimmunoassay (Iso Data, IL, USA) following the Coat-A-Count® procedure (Coat-A-Count, DPC) and by enzyme-linked immunosorbent assay (DRG Instruments GmbH, Marburg, Germany), using ALPCO™ (cat. EIA2935 DRG). The homeostasis model assessment of insulin resistance (HOMA-IR) was calculated using the Matthews' equation (28) and insulin resistance was defined based on percentile distribution using the 75th percentile (HOMA-IR = 2.43). Lipid profile was calculated by the enzymatic-colorimetric method and, more recently, by RX monza (Randox Laboratories Ltd; Crumlin, UK). Serum interleukin 6 (IL-6) and CRP concentrations were measured by ELISA High Sensitivity HS600 Quantikine® kit (R&D Systems Inc., Minneapolis, MN, USA).

Blood pressure measurements

Blood pressure (BP) was measured with a mercury column sphygmomanometer (Graham-Field™ Inc., NY, USA). The values reported are the mean of two measurements. In relation to the application of the MetS criteria, subjects with a systolic BP > 130 or diastolic BP > 85 mmHg, or who were taking medications for previously-diagnosed hypertension were registered as hypertensive (ATP III and AHA/NHLBI), while for the 2009 IDF standards, systolic BP ≥ 130 or diastolic BP ≥ 85 mmHg, or treatment of previously-diagnosed hypertension were the parameters used.

Assessment of demographic variables

In the study protocol, age and gender were recorded. Family income was ascertained from the amount estimated by subjects considering all household members who contributed to total monthly family income. Classification of socioeconomic status followed the procedure in Joan et al. (2007) (29). The estimates in this study are in line with those shown in official poverty figures from CONEVAL (2015) (30). In addition, educational level was classified in accordance with Mexico's educational system. Technical careers were

also considered when classifying educational levels. Marital status, toxicities (smoking and alcoholism) and employment status were identified.

Physical activity level

Physical activity levels (PAL) were estimated by predictive equations that estimate total energy expenditure and resting metabolic rate in older people (31). This factor was classified as sedentary, moderately active, vigorously active, and extremely active.

Diagnoses of MetS

We applied three sets of criteria to diagnose Mets: ATP III (32), ATP III modified by the AHA/NHLBI in 2005 (AHA/NHLBI) (1), and the 2009 IDF classification (33). For the 2009 IDF criteria (33), the cut-off points for WC recommended for Asian populations were used.

Statistical analysis

Student's t-tests or Chi-squared tests were used to compare several characteristic of the subjects with and without MetS. The main determinants of the MetS were explored by multiple logistic regression, both univariate analysis and multivariate stepwise regression methods. It is important to specify that models were constructed separately for MetS as diagnosed by the ATP III, AHA/AHLBI, and 2009 IDF criteria. Models were evaluated for logistic regression assumptions (*i.e.*, lack of strongly-influential outliers) and interactions of all variables in the model with gender were tested at $p \leq 0.1$. All analyses were performed using STATA (version 11.0; Stata Corp, College Station, TX, USA).

RESULTS

The mean age of the total sample was 68.9 ± 6.5 years, and they had a mean BMI of 27.3 ± 3.9 kg/m^2. Women represented 53% of the total sample. Overall prevalence of MetS was 36% and 45% according to ATP III and AHA/NHLBI, respectively, increasing to 52% with the 2009 IDF criteria.

Table I shows the behavior of several cardio-metabolic, inflammatory and demographic variables according to the different criteria used. Subjects with MetS were heavier and had greater BMI, total body fat, and WC. Overweight and obesity were more prevalent in subjects with MetS, regardless of the criteria applied ($p < 0.0001$). Additionally, they had higher values of triglycerides and lower values of total HDL-cholesterol compared to those without MetS ($p < 0.0001$). Fasting glucose and insulin were significantly higher in the MetS group diagnosed by AHA/NHLBI and 2009 IDF criteria. Also, an effect of gender and hypothyroidism was found. MetS was also more prevalent in older subjects with educational levels of high school or less, low socioeconomic status, and those who were sedentary or had low physical activity levels, regardless of the criteria applied.

Table II shows the potential predictors of MetS. Waist circumference, BMI, total body fat, fasting glucose and insulin, HDL-cholesterol, TGs, gender, educational level, alcohol consumption, PAL, BMI (as a categorical variable) and hypertension, all proved to be predictors of MetS defined by all three sets of criteria ($p \leq 0.2$). Other variables were selected as predictors of MetS, but for only one or two criteria, such as place of residence, marital status, socioeconomic status, and insulin resistance.

Tables III, IV and V show the final separate models, adjusted for age and gender. The model in tables III and IV shows that the variables gender, WC, HDL-cholesterol, fasting glucose, TGs, and hypertension were the best predictors of MetS defined by the ATP III and AHA/NHLBI criteria, while gender, WC, HDL-cholesterol, fasting glucose, BMI, hypertension, and insulin were the best predictors of MetS defined by the 2009 IDF criteria (Table V). In the three models (Tables III-V), an effect of gender was found, since women had an OR of 15.91 ($p = 0.000$) compared to men by using ATP III and 24.45 ($p = 0.000$) by using AHA/HHLBI criteria, respectively, and an OR of 10.58 times compared with men ($p = 0.000$) using the 2009 IDF criteria. The OR for each predictor of the different criteria is depicted in tables III, IV and V.

DISCUSSION

The prevalence of MetS in this Mexican aged group is high, and varies widely according to the diagnostic criteria used (p = 0.0001), with the 2009 IDF standards generating the highest prevalence. Similar findings have been reported by studies carried out in some Latin American countries with older people (5,6,21). This could be explained largely by the high proportion of obesity, especially central obesity, in this age group. In fact, recent evidence underscores that older obese people with MetS have more abdominal visceral fat, but less subcutaneous thigh fat than older obese people without this condition (34). To our knowledge, few studies have explored cardio-metabolic, inflammatory and demographic variables as the main the determinants of MetS in older people in a developing country. Our results show that this high prevalence is strongly determined by gender because women were more severely affected regardless of the criteria applied. This probably reflects the different patterns in sex differences in the MetS among older Mexican people. It is important to note that, aside from gender, only the cardio-metabolic variables assessed in this study were found to be mainly determinants of the high prevalence of MetS. Therefore, our findings are important and may help define specific cardio-metabolic strategies for preventing MetS in this vulnerable age group as evidence of the association between MetS and cardiovascular mortality in older adult population continues to accumulate (11-13).

At the national level, the prevalence of MetS in older people is relatively high in Mexico. The 2012 National Health and Nutrition Survey (2012 ENSANUT for its initials in Spanish) reported a prevalence of MetS of 56.3% using the ATP III criteria, 60.8% according to the AHA/NHLBI's definition, and 67.9% by the IDF criteria (24). The prevalence found in this non-representative sample is lower (36%, 45% and 52% according to the ATP III, AHA/NHLBI, and 2009 IDF criteria, respectively), perhaps because our study excluded subjects diagnosed with type 2 diabetes by the OGTT, while the ENSANUT report included them. However, independently of the inclusion of diabetics, prevalence in this non-representative sample is high, indicating that greater attention must be paid to preventing this condition. Overall, prevalence of MetS in this age group is within the range reported for other, non-Latin American populations (3,4,7). Thus, it seems that the presence of

MetS in older adult populations is relatively high regardless of genetic background, environmental exposures and the diagnostic criteria used.

The high prevalence of MetS in this sample is explained by central obesity, hypertension and low-HDL-cholesterol. Central obesity was consistently the most prevalent factor identified by each set of criteria (87%, 87% and 99% by the ATP III, AHA/NHLBI, and 2009 IDF, respectively), followed, in second place, by hypertension (84%, 81% and 79% by the ATP III, AHA/NHLBI and 2009 IDF criteria, respectively), and then low HDL-cholesterol (87%, 75% and 72%, respectively). It is interesting to note that low HDL-cholesterol was the most prevalent component of abnormality found in a study of young and middle-aged Korean men and women (35). In our sample, the prevalence of obesity and hypertension was related to the increasing prevalence of MetS, which has been found to be relatively high among older age groups (36).

The regression analysis showed that most of the variables were determined to be significant predictors of MetS, but that some cardio-metabolic, inflammatory and demographic variables (including age, TASM, total cholesterol, LDL-cholesterol, CRP, interleukin-6, marital status, employment status, smoking, alcohol consumption, insulin resistance and chronic diseases) were not selected as predictors of MetS (Table II). It is important to note that several studies have shown a strong association between demographic variables and MetS in adult and older adult subjects (15-21). In fact, in this study we also found a significant association between schooling or education level, socioeconomic status, gender and physical activity level with MetS as shown in table I and II. However, our tables III and IV show that only gender and some cardio-metabolic risk factors were main determinants, regardless of the criteria used. Therefore, our results do not support other demographic variables as the main determinants of the high prevalence of MetS, though some other studies have reported a significant association between such variables as gender, socioeconomic status, educational level and marital status, among others, and MetS in adults (15,16) and older adult subjects (17-21).

In accordance with the results of our multiple regression analysis, it is clear that in addition to gender, some cardio-metabolic variables were main determinants of MetS in

older subjects who may, therefore, be at high risk of cardiovascular morbidity and mortality. Of the total mortality recorded in Mexico in 2014 (633,000 deaths), 63.9% corresponded to people aged ≥ 60. Heart diseases (16.9%), cerebrovascular diseases (6.8%) and hypertension (4.7%) were the main contributing factors to all deaths that occurred in this population group (INEGI, 2014) (37). Therefore, we must give high priority to defining and implementing strategies to prevent MetS in this growing, older Mexican adult population.

The present study had some limitations. First, all subjects included were free of type 2 diabetes, using the former criteria of two hour glucose value OGTT (> 200 mg/dl). Therefore, prevalence of MetS found is only valid for this particular sample. Second, HOMA-IR and its associations could not be determined using the hyperinsulinemic-euglycemic clamp. However, it is well known that the method used in the present study correlated well with the hyperinsulinemic-euglycemic clamp. Additionally, the methods used for insulin determination in the three different cited studies varied in sensitivity. Third, this is a cross-sectional study, therefore only an association, not a causal relationship, is shown. Further studies in different settings are required to explore the effect of demographic variables as determinant of MetS in older people.

In conclusion, metabolic syndrome is highly prevalent in non-diabetic older adults and in a non-representative sample, with women being more severely affected. In this study, the main determinants were gender and a series of potential modifiable cardio-metabolic risk factors such as waist circumference, HDL-cholesterol, fasting glucose, triglycerides, hypertension, obesity and insulin. However, more research in other populations on the interrelation between MetS and socioeconomic status and other demographic variables would provide additional evidence and allow us to identify other significant factors. At present, however, our findings support the importance of strengthening specific cardio-metabolic strategies to help prevent MetS in this vulnerable age group.

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Table I. Behavior of several cardio-metabolic, inflammatory and demographic variables according to MetS status as defined by three different sets of criteria

Variables	*MetS*								
	2001 NECP ATP III			*2005 AHA/NHLBI*			*2009 IDF*		
	Without	With	*p-value*	Without	With	*p-value*	Without	With	*p-value*
Age, years	69.2 ± 6.6	68.4 ± 6.3	0.2440	69.2 ± 6.7	68.5 ± 6.4	0.3297	69.1 ± 6.3	68.8 ± 6.7	0.5174
Body weight, kg	69.6 ± 11.6	74.3 ± 12.3	0.0003	67.9 ± 10.8	75.5 ± 12.1	0.0000	67.5 ± 10.6	75.0 ± 12.2	0.0000
Height, m	1.67 ± 0.09	1.60 ± 0.09	0.0103	1.62 ± 0.09	1.60 ± 0.08	0.1742	1.62 ± 0.08	1.61 ± 0.09	0.2196
Waist circumference, cm	94.5 ± 10.8	103.1 ± 9.9	0.0000	92.3 ± 10.0	103.6 ± 9.7	0.0000	92.7 ± 10.3	102.4 ± 10.1	0.0000
Fat-free mass, kg	44.3 ± 9.0	43.2 ± 9.4	0.2563	43.8 ± 8.9	43.9 ± 9.6	0.9097	43.5 ± 8.6	44.2 ± 9.7	0.4759
TASM, kg	18.5 ± 4.2	17.9 ± 4.4	0.2494	41.4 ± 8.5	41.5 ± 9.2	0.9136	41.1 ± 8.2	41.7 ± 9.3	0.4654
Total body fat, kg	24.1 ± 8.7	29.5 ± 7.7	0.0000	22.9 ± 8.5	29.8 ± 7.4	0.0000	22.9 ± 8.8	29.1 ± 7.5	0.0000
Fasting glucose (mg/dl)	94.7 ± 8.5	96.4 ± 10.5	0.0941	93.2 ± 8.1	97.9 ± 9.9	0.0000	93.2 ± 8.0	97.4 ± 9.9	0.0000
Fasting insulin, UI/ml	9.2 ± 4.4	9.9 ± 7.1	0.4213	8.9 ± 4.0	10.0 ± 6.9	0.0524	8.6 ± 3.2	10.2 ± 7.0	0.0057
Insulin resistance, %									

Yes No	 65.9 62.9	 34.0 37.0	 0.5957	 56.3 51.0	 43.7 49.0	 0.3726	 51.2 43.6	 48.8 56.4	 0.2000
Total cholesterol, mg/dl	207.4 ± 38.2	205.9 ± 41.2	0.7457	207.7 ± 3.2	205. ± 41.2	0.6387	208.0 ± 36.6	205.7 ± 41.7	0.5806
HDL-cholesterol, mg/dl	54.1 ± 15.1	39.0 ± 9.1	0.0000	54.6 ± 15.8	41.3 ± 10.4	0.0000	55.6 ± 15.8	41.8 ± 10.8	0.0000
Triglycerides, mg/dl	126.2 ± 66.8	177.5 ± 63.6	0.0000	124.3 ± 65.9	169.9 ± 66.9	0.0000	120.6 ± 65.5	168.4 ± 66.3	0.0000
LDL-cholesterol, mg/dl	128.3 ± 33.1	131.9 ± 35.1	0.3211	128.5 ± 32.2	131.9 ± 35.8	0.4495	128.4 ± 31.5	130.9 ± 36.0	0.4751
CRP, log natural (mg/l)	0.87 ± 0.83	1.0 ± 0.63	0.3257	0.77 ± 0.81	1.0 ± 0.67	0.0298	0.82 ± 0.75	1.0 ± 0.76	0.1689
IL-6 log natural (pg/ml)	0.67 ± 0.95	0.81 ± 0.65	0.3076	0.58 ± 0.98	0.86 ± 0.67	0.0579	0.57 ± 1.0	0.84 ± 0.66	0.0651
Gender, % women	54.9	45.1	0.0002	47.7	52.3	0.0028	43.6	56.4	0.0197
Residence, % Rural Urban	 52.0 65.4	 48.0 34.6	 0.0731	 41.6 57.0	 58.4 43.0	 0.0463	 41.7 50.5	 58.3 49.5	 0.2553

Schooling, %									
High school,	80.2	19.8		71.4	28.6		62.6	37.4	0.0041
High school or less	58.4	41.6	0.0002	49.6	50.4	0.0003	45.2	54.8	
Marital status, %									
Married or common-law	65.1	34.9	0.2514	60.9	39.1	0.0026	50.7	49.3	0.3026
Single or widow/er or divorced	58.8	41.2		44.6	55.4		44.7	55.3	
Employment status, %									
Manual and non-manual	67.6	32.4	0.3433	57.6	42.4	0.6179	54.0	56.0	0.2685
None	62.3	37.7		54.8	45.4		47.7	52.3	
Smoking, %									
No	63.2	36.8		53.9	46.1		48.8	51.2	
At least 100 cigarettes	66.6	33.4	0.6909	63.6	36.4	0.2833	51.5	48.5	0.7622
Alcohol consumption, %									
No	59.3	40.7	0.0148	51.2	48.8	0.1289	45.3	54.7	0.1363

Yes	74.3	25.7		60.9	39.1		54.9	45.1	
Chronic disease, %									
No	64.6	35.4		55.5	44.5		49.4	50.6	
Yes	58.6	41.6	0.5175	51.7	48.3	0.6961	48.3	51.7	0.9084
Hypertension, %									
No	63.8	36.2		55.2	44.8		49.3	50.6	
Yes	64.8	35.2	0.8879	53.7	46.3	0.8319	48.1	51.9	0.8715
Body mass index, %									
Normal	81.8	18.2		80.9	19.1		76.4	23.6	
Overweight	60.3	39.7		51.1	48.9		43.1	56.9	
Obese	47.0	53.0	0.0000	29.4	70.6	0.0000	27.0	73.0	0.0000
SES, %									
High and medium	69.8	30.2		60.9	39.1		53.5	46.5	
Low	53.2	46.8	0.0015	44.7	55.3	0.0026	41.8	58.2	0.0316
PAL, %									
Active or moderately active	96.1	3.9		96.1	3.9		92.3	7.7	
Sedentary or light	61.2	38.8	0.0004	51.9	48.1	0.0000	46.0	54.0	0.0000
Heart disease, %									

No	63.7	36.3		55.1	44.9		49.1	50.9	
Yes	71.4	28.6	0.6740	42.8	58	0.5178	42.8	57.2	0.7419
Hypothyroidism, %									
No	62.8	37.2		53.4	46.6		47.2	52.8	
Yes	93.3	6.7	0.0157	93.3	6.7	0.0023	93.3	6.7	0.0005

CRP: C-reactive protein; IL-6: interleukin 6; TASM: total appendicular skeletal muscle; HDL: high-density lipoprotein; LDL: low-density lipoprotein; SES: socioeconomic status; PAL: physical activity level. A Student's t-test was used for continuous variables. A Chi-squared test was used for categorical variables


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Table II. Univariate associations of potential predictors of MetS as defined by three different sets of criteria

Variables	*MetS*								
	2001 NECP ATP III			*2005 AHA/NHLBI*			*2009 IDF*		
	B	EE	*p*	B	EE	*p*	β	EE	*p*
Age, years	0.98	0.02	0.244†	0.98	0.02	0.329†	0.99	0.02	0.362†
Waist circumference, cm	1.08	0.01	0.000	1.12	0.02	0.000	1.09	0.01	0.000
BMI, kg/m^2	1.20	0.04	0.000	1.29	0.05	0.000	1.26	0.04	0.000
TASM, kg	0.97	0.03	0.247†	1.00	0.02	0.941†	1.03	0.03	0.304†
Total body fat, kg	1.08	0.02	0.000	1.11	0.02	0.000	1.09	0.02	0.000
Fasting glucose, mg/dl	1.02	0.01	0.095	1.06	0.01	0.000	1.06	0.01	0.000
Fasting insulin, UI/ml	1.02	0.02	0.432	1.05	0.03	0.007	1.09	0.03	0.004
Total cholesterol, mg/dl	1.00	0.00	0.745†	1.00	0.00	0.638†	1.00	0.00	0.394†
HDL-cholesterol, mg/dl	0.89	0.01	0.000	0.92	0.01	0.000	0.91	0.01	0.000
Triglycerides, mg/dl	1.01	0.00	0.000	1.01	0.00	0.000	1.01	0.00	0.000
LDL-cholesterol, mg/dl	1.00	0.00	0.320†	1.00	0.00	0.448†	1.00	0.00	0.610†
C-reactive protein, mg/l*	1.26	0.29	0.324†	1.67	0.40	0.033†	1.22	0.29	0.382†
Interleukin 6, pg/ml*	1.25	0.27	0.306†	1.51	0.33	0.061†	1.39	0.30	0.132†
Gender, % women	2.29	0.51	0.000	1.89	0.40	0.003	1.42	0.30	0.095
Residence, % Rural	Ref.			Ref.			Ref.		

Urban	0.57	0.18	0.076	0.54	0.17	0.049	0.76	0.24	0.371†
Schooling, % High school High school or less	 Ref. 2.56	 0.80	 0.003	 Ref. 2.18	 0.61	 0.006	 Ref. 1.61	 0.43	 0.072
Marital status, % Married or common-law Single or widow/er or divorced	 Ref. 1.40	 0.33	 0.156	 Ref. 1.33	 0.31	 0.217†	 Ref. 1.24	 0.29	 0.350†
Employment status, % Manual and non-manual None	 Ref. 1.26	 0.31	 0.344†	 Ref. 1.12	 0.26	 0.618†	 Ref. 1.15	 0.27	 0.532†
Smoking, % No At least 100 cigarettes	 Ref. 1.17	 0.38	 0.624†	 Ref. 0.85	 0.27	 0.616†	 Ref. 0.89	 0.28	 0.724†
Alcohol consumption, % No Yes	 Ref. 0.54	 0.15	 0.027	 Ref. 0.72	 0.19	 0.204	 Ref. 0.80	 0.20	 0.374†
SES, % High Medium Low	 Ref. 1.81 3.30	 0.77 1.43	 0.166 0.006	 Ref. 1.51 2.68	 0.58 1.04	 0.276† 0.011	 Ref. 1.62 2.13	 0.59 0.80	 0.184 0.043
PAL, % Active or moderately-active	 Ref. 15.83	 16.24	 0.007	 Ref. 23.17	 23.76	 0.002	 Ref. 15.08	 11.22	 0.000

Sedentary or light									
Heart disease, %									
No	Ref.			Ref.					
Yes	0.70	0.59	0.676†	1.64	1.26	0.522†	1.20	0.93	0.811†
Categories of BMI,									
%	Ref.			Ref.			Ref.		
Normal	2.96	0.86	0.000	4.05	1.16	0.000	3.69	0.97	0.000
Overweight	5.06	1.67	0.000	10.17	3.46	0.000	7.19	2.33	0.000
Obese									
Hypertension, %									
No	Ref.			Ref.			Ref.		
Yes	3.38	0.76	0.000	3.44	0.76	0.000	4.05	0.91	0.000
Insulin resistance,									
%	Ref.			Ref.			Ref.		
No	0.88	0.22	0.596†	1.23	0.30	0.373†	1.48	0.36	0.103
Yes									
Chronic diseases, %									
No	Ref.			Ref.			Ref.		
Yes	1.29	0.51	0.518†	1.63	1.26	0.522†	1.20	0.93	0.811†

BMI: body mass index; TASM: total appendicular skeletal muscle; HDL: high-density lipoprotein; LDL: low-density lipoprotein; SES: socioeconomic status; PAL: physical activity level; Ref.: reference. †Variables not selected for the multivariate analysis according to the criteria $p \leq 0.2$ and/or a reduced number of observations or categories.

Table III. Association between MetS defined by the 2001 NECP ATP III criteria as dependent variable and gender and cardio-metabolic variables as risk factors

Independent variables	*OR*	*SE*	*CI 95%*	*p-value*
Gender, women *vs* men	15.91	6.68	6.98-36.25	0.000
Waist circumference, cm	1.09	0.02	1.05-1.13	0.000
HDL-cholesterol, mg/dl	0.84	0.02	0.80-0.88	0.000
Fasting glucose, mg/dl	1.06	0.02	1.02-1.10	0.000
Triglycerides, mg/dl	1.01	0.00	1.01-1.02	0.000
Hypertension, no *vs* yes	3.22	1.12	1.63-6.35	0.000

Stepwise backward using logistic regression analysis using MetS as the dependent variable. The model was age-adjusted. OR: odds ratio; SE: standard error; CI: confidence intervals.

Table IV. Association between MetS defined by 2005 AHA/NHLBI criteria as dependent variable and gender and cardio-metabolic variables as risk factors

Independent variables	*OR*	*SE*	*CI 95%*	*p-value*
Gender, women *vs* men	24.45	11.93	9.40-63.62	0.000
Waist circumference, cm	1.17	0.02	1.12-1.23	0.000
HDL-cholesterol, mg/dl	0.86	0.02	0.82-0.90	0.000
Fasting glucose, mg/dl	1.17	0.03	1.11-1.23	0.000
Triglycerides, mg/dl	1.01	0.00	1.01-1.02	0.000
Hypertension, no *vs* yes	4.76	1.82	2.25-10.01	0.000

Stepwise backward using logistic regression analysis using MetS as the dependent variable. The model was age-adjusted. OR: odds ratio; SE: standard error; CI: confidence intervals.

Table V. Association between MetS defined by 2009 IDF criteria as dependent variable and gender and cardio-metabolic variables as risk factors

Independent variables	*OR*	*SE*	*CI 95%*	*p-value*
Gender, women *vs* men	10.58	4.46	4.63-24.17	0.000
Waist circumference, cm	1.09	0.02	1.05-1.13	0.000
HDL-cholesterol, mg/dl	0.86	0.02	0.83-0.90	0.000
Fasting glucose, mg/dl	1.15	0.03	1.10-1.21	0.000
Triglycerides, mg/dl	1.01	0.00	1.01-1.02	0.000
BMI, normal *vs* obesity	1.99	0.67	1.03-3.85	0.041
Hypertension, no *vs* yes	6.04	2.26	2.94-12.44	0.000
Insulin, UI/ml	1.11	0.05	1.02-1.20	0.013

Stepwise backward by logistic regression analysis using MetS as the dependent variable. The model was age-adjusted. BMI: body mass index; OR: odds ratio; SE: standard error; CI: confidence intervals.