Prevalence of The Metabolic Syndrome Among a Determined Puerto Rican Population

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The metabolic syndrome defined as diabetes, hypertension, obesity, dyslipidemia, Glucose intolerance and hyperinsulinemia, also known as the syndrome of insulin resistance, has been found highly prevalent among Hispanic populations. The reason is attributed to the high prevalence of obesity and diabetes due to genetic factors, sedentary lifestyle and poor nutritional habits. The association of the metabolic syndrome with cardiovascular disease is widely recognized but the prevalence of the syndrome varies between studies due to the variations among both definitions (ATP III and WHO). We aim to determine the prevalence of the metabolic syndrome in a determined Puerto Rican population at the outpatient employee's clinic to further support the burden of the metabolic syndrome among hispanics. In this study, the ATP III criteria presented higher prevalence of the metabolic syndrome than the WHO definition and the modified criteria detected more cases of impaired fasting glucose than ATP III. The 32% overall prevalence support the NHANES III reported prevalence among Mexican-Americans.

Key words: Prevalence, Metabolic syndrome, Obesity, Hypertension, Hypertriglyceridemia, Impair glucose tolerance, Diabetes

The combination of hypertension, dyslipidemia, insulin resistance, hyperinsulinemia, glucose intolerance and obesity, particularly central obesity, has been termed the metabolic syndrome(1) also known as the syndrome of insulin resistance. Insulin resistance underlies many of the metabolic abnormalities associated with the syndrome. Although the pathogenesis of the syndrome are not completely understood, genetic factors and environmental factors such as sedentary lifestyle and western dietary habits, contribute to its development. Studies suggest an association between the metabolic syndrome and diabetes, cardiovascular disease and mortality(2).

The recently released Third Report of the National Cholesterol Education Program Expert Panel on Detection, Evaluation and Treatment of High Blood Cholesterol in Adults (Adult Treatment Panel III) (ATP III) draws attention to the importance of the metabolic syndrome and provides a working definition of this syndrome for the first time (3). The World Health Organization has published working definitions as well. The availability of these definitions provides the opportunity to asses and compare the prevalence of the metabolic syndrome in various populations (4).

The unadjusted and age adjusted prevalence of the metabolic syndrome was found to be 21.8% and 23.7% respectively among 8,814 US adults participating in the National Health and Nutrition Examination Survey (NHANES) III. Hispanics had the highest age adjusted prevalence of the metabolic syndrome at 31.9%, which may be due to the higher prevalence of obesity and diabetes among Mexican-Americans. This prevalence was lowest among whites (23.8%), African-Americans (21.6%) and those reporting "other" ethnicities (20.3%). (3)

Because of the implications of the metabolic syndrome on health care we sought to establish the prevalence of the metabolic syndrome in a determined Puerto Rican population to further support the burden of the metabolic syndrome among hispanics.

Methods

The present study is an observational study of the patients seen consecutively at the Outpatient clinic for the employees of our institution, the University of Puerto Rico, Medical SciencesCampus, to estimate the prevalence of the metabolic syndrome. The researcher, in collaboration

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with the employee's outpatient clinic physicians and staff, screened 200 employees by age, sex, waist and BMI using the Adult Treatment Panel III (ATP III) and the World Health Organization (WHO) definition, to determine the presence of the metabolic syndrome among this population. The clinic's physicians and staff followed the routine procedure for the required annual health exam on the employees. The investigator administered a Research Interview Questionnaire (RIQ) face to face. Information gathered included: sociodemographic data (age, sex and occupation), antropometric data (height, weight and waist circumference), lifestyle data (diet, exercise and toxic habits), and medical history pertinent to metabolic syndrome criteria. In addition, blood samples were taken to measure fasting blood glucose and a lipid panel.

In a follow-up visit to the clinic, the laboratory results were evaluated. Outcome was notified to the participant and those who met criteria for the metabolic syndrome were oriented on the clinical significance of this diagnosis, instructed on lifestyle modification and referred for further evaluation and management.

Inclusion criteria included men and nonpregnant women aged at least 20 years who attended the employees outpatient clinic and fulfill the ATP III or WHO criteria definition.

All participants provided written consent. Patients were excluded from the study if the ATP III or WHO criteria were not met or patient decided to quit the study.

The ATP III criteria for the metabolic syndrome were met if the subject had three or more of the following: waist circumference > 102 cm (40 in) in men and > 88 cm (35 in) in women;serum tryglicerides level >150 mg/dL; HDL <40 mg/dl in men and <50 mg/dl in women; systolic blood pressure >130 mmHg and diastolic >85 mmHg or on treatment for hypertension; serum glucose level >110 mg/dl (6.1 mmol/l) or on therapy for diabetes.

Participants who reported currently using antihypertensive, hypoglycemic or hypolipemic medications were considered to meet the respective criteria implied by the need for specific therapy.

The WHO criteria for the metabolic syndrome was met if an individual had the following: diabetes, impaired glucose tolerance (IGT), impaired fasting glucose (IFG) or insulin resistance plus two or more of the following abnormalities: blood pressure >160/90 mmHG; serum tryglicerides > 150 mg/dL and /or serum HDL cholesterol <35 mg/dl in men and <39 mg/dl in women; and central obesity with waist to hip ratio of 0.90 in men and >0.85 in women and/or BMI >30 kg/m².

All statistical analysis were performed separately by sex. Results are expressed as means ± SD. Depending on whether the outcome measure was continuous or discrete, weighted one-way ANOVA or X^2 test was performed to compare the two age groups and men versus women.

Results

A total of 81 men and 121 women participated in the study. The mean age was 41 ± 10 years (mean ± SD) and BMI was 27 ± 5.5 kg/m². We found 21 (10%) with diabetes, 34 (17%) with impaired fasting blood sugar by ATP III/ WHO definition, 63 (31%) with arterial hypertension, 64 (32%) with hypertriglyceridemia, 72 (36%) overweight, 76 (38%) obese, and 85 women and 25 men with low HDL (42% and 13% respectively). Women and men that met the ATP III criteria for waist circumference were 143 (71%) and 70 (35%) respectively. Forty two percent (86/202) of subjects were diagnosed as having the metabolic syndrome by both ATP III and WHO criteria, and 64% (116/202) were diagnosed as not having the metabolic syndrome by both criteria. Thirty one percent (63/202) were diagnosed as having the metabolic syndrome by the ATP III criteria alone, and 11.3% (23/202) were diagnosed as having the metabolic syndrome by the WHO criteria alone. The great majority of the patients were sedentary.

The age adjusted prevalence of one or more components of the metabolic syndrome in men and women are summarized in Table 1. The overall age-adjusted prevalence of the metabolic syndrome was 32% by the ATP III definition, 11% by WHO criteria.

By the ATP III definition, the age-adjusted prevalence was 41% in men and 26% in women (P = 0.024) . By the WHO criteria, the aged-adjusted prevalence was 19% in men and 7% in women. (P = 0.009).

Table 1. Age-adjusted prevalence of one or more components of the metabolic syndrome by sex*. The prevalence of the metabolic syndrome in men and women by age and BMI are shown in Figs 1 and 2. The prevalence of the metabolic syndrome was higher for women than men aged 20 to 29 years. Overall, the prevalence of the metabolic syndrome was greater in men older than 30 years by the ATP definition nevertheless the prevalence of the syndrome increased significantly with age in both genders by this definition. The highest prevalence of the metabolic syndrome in men and women ages 50 to 59 years by the ATP was 79%. The prevalence begins increasing between ages 30 to 39 years and significantly rises at age 50 by approximately 34%.

Figure 1. Prevalence (%) of metabolic syndrome by age and sex

Figure 2. Prevalence (%) of metabolic syndrome by sex and BMI The prevalence of the metabolic syndrome rose rapidly with increasing BMI until 35 kg/m²in both women and men using either definition.

Table 1. Age-adjusted prevalence of one or more components of the metabolic syndrome by sex*

Metabolic Abnormalities	Total		Men		Women		P
n	202		81		121		
ATP III							
>=1	80.2	(74.7, 85.7)	82.7	(74.5, 91.0)	78.5	(71.2, 85.8)	0.462
>=2	55.4	(48.6, 62.3	59.3	(48.6, 70.0)	52.9	(44.0, 61.8)	0.372
>=3	31.7	(25.3, 38.1)	40.7	(30.0, 51.4)	25.6	17.8, 33.4)	0.024
>=4	15.8	(10.8, 20.9)	21.0	(12.1, 29.9)	12.4	(6.5, 18.3)	0.101
=5	34.7	(0.9, 6.0)	2.5	(0.0, 5.8)	4.1	(.59, 7.7)	0.526
WHO							
>=1	17.3	(12.1, 22.5)	24.7	(15.3, 34.1)	12.4	(6.5, 18.3)	0.024
>=2	11.4	(7.0, 15.8)	18.5	(10.1, 27.0)	6.6	(2.2, 11.0)	0.009
>=3	6.4	(3.1, 9.8)	12.3	(5.2, 19.5)	2.5	(0.0, 5.2)	0.005

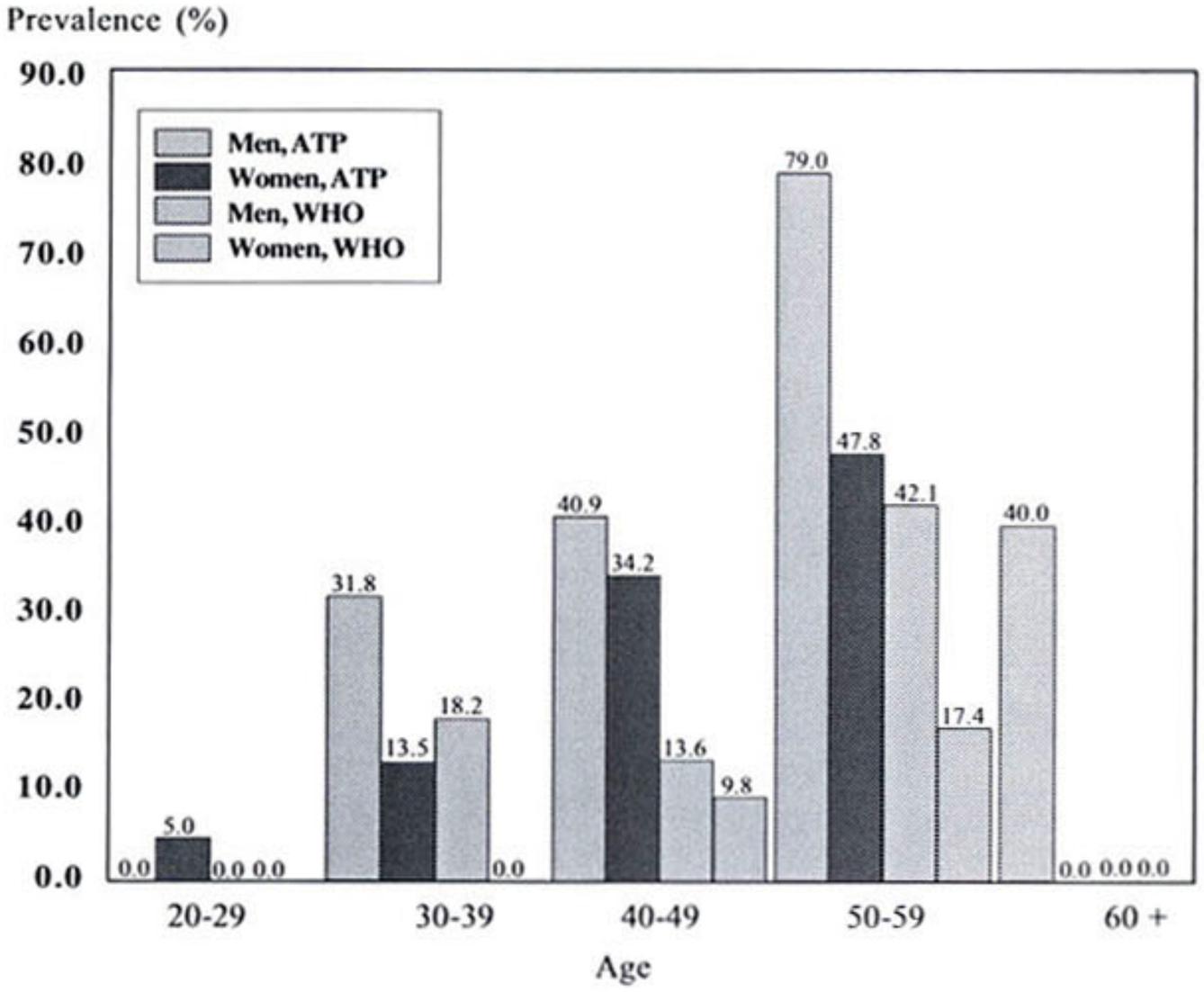
*Data are percent (95% CI) or n (%)

The relative frequencies of the individual components of the metabolic syndrome by age, sex and BMI are shown in Tables 2 and 3. By the ATP III definition, hypertension and waist circumference were the most common abnormalities. Men showed the highest prevalence for hypertension (P = 0.057) and women for waist circumference (P < 0.000). Hypertriglyceridemia was the third most common component for both men and women (P = 0.003). The frequencies of low HDL concentrations (P = 0.038) were higher in women than men and fasting plasma glucose (P = 0.015) was higher in men than women especially in those older than 49 years (P = 0.001).

Table 2- The relative frequencies of the individual components of the metabolic syndrome by age and sex.

Table 2. The Relative Frequencies of the Individual Components of the Metabolic Syndrome by Age and Sex.

	Total Population	Men 20-49 years	>49 years	P (young vs. old)	Total Men	Women 20-49 years	> 49 years	P (Young vs. old)	Total women	P (men vs. Women)
n(%)	202	57	24		81	98	23		121	
ATP										
Waist circumference (man >102; women >88cm	48.5	28.1	45.8	0.121	33.3	55.1	73.9	0.099	58.7	< 0.000
Blood pressure ≥130/ 85 mmHg or medication use	77.2	19.3	54.2	0.002	29.6	16.3	26.1	0.275	18.2	0.057
Hypertriglyceridemia (≥150mg/dl)	31.2	42.1	45.8	0.757	43.2	19.4	39.1	0.043	23.1	0.003
Low HDL Cholesterol (men <40;women <50 mg/dl)	27.7	21.1	16.7	0.767	19.8	33.7	30.4	0.766	33.1	0.038
FPG(>110mg/dl) of Medication use	16.8	14.0	50.0	0.001	24.7	6.1	34.8	< 0.000	11.6	0.015
WHO										
Diabetes, IFG	16.8	14.0	50.0	0.001	24.7	6.1	34.8	< 0.000	11.6	0.015
Blood pressure ≥160/ <90 mmHg	6.4	8.8	12.5	0.689	9.9	5.1	0.0	0.582	4.1	0.103
Hypertriglyceridemia (≥150 mg/dl) or low HDL (men <35; women <39 mg/dl)	33.2	43.9	45.8	0.870	44.4	22.4	39.1	0.099	25.6	0.005
Obesity BMI (>30kg/m2)	31.7	35.1	33.3	0.880	34.6	29.6	30.4	0.937	29.8	0.471



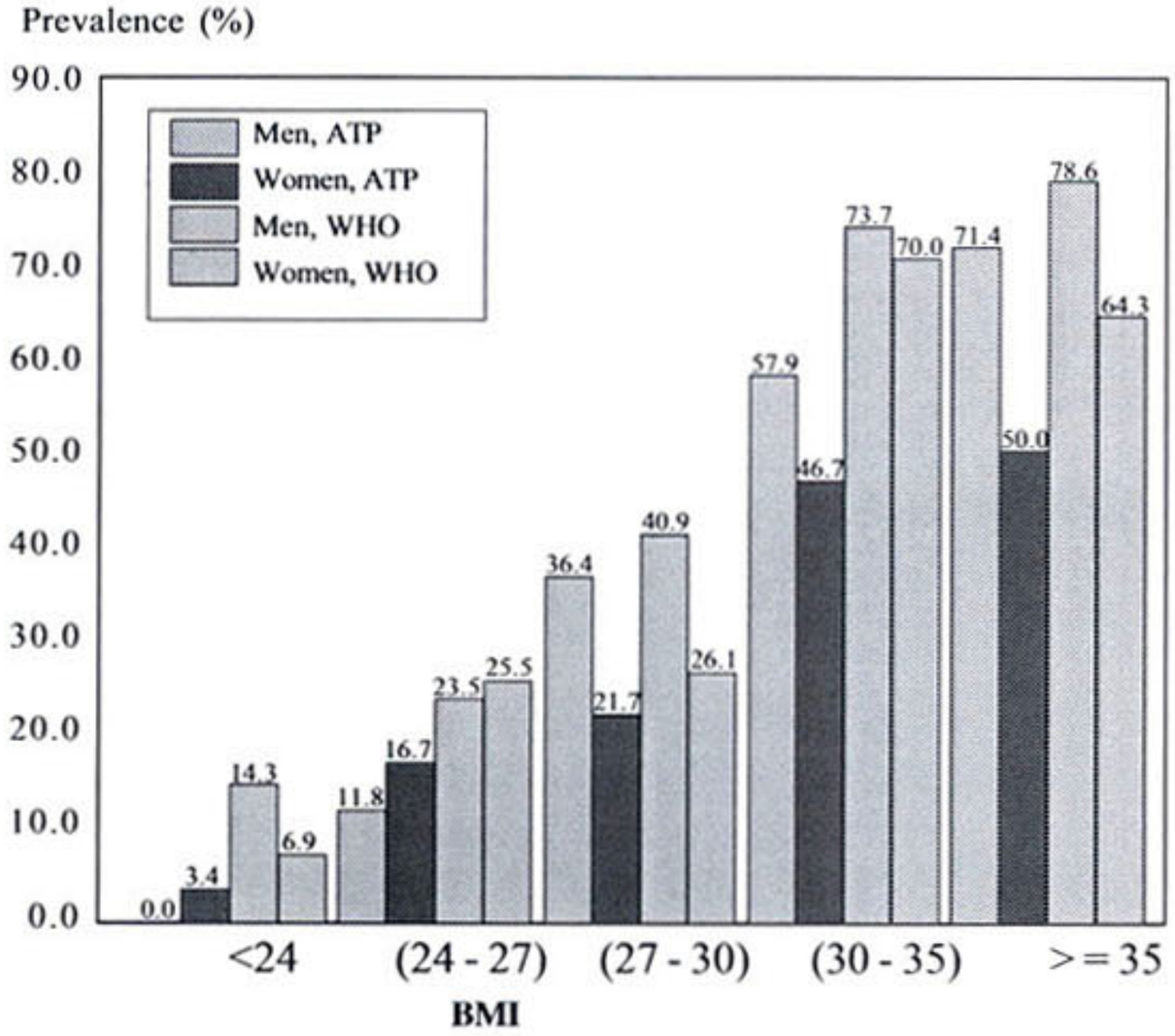


Figure 1. Prevalence (%) of Metabolic Syndrome by Age and Sex

In men younger than 49 years old the most common component was hypertriglyceridemia, (P =0.003). In men older than 49 the most common component was arterial hypertension (P= 0.057), followed by impaired fasting blood sugar/diabetes, hypertriglyceridemia and obesity. By the WHO criteria, the presence of hypertriglyceridemia and/or low HDL (P = 0.005) was the most common abnormality in younger men while diabetes was the most common abnormality in older men (P=.015).

Table 3- The relative frequencies of the individual components of the metabolic syndrome by sex and BMI Obesity was equally prevalent in men and women but the P value was not statistically significant (P = 0.471). Diabetes or IFG were more prevalent in the participants older than 49 years (P = 0.015) and significantly more prevalent in men than women (P =0.001). Hypertension had the lowest prevalence by the WHO definition.

The most common component of the metabolic syndrome in men with BMI < 30 was hypertriglyceridemia, followed by hypertension. In men with BMI >30 the most common characteristic was obesity , followed by hypertriglyceridemia and impaired fasting glucose by the modified definition .The most common component of the metabolic syndrome in women with any BMI, was obesity, followed by low HDL, hypertension and impaired fasting blood sugar.

In this study, insulin resistance defined by the homeostasis model assessment (HOMA-IR) was not included. Other surrogate measures of insulin resistance such as, serum triglycerides and overweight status, considered strong markers of insulin resistance, have been included in this study.

Conclusions

The prevalence of the metabolic syndrome was high among a determined Puerto Rican population, as previously seen in other Hispanic populations due to the high prevalence of obesity and diabetes among Hispanics.

These results support the data obtained by the NHANES III, in which the reported prevalence of the metabolic syndrome among Mexican-Americans was 32% and the overall age-adjusted prevalence of the metabolic syndrome in the US population was 24%. (3). In our study, the aged-adjusted prevalence was 32% by ATP III, 11% by WHO and 33% by the modified definition.

The most common abnormality of the metabolic syndrome by the ATP III was hypertension for men and obesity for women. Hypertriglyceridemia was equally

Table 3. The Relative Frequencies of the Individual Components of the Metabolic Syndrome by Sex and BM

	BMI<30 Kg/m²	BMI≥30 Kg/m²	P value (BMI) <30 vs. ≥30 Kg/m²	BMI<30 Kg/m²	BMI≥30 Kg/m²	P value (BMI) <30 vs.≥30 Kg/m²
n(%)46	33		76	44		
ATP						
Waist circumference (man > 102 cm; women >88 cm)	10.9	60.6	< 0.000	38.2	95.5	< 0.000
Blood pressure ≥130/ 85 mmHg or medication use	19.6	45.5	0.014	11.8	29.5	0.016
Hypertriglyceridemia (≥150mg/dl)	37.0	48.5	0.060	15.8	36.4	0.010
Low HDL Cholesterol (men <40; women >50 mg/dl)	17.4	21.2	0.669	19.7	56.8	< 0.000
FPG(≥110mg/dl) or medication use	15.2	36.4	0.030	6.6	20.5	0.023
WHO						
Diabetes or IFG	15.2	36.4	0.030	6.6	20.5	0.023
Blood pressure ≥160/ ≥90 mmHg	6.5	15.2	0.268	2.6	6.8	0.269
Hypertriglyceridemia (≥150 mg/dl) or low HDL (men <35; women <39 mg/dl)	39.1	48.5	0.408	15.8	43.2	0.001

common in men and women. By WHO definition the most common component was hypertriglyceridemia; obesity was equally prevalent in men and women and diabetes/ IFG was greater in men older than 49 years. The least prevalent component was hypertension. By the modified criteria IFG was higher among men older than 49 years.

The prevalence of the metabolic syndrome increased with age in men and women, with a notorious rise after the third decade and sharp increase on the fifth decade. Aging changes in body mass, fat distribution and insulin resistance contribute to the development of this syndrome with age and its increased prevalence.

By ATP III definition hypertension was the commonest abnormality in men older than 49 years but overall obesity and hypertriglyceridemia by both definitions were highly prevalent at any age. Women presented the highest prevalence for low HDL cholesterol. All these factors are important prognostic criteria for coronary heart disease due to the atherogenic lipoprotein profile characterized by high triglyceride and low HDL cholesterol, more powerful predictors of insulin resistance than obesity, elevated blood pressure or IFG, and, in the presence of obesity, greatly increases the risk of coronary heart disease (2).

The ATP III showed the higher prevalence of the metabolic syndrome than the WHO definition, but the ATP III detected more cases of impaired fasting glucose than WHO definition. These results are important to consider identification of the metabolic syndrome, rather than consideration of the individual components for the risk assessment and treatment of patients due to the risk for CVD and mortality. Differences between the two definitions emerge and rise the questions: which one will detect more cases of metabolic syndrome? and would it be necessary to standardize one criteria instead of having two or three?. As an example in the population observed in this study, waist circumference detected more cases of obesity than BMI, however the combination of both doubles the results.

Because the metabolic syndrome was highly prevalent in middle aged and older adults, it is imperative that primary care and subspecialty physicians evaluate patients at regular intervals and intensify efforts at lifestyle modification to improve this insulin resistant state. Programs that focus on weight reduction, nutritional counseling and exercise will aim to decrease the frequency of this syndrome and may help achieve a healthier population and improve health care cost.

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