Geographic Variations of the International Diabetes Federation and the National Cholesterol Education Program–Adult Treatment Panel III Definitions of the Metabolic Syndrome in Nondiabetic Subjects

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OBJECTIVE — We have carried out international comparisons of the metabolic syndrome using the International Diabetes Federation (IDF) and National Cholesterol Education Program–Adult Treatment Panel III (ATP III) definitions. This analysis could help to discern the applicability of these definitions across populations.

RESEARCH DESIGN AND METHODS — Nondiabetic subjects aged 35–64 years were eligible for analysis in population-based studies from San Antonio (Mexican Americans and non-Hispanic whites, $n = 2,473$), Mexico City ($n = 1,990$), Spain ($n = 2,540$), and Peru ($n = 346$). κ Statistics examined the agreement between metabolic syndrome definitions.

RESULTS — Because of the lower cutoff points for elevated waist circumference, the IDF definition of the metabolic syndrome generated greater prevalence estimates than the ATP III definition. Prevalence difference between definitions was more significant in Mexican-origin and Peruvian men than in Europid men from San Antonio and Spain because the IDF definition required ethnic group–specific cutoff points for elevated waist circumference. ATP III and IDF definitions disagreed in the classification of 13–29% of men and 3–7% of women. In men, agreement between these definitions was 0.54 in Peru, 0.43 in Mexico City, 0.62 in San Antonio Mexican Americans, 0.69 in San Antonio non-Hispanic whites, and 0.64 in Spain. In women, agreement between definitions was 0.87, 0.89, 0.86, 0.87, and 0.93, respectively.

CONCLUSIONS — The IDF definition of the metabolic syndrome generates greater prevalence estimates than the ATP III definition. Agreement between ATP III and IDF definitions was lower for men than for women in all populations and was relatively poor in men from Mexico City.

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Abbreviations: ATP III, Adult Treatment Panel III; IDF, International Diabetes Federation; MCDS, Mexico City Diabetes Study; PIRS, Peruvian Insulin Resistance Study; SAHS, San Antonio Heart Study; SIRS, Spanish Insulin Resistance Study.

A table elsewhere in this issue shows conventional and Système International (SI) units and conversion factors for many substances.

Cardiovascular diseases accounted for 29.3% (16.7 of 57 million) of the world's deaths in 2002, and more than one-third of these deaths occured in middle-aged adults (1). Many cardiovascular risk factors are related to the adoption of a sedentary lifestyle (2). The metabolic syndrome is characterized by a clustering of central obesity, insulin resistance, glucose intolerance, hypertension, atherogenic dyslipidemia, hypercoagulability, and proinflammatory state (2). The etiology of the metabolic syndrome is unknown, but predisposing factors include aging, obesity, sedentary lifestyle, and genetics. This syndrome predicts cardiovascular disease and type 2 diabetes (3). However, concept and definition of the metabolic syndrome are subject to debate (4,5), including the applicability of a single definition to people of different ethnic origin (6).

The analysis of geographic variations of the metabolic syndrome could generate new insights since similar analyses on cardiovascular risk factors have improved our knowledge of cardiovascular disease (7). Studies on geographic variations of the metabolic syndrome are few (8–10). They are often difficult because of differences in aims, survey protocols, assessment period, and definition of the metabolic syndrome.

We examined two definitions of this syndrome, International Diabetes Federation (IDF) (6) and National Cholesterol Education Program–Adult Treatment Panel III (ATP III) definitions (11) in Mexican (Mexico and Texas), Peruvian Mestizo, and Europid (Texas and Spain) ethnic origin populations. We used original data from four population-based studies. These studies had similar aims (cardiovascular risk factors in middle-aged subjects), survey protocols, and time frame period of assessment (within 14 years). We limited our analysis to nondiabetic subjects, because diabetes could

inflate the prevalence of individual metabolic disorders masking differences in the pattern of metabolic disorders.

RESEARCH DESIGN AND METHODS

— The San Antonio Heart Study (SAHS) randomly sampled Mexican-American and non-Hispanic households from low-, middle-, and high-income neighborhoods of San Antonio, Texas. Men and nonpregnant women aged 25–64 years were enrolled in two phases (overall response rate 65.3%). A total of 3,682 subjects returned to follow-up: those from phase 1 between October 1987 and November 1990; those from phase 2, between October 1991 and October 1996 (12). We used SAHS follow-up data because the period of assessment was contemporary to that of the other three studies.

The Mexico City Diabetes Study (MCDS) randomly selected households from low-income neighborhoods of Mexico City between February 1990 and October 1992. A total of 2,282 men and nonpregnant women aged 35–64 years were enrolled (overall response rate 68.5%) (13).

The Spanish Insulin Resistance Study (SIRS) randomly sampled subjects from census tracts of small- and middle-size towns across Spain from March 1995 to April 1998. A total of 2,947 men and nonpregnant women aged 35–69 years completed survey questionnaires and examination (overall response rate 66.9%) (14).

Using a multistage, stratified sampling procedure by conglomerates, the Peruvian Insulin Resistance Study (PIRS) randomly sampled households from low-income coastal districts of Lima (Rimac, San Martin de Porres, and Los Olivos), Peru, in 1999. Mother tongue (Quechua) and skin color were used to identify Peruvian Mestizo subjects: those with Peruvian Indian ancestry mixed with Spanish and Japanese (15). A total of 838 Peruvian Mestizo men and nonpregnant women aged ≥30 years were enrolled (overall response rate 73%), and 612 of those subjects had complete laboratory data.

Acquisition of data and definition of variables

Laboratory procedures for SAHS and MCDS were carried out in the Division of Clinical Epidemiology Laboratory in San Antonio (12,13), for SIRS in Fundación Jiménez Díaz in Madrid (14), and for PIRS in Universidad Cayetano Heredia in Lima. Plasma glucose was measured by the glucose oxidase method and triglycerides and total and HDL cholesterol by enzymatic analytical chemistry.

Diabetes was diagnosed by the 1997 American Diabetes Association definition for epidemiological studies (fasting glucose ≥7.0 mmol/l or pharmacological treatment for diabetes [16]). ATP III–defined metabolic syndrome required at least three of the following criteria (11): elevated waist circumference (>102 cm in men, >88 cm in women), hypertriglyceridemia (≥1.7 mmol/l), low HDL cholesterol (<1.0 mmol/l in men, <1.3 mmol/l in women), high blood pressure (≥130/85 mmHg or pharmacological treatment for hypertension), and elevated fasting plasma glucose (≥5.6 mmol/l).

For the IDF definition of metabolic syndrome, elevated waist circumference was always required and ethnicity-specific cutoff points (>94 cm in Europid men from San Antonio and Spain, >90 cm in men of Mexican and Peruvian Mestizo ethnic origin, and >80 cm in women in all regions) were used (6). In addition to elevated waist circumference, the IDF definition required at least two of the following criteria: hypertriglyceridemia (≥1.7 mmol/l), low HDL cholesterol (<1.0 mmol/l in men, <1.3 mmol/l in women), high blood pressure (≥130/85 mmHg or pharmacological treatment for hypertension), and elevated fasting plasma glucose (≥5.6 mmol/l). Our datasets lacked information regarding specific treatment for hypertriglyceridemia and low HDL cholesterol level.

Statistical analysis

Statistical analyses were performed with the SAS statistical software (SAS Institute, Cary, NC). We examined descriptive statistics of the characteristics and unadjusted prevalence of the metabolic syndrome in nondiabetic men and women aged 35–64 years in each population. Subsequently, we estimated BMI adjusted for age by one-way ANOVA and the prevalence of the metabolic syndrome (or each of the disorders) also adjusted for age by logistic regression analysis. We applied the κ statistic to analyze statistical agreement between ATP III and IDF definitions of the metabolic syndrome. We used Spearman correlation coefficients to assess the relationship between prevalence of the metabolic syndrome and prevalence of individual metabolic disorders across populations. All probability values were two sided.

RESULTS

— We limited our analysis to nondiabetic subjects aged 35–64 years (n = 2,473 in SAHS, 1,990 in MCDS, 2,540 in SIRS, and 346 in PIRS). However, the age-adjusted prevalence of type 2 diabetes in men aged 35–64 years was 8.8% in Lima, 11.1% in Mexico City, 11.4% in San Antonio Mexican Americans, 5.7% in San Antonio non-Hispanic whites, and 5.8% in Spain. The prevalence in women was 6.3, 11.3, 13.3, 3.6, and 3.9%, respectively.

Each population had a characteristic profile of risk factors (Table 1). Triglyceride levels were high and HDL and total cholesterol levels were particularly low in Mexico City. HDL cholesterol levels were also low in San Antonio. Blood pressure, fasting glucose levels, and HDL and total cholesterol levels were high in Spain. Blood pressure and total cholesterol levels were low and HDL cholesterol levels were high in Peru. BMI was particularly high in women of Mexican ethnic origin and Mexican-American men. BMI was also high in women from Peru and Spain. Relative to the mean level of BMI, waist circumference was low in Mexican Americans from San Antonio and high in non-Hispanic white men from San Antonio and women from Mexico City. Cigarette smoking was more frequent in Spain and Mexico than in San Antonio.

The pattern of individual metabolic disorders was similar to the profile of risk factors (Table 2). The metabolic syndrome was very prevalent in Mexican ethnic origin populations. The IDF definition of the metabolic syndrome generated greater prevalence estimates than the ATP III definition. Prevalence differences between ATP III– and IDF-defined metabolic syndrome were more significant in men of Mexican and Peruvian Mestizo ethnic origin than in Europid men from San Antonio and Spain.

Men had a lower prevalence of ATP III–defined metabolic syndrome than women in Lima (P = 0.001), Mexico City ($P < 0.001$), and Spain ($P < 0.001$) (Table 2). In San Antonio, men and women had similar prevalence of ATP III–defined metabolic syndrome among Mexican Americans (P = 0.129) and non-Hispanic whites (P = 0.238). Men had a lower prevalence of IDF-defined metabolic syndrome than women in Mexico City (P = 0.002) and Spain (P = 0.002) and a similar prevalence in Peru (P = 0.464). In San Antonio, men had a higher prevalence of IDF-defined metabolic syndrome than women among Mexican Americans

Table 1—*Descriptive characteristics of nondiabetic participants aged 35–64 years*

Characteristic	Lima, Peru	Mexico City	San Antonio Mexican Americans	San Antonio non-Hispanic whites	Spain
Men					
n	104	821	643	400	1,134
Age (years)	47.5 ± 8.4	46.6 ± 8.1	49.0 ± 8.4	49.5 ± 8.4	48.5 ± 8.5
BMI (kg/m^2)	26.5 ± 3.8	27.0 ± 3.5	28.8 ± 4.9	27.7 ± 4.4	27.4 ± 3.6
Waist circumference (cm)	93.2 ± 9.2	93.9 ± 9.8	98.1 ± 11.1	98.8 ± 11.3	95.7 ± 10.0
Triglyceride level (mmol/l)	1.68 ± 0.90	2.78 ± 2.00	2.06 ± 1.49	1.78 ± 1.26	1.52 ± 0.97
HDL cholesterol level (mmol/l)	1.32 ± 0.44	0.78 ± 0.22	1.02 ± 0.29	1.04 ± 0.29	1.19 ± 0.32
LDL cholesterol level (mmol/l)	2.88 ± 1.28	3.00 ± 0.93	3.60 ± 0.95	3.61 ± 0.97	3.92 ± 0.99
Total cholesterol level (mmol/l)	4.94 ± 1.28	4.92 ± 1.05	5.51 ± 1.10	5.42 ± 1.05	5.80 ± 1.09
Systolic blood pressure (mmol/l)	118.0 ± 16.0	119.7 ± 16.4	125.5 ± 15.9	122.8 ± 13.9	126.1 ± 18.3
Diastolic blood pressure (mmol/l)	73.9 ± 11.1	77.4 ± 29.3	75.9 ± 9.6	73.5 ± 8.7	79.7 ± 11.7
Fasting plasma glucose level (mmol/l)	4.93 ± 0.76	4.76 ± 0.70	5.10 ± 0.64	5.02 ± 5.7	5.18 ± 0.68
Treatment for hypertension*	18.2	16.7	43.2	62.0	21.3
ATP III–defined metabolic syndrome	11.5 (6.7–19.2)	31.9 (28.8–35.2)	32.5 (29.0–36.2)	29.3 (25.0–33.9)	22.3 (20.0–24.8)
IDF-defined metabolic syndrome	26.0 (18.4–35.2)	54.4 (51.0–57.8)	46.3 (42.5–50.2)	38.3 (33.6–43.1)	27.7 (25.2–30.4)
Current cigarette smoking	N/A	51.8 (48.4–55.2)	26.1 (22.8–29.6)	17.8 (14.4–21.9)	46.1 (43.2–49.0)
Women					
n	242	1,169	507	923	1,406
Age (years)	45.7 ± 8.3	46.5 ± 7.9	48.8 ± 8.2	49.7 ± 8.4	48.7 ± 8.5
BMI (kg/m^2)	27.1 ± 4.7	28.8 ± 4.7	29.3 ± 6.2	26.5 ± 5.8	27.9 ± 4.9
Waist circumference (cm)	92.0 ± 12.9	98.3 ± 13.4	93.4 ± 15.9	87.6 ± 15.3	93.9 ± 12.4
Triglyceride level (mmol/l)	1.60 ± 0.84	2.04 ± 1.28	1.70 ± 1.11	1.47 ± 0.89	1.12 ± 0.61
HDL cholesterol level (mmol/l)	1.42 ± 0.35	0.90 ± 0.23	1.24 ± 0.34	1.30 ± 0.34	1.42 ± 0.34
LDL cholesterol level (mmol/l)	2.81 ± 1.17	3.10 ± 1.00	3.47 ± 1.00	3.43 ± 0.93	3.74 ± 0.94
Total cholesterol level (mmol/l)	4.96 ± 1.26	4.91 ± 1.14	5.45 ± 1.12	5.40 ± 1.04	5.66 ± 1.04
Systolic blood pressure (mmol/l)	115.2 ± 14.6	117.0 ± 18.6	121.4 ± 17.5	118.9 ± 15.7	126.4 ± 21.0
Diastolic blood pressure (mmol/l)	72.0 ± 11.7	73.9 ± 26.6	71.9 ± 9.0	71.3 ± 9.6	78.5 ± 12.0
Fasting plasma glucose level (mmol/l)	4.86 ± 0.76	4.73 ± 0.73	4.97 ± 0.62	4.77 ± 0.56	4.99 ± 0.70
Treatment for hypertension*	16.7	45.8	57.8	56.0	42.7
ATP II–defined metabolic syndrome	25.6 (20.5–31.5)	56.3 (53.4–59.1)	36.1 (33.0–39.2)	25.8 (22.2–29.8)	30.7 (28.4–33.2)
IDF-defined metabolic syndrome	28.1 (22.8–34.1)	61.0 (58.2–63.7)	41.0 (37.8–44.2)	28.8 (25.0–32.9)	33.6 (31.1–36.1)
Current cigarette smoking	N/A	20.6 (18.4–23.0)	13.6 (11.6–16.0)	15.7 (12.8–19.1)	18.6 (16.6–20.7)

Data are means ± SD or % (95% CI); *Percent of subjects with hypertension (≥140/90 mmHg or taking antihypertensive medications); N/A, not available.

($P = 0.037$) and non-Hispanic whites ($P = 0.002$).

ATP III and IDF definitions of the metabolic syndrome differed in classifying 14–30% of men and 3–7% of women (Fig. 1). Agreement between definitions was lower for men than for women in all populations and was particularly poor in men from Mexico City.

In comparisons between populations, the prevalence of the metabolic syndrome correlates better with prevalence of elevated waist circumference and dyslipidemia than with the prevalence of high blood pressure and elevated fasting glucose value (Table 3).

CONCLUSIONS — Criteria used in the ATP III and IDF definitions of the metabolic syndrome are quite similar except for elevated waist circumference. ATP III cutoff points for waist circumference, >102 cm in men and >88 cm in women, do not reflect the same level of BMI in both sexes. In the Third National Health and Nutrition Examination Survey, cutoff points for BMI that produce equal prevalence estimates of ATP III–defined metabolic syndrome are ≥29.2 kg/m^2 in men and ≥24.9 kg/m^2 in women (17). IDF recommends using lower cutoff points for waist circumference. As a result, prevalence differences in elevated waist circumference between men and women are less marked using IDF cutoff points than using ATP III cutoff points. Additionally, prevalence differences between IDF and ATP III definitions of elevated waist circumference are greater in men of Mexican and Peruvian Mestizo ethnic origin than among Europid men, because the IDF definition uses ethnic group–specific cutoff points.

The IDF definition produces greater prevalence estimates for metabolic syndrome than the ATP III definition, because IDF definition requires lower cutoff points for elevated waist circumference. Moreover, ATP III and IDF definitions agree in the classification of women as having metabolic syndrome more often than men. Therefore differences are higher in men, because ATP III and IDF cutoff points for waist circumference differ in men more than in women.

Whether any current definition of the metabolic syndrome can outperform the others as a marker for increased risk of cardiovascular disease and diabetes is unresolved. This question is at the center of current controversies (4,5) but requires prospective data. Therefore we cannot determine in this study which definition is better, IDF or ATP III. However, the IDF definition is not satisfactory in Mexico City, since 94.4% of the women have el-

Table 2—*Age-adjusted BMI and prevalence of the metabolic syndrome (or individual metabolic disorders) in nondiabetic participants aged 35–64 years*

Characteristic	Lima, Peru	Mexico City	San Antonio Mexican Americans	San Antonio non-Hispanic whites	Spain
Men					
BMI (kg/m^2)	26.5 ± 0.4	27.0 ± 0.1	28.8 ± 0.2	27.7 ± 0.2	27.4 ± 0.1
Elevated waist circumference using ATP III cutoff points	15.4 (9.7–23.7)	16.0 (13.7–18.7)	28.7 (25.4–32.4)	33.7 (29.3–38.5)	22.1 (19.8–24.6)
Elevated waist circumference using IDF cutoff points	63.4 (53.7–72.2)	66.4 (63.0–69.5)	78.2 (74.8–81.3)	65.5 (60.7–70.1)	54.7 (51.8–57.6)
Hypertriglyceridemia	38.3 (29.5–47.9)	69.6 (66.3–72.7)	49.7 (45.8–53.5)	39.8 (35.1–44.7)	29.7 (27.1–32.4)
Low HDL cholesterol levels	25.7 (18.3–35.0)	88.6 (86.3–90.6)	56.4 (52.5–60.2)	58.4 (53.5–63.2)	30.8 (28.2–33.6)
High blood pressure	30.7 (22.4–40.4)	30.9 (27.7–34.3)	40.1 (36.3–44.1)	32.9 (28.4–37.7)	46.3 (43.3–49.3)
Elevated fasting glucose levels	19.3 (12.8–28.1)	12.0 (10.0–14.5)	21.6 (18.6–24.9)	15.8 (12.6–19.7)	28.3 (25.8–31.0)
ATP III–defined metabolic syndrome	11.6 (6.7–19.3)	32.6 (29.4–35.9)	32.0 (28.5–35.7)	28.5 (24.3–33.1)	22.0 (19.7–24.5)
IDF-defined metabolic syndrome	26.1 (18.5–32.3)	55.6 (52.1–59.0)	45.8 (41.9–49.7)	37.3 (32.7–42.1)	27.3 (24.8–30.0)
Women					
BMI (kg/m^2)	27.3 ± 0.3	28.9 ± 0.1	29.2 ± 0.2	26.4 ± 0.2	27.9 ± 0.1
Elevated waist circumference using ATP III cutoff points	60.8 (54.4–66.9)	81.0 (78.6–83.1)	57.5 (54.2–60.8)	39.9 (35.6–44.3)	64.1 (61.5–66.6)
Elevated waist circumference using IDF cutoff points	85.5 (80.8–89.2)	94.4 (93.0–95.5)	78.5 (75.6–81.0)	62.9 (58.4–67.1)	85.9 (84.0–87.7)
Hypertriglyceridemia	36.7 (30.7–43.2)	54.9 (52.0–57.8)	36.1 (33.0–39.3)	26.5 (22.9–30.5)	12.2 (10.6–14.0)
Low HDL cholesterol levels	33.7 (28.0–39.9)	94.2 (92.7–95.4)	61.9 (58.7–65.0)	54.9 (50.5–59.2)	35.8 (33.4–38.4)
High blood pressure	25.3 (19.8–31.7)	26.7 (24.1–29.6)	27.7 (24.8–30.8)	23.5 (20.0–27.5)	44.9 (42.1–47.7)
Elevated fasting glucose levels	23.0 (18.0–28.8)	13.2 (11.4–15.3)	15.2 (13.0–17.6)	8.8 (6.7–11.6)	21.0 (18.9–23.2)
ATP III–defined metabolic syndrome	27.3 (21.8–33.6)	59.2 (56.3–62.1)	34.2 (31.1–37.4)	22.7 (19.3–26.6)	28.8 (26.4–31.2)
IDF-defined metabolic syndrome	30.0 (24.3–36.4)	64.0 (61.2–66.8)	39.3 (36.1–42.5)	25.7 (22.0–29.6)	31.7 (29.3–34.2)

Data are means ± SE or % (95% CI).

evated waist circumference and 94.2% have low HDL cholesterol. IDF-defined metabolic syndrome is therefore mostly determined in women by the presence of any one of the other three factors.

In comparisons between populations, the prevalence of the metabolic syndrome correlates better with the prevalence of elevated waist circumference and dyslipidemia than with the prevalence of high blood pressure and elevated fasting glucose values. These results have to be seen with caution, because we have used a limited number of observations (men and women from five different populations). Nevertheless, they are in agreement with Meigs et al.'s (18) hypothesis on clustering of the components of the metabolic syndrome: there is a basic physiological domain, central metabolic syndrome (characterized by hyperinsulinemia, dyslipidemia, and obesity), with additional physiological abnormalities that predispose to glucose intolerance and hypertension. The lack of correlation between prevalences of the metabolic syndrome and hypertension across populations is not surprising. Hypertension is the most controversial component of the metabolic syndrome (18,19). In contrast, the lack of correlation between prevalences of the metabolic syndrome and elevated fasting glucose is unexpected and suggests that the conversion rate to diabetes in a given population is influenced by the prevalence of the metabolic syndrome.

The metabolic syndrome in Mexican Americans is more prevalent than in non-Hispanic whites (10,20). Greater insulin resistance in Mexican Americans (21) and differences in diet (22) explain partially differences in the pattern of metabolic disorders. On the other hand, the prevalence of the metabolic syndrome in Mexico City is higher than what is expected for the level of BMI alone. Subjects in Mexico City have a high prevalence of hypertri-

Table 3—*Spearman correlation coefficients* between prevalence of the metabolic syndrome and prevalence of individual metabolic disorders across populations†*

	Prevalence of ATP III–defined metabolic syndrome	Prevalence of IDF-defined metabolic syndrome
Prevalence of elevatedwaist circumference using ATP III cutoff points	0.47 ($P = 0.205$)	0.57 ($P = 0.112$)
Prevalence of elevated waist circumference using IDF cutoff points	0.70 ($P = 0.036$)	0.80 ($P = 0.009$)
Prevalence of hypertriglyceridemia	0.72 ($P = 0.029$)	0.79 ($P = 0.011$)
Prevalence of low HDL cholesterol	0.91 ($P < 0.001$)	0.86 ($P = 0.003$)
Prevalence of high blood pressure	0.12 ($P = 0.752$)	0.12 ($P = 0.764$)
Prevalence of elevated fasting glucose	−0.34 ($P = 0.363$)	−0.24 ($P = 0.534$)

*Sex was considered a partial variable. †Men and women were considered separately.

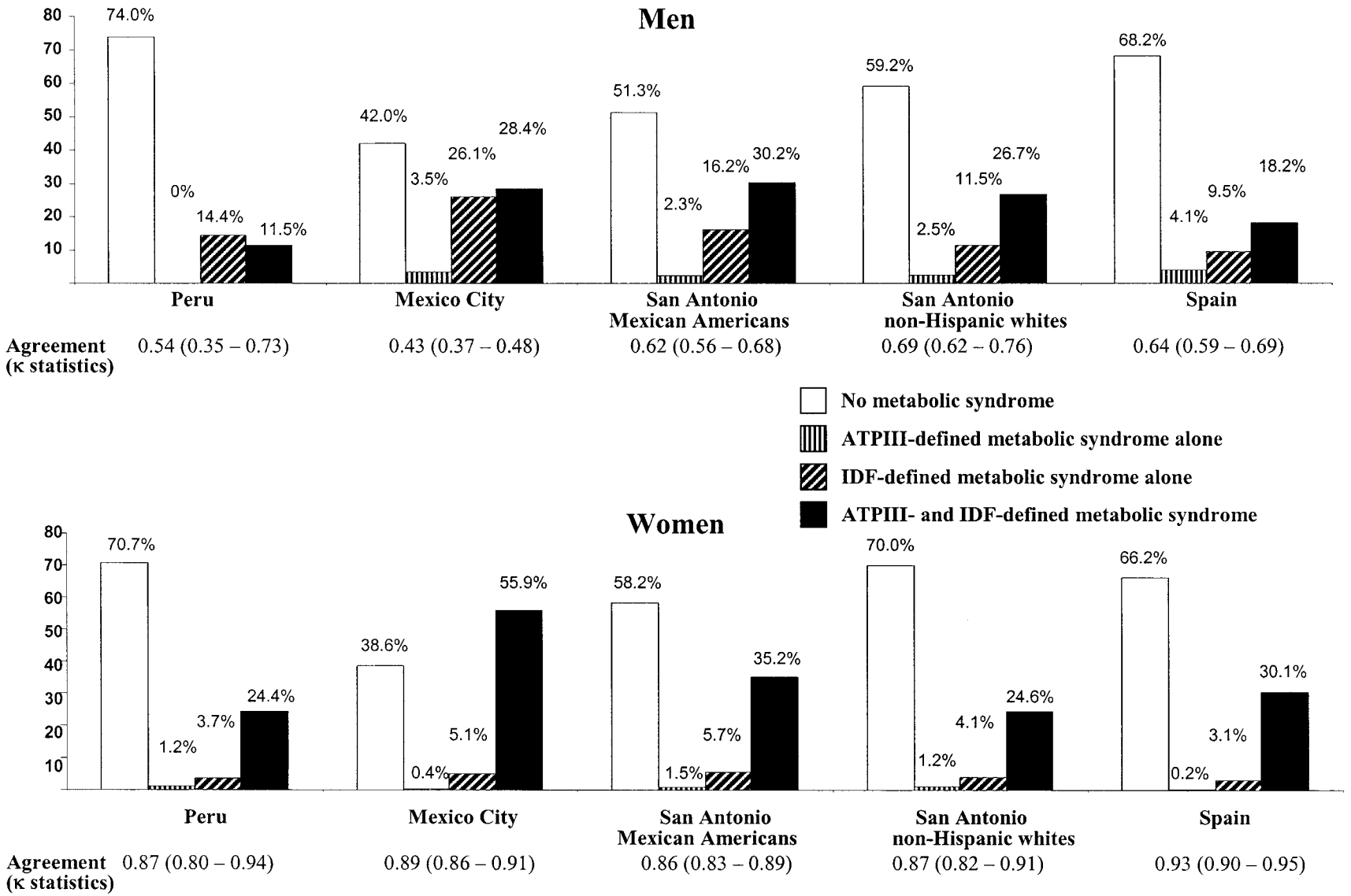

Figure 1—*Agreement between ATP III and IDF definitions of the metabolic syndrome.*

glyceridemia and low HDL cholesterol. We have previously described that differences in hypertriglyceridemia and low HDL cholesterol between both Mexican ethnic origin populations are due not so much to insulin resistance but to diet (23). Fat consumption is lower in Mexico City than in San Antonio (18 vs. 31% of the daily caloric intake) and carbohydrate consumption is greater in Mexico City (64 vs. 49%).

Although studies in Mexico City and Lima target residents in low-income neighborhoods, the prevalence of the metabolic syndrome is lower in Lima because of the lower rates of hypertriglyceridemia and low HDL cholesterol. Differences in hypertriglyceridemia and low HDL cholesterol cannot be explained by diet. Although dietary data are not available in PIRS, Sacco et al. (24) have described macronutrient composition in poor neighborhoods of Lima (fat intake 17% and carbohydrate consumption 68% of the daily caloric intake), which is similar to that in Mexico City (23). Nevertheless, wide CIs in PIRS call for caution, particularly in men. The number of men eligible for analysis is relatively small due to job-related obstacles for recruitment and age range limits for comparisons.

Dietary fat consumption may partially account for differences in total and LDL cholesterol levels across populations. Total and LDL cholesterol levels are highest in Spain probably because of the high fat intake (41.5% of the daily caloric intake), and HDL cholesterol levels are too because of the high monounsaturated and polyunsaturated fat consumption (18.8 and 6.8% of the daily caloric intake, respectively) (25). Blood pressure is high in Spain as well as in other European countries. Hypertension prevalence is 60% higher in European countries than in the U.S. and Canada (26). Blood pressure is also relatively low in Mexican origin (13,14) and Peruvian Mestizo populations. Adiposity is more centrally distributed in women from Mexico City, Lima, and Spain relative to San Antonio counterparts. This distribution pattern is not evident in men. However, longitudinal studies are needed to support the use of South Asian cutoff points for waist circumference in ethnic Mexicans and Peruvian Mestizos.

In summary, we have addressed the absence in the medical literature of international comparisons of the metabolic syndrome and a simultaneous analysis of the ATP III and IDF definitions. Our results demonstrate that these definitions differ more in classifying men than in classifying women. They also suggest, because our analysis cannot provide causal explanations, that prevalence differences in the metabolic syndrome between Europid and Latin American populations appear to exceed differences in obesity, insulin resistance, and macronutrient composition. Furthermore, our study sheds some light on two additional queries behind the IDF Epidemiology Task Force's rationale (6). First, there is insufficient information for selecting waist circumference cutoff points among ethnic South and Central Americans. They are considered equal to South Asians, because all have a higher risk of type 2 diabetes at much lower levels of adiposity than Europeans. Our results indicate that the IDF definition might not be satisfactory in Mexico City because of the very high prevalence in women of elevated waist circumference and low HDL cholesterol. Second, there is a need to study how blood pressure relates to the other components of the metabolic syndrome. In our study, the relationship between prevalences of the metabolic syndrome and high blood pressure (or elevated fasting glucose levels) is subject to more variability across populations than the relationship between prevalences of the metabolic syndrome and elevated waist circumference (or dyslipidemia).

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