Prevalence of Metabolic Syndrome in the Spanish Working Population: MESYAS Registry

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Introduction and objectives. To assess the prevalence of metabolic syndrome in the active Spanish working population and to describe differences related to work type.

Subjects and method. Data were collected on 7256 individuals [82.4% male; mean age (SD), 45.4 (9.8) years] actively employed in a large car factory and a department store. Metabolic syndrome was diagnosed according to modified ATP-III criteria (using body mass index instead of waist circumference).

Results. Overall, the prevalence of metabolic syndrome was 10.2%. When data were adjusted to match the age and gender of the general population (age range, 20-60 years), the prevalence was 5.8% (95% CI, 4.1%-7.6%). Moreover, it was significantly higher in men than women, at 8.7% (95% CI, 7.3%-10.0%) vs 3.0% (95% CI, 0.8%-5.1%), respectively. All the components of the metabolic syndrome were significantly more common in males, except a low HDL-cholesterol level. Prevalence increased with age and male gender (OR=1.7), obesity (OR=9.6), hypertension (OR=3.4), and diabetes (OR=15.4). The prevalence was highest in manual workers (11.8%), and lower in office workers (9.3%) and managers (7.7%),

which indicates an inverse relationship with social class. The likelihood of presenting with metabolic syndrome, irrespective of age or gender, was highest in manual workers (OR=1.3). This phenomenon seemed to depend on the serum triglyceride level.

Conclusions. One in ten active workers had metabolic syndrome. The prevalence rose with age, male gender, and blood pressure, and was greatly increased by obesity and diabetes. Manual workers had the highest prevalence, whereas managers had a more favorable profile.

Key words: *Prevalence. Metabolic syndrome. Working population.*

Prevalencia del síndrome metabólico en población laboral española: registro MESYAS

Introducción y objetivos. Estudiar la prevalencia del síndrome metabólico (SM) en la población laboral activa española y analizar sus diferencias según las categorías laborales.

Sujetos y método. Se recogieron los datos de 7.256 trabajadores activos (un 82,4% varones), con una edad media de 45,4 ± 9,8 años, empleados en una factoría de coches y unos grandes almacenes. El diagnóstico del SM se realizó mediante los criterios modificados del ATP-III (se utilizó el índice de masa corporal en lugar del perímetro abdominal).

Resultados. La prevalencia bruta del SM fue del 10,2%. Ajustada por edad y sexo en una población plana (20-60 años) fue del 5,8% (intervalo de confianza [IC] del 95%, 4,1-7,6%), significativamente más alta en varones que en mujeres (el 8,7%; IC del 95%, 7,3-10,0 frente al 3,0%; IC del 95%, 0,8-5,1). Todos los componentes del SM fueron significativamente más prevalentes en varones, excepto las concentraciones de lipoproteínas de alta densidad, que fueron más bajas. La prevalencia aumentó con la edad y el sexo masculino (*odds ratio* [OR] = 1,7), la obesidad (OR = 9,6), la hipertensión (OR = 3,4) y la diabetes (OR = 15,4). Los trabajadores manuales presentaron la mayor prevalencia de SM (11,8%), seguidos por los trabajadores de oficina (9,3%) y los directivos (7,7%)

ABBREVIATIONS

HDL: high-density lipoprotein.
LDL: low-density lipoprotein.
CVRF: cardiovascular risk factors.
BMI: body mass index.
BP: blood pressure.
MS: metabolic syndrome.

(gradiente social inverso). Los trabajadores manuales tienen un riesgo superior de presentar SM, con independencia de la edad y el sexo (OR = 1,3); este efecto parece depender de las concentraciones de triglicéridos.

Conclusiones. Uno de cada 10 trabajadores activos tiene SM; la prevalencia aumenta con la edad y el sexo masculino. La obesidad y la diabetes suponen gran incremento de la prevalencia. Los trabajadores manuales son el colectivo con mayor prevalencia.

Palabras clave: *Prevalencia. Síndrome metabólico. Población laboral.*

INTRODUCTION

Since cardiovascular risk factors (CVRF) were first identified, the principal goal regarding prevention and treatment strategies has been to describe the prevalence of these factors.[1,2] Several different CVRF usually appear together in the same person. At the end of the 1980s, Reaven[3] described the metabolic syndrome (MS) as the combination of different clinical features with a common pathophysiological nexus: insulin resistance. Later studies have shown the basic role of CVRF and insulin resistance in the course of atherosclerotic diseases. For instance, ischemic heart disease is known to be the main cause of death and disease in persons who have MS.[4]

The prevalence of CVRF has been widely studied, especially since the publication of the findings from the Framingham study. However, the prevalence of MS and its impact on cardiovascular diseases, although simple to diagnose,[5] has not yet been clearly described. The results of the third National Health and Nutrition Examination Survey (NHANES III) showed an alarming prevalence of the MS of 24%, which rose to 42% among women older than 60 years of age.[6] Ot-

her cohorts from America[7,8] and Europe[9,10] have confirmed these findings.

MS has been consistently associated with CVRF and it has received increasing interest since the description of its close correlation with new markers of atherosclerotic disease and endothelial dysfunction, such as C-reactive protein,[8] microalbuminuria,[11] or vascular thickness and stiffness[12]; furthermore, the number of components of the MS is associated with the extension of coronary disease and its complications,[13] and MS has been proposed as the best integration of the analytical variables in patients who have had an acute myocardial infarction.[14] This increasing evidence has led prestigious expert committees from cardiology societies to formulate specific recommendations for the clinical management of patients with MS.[15]

Although much information exists in Spain about CVRF,[16-21] less is available on MS. The high prevalence of insulin resistance and its important predictive value for the development of MS have been demonstrated.[22] The prevalence of MS in a community survey was 24%,[23] whereas another study reported the prevalence to be 8% among persons without ischemic heart disease and 41% among those who had ischemic heart disease.[24] These data, related to both the prevalence of MS and insulin resistance, were corroborated by a recent study.[25] Moreover, a new study now shows that the presence of MS increases cardiovascular risk in diabetics.[26]

These data, however, are probably not fully representative of the population of Spain. The MESYAS (MEtabolic SYndrome in Active Subjects) Registry developed the idea of clarifying the prevalence of MS in a large population sample from Spain. It was decided to include employed persons due to their accessibility via company benefit organizations; and it included an age range with a higher incidence of cardiovascular diseases. Furthermore, it is within this group that the number of potential years of life lost, days off work, or illness have more social and economic relevance. Later stages of the MESYAS Registry, which have already been designed, aim to undertake a prospective evaluation of the incidence of the MS and its specific impact on cardiovascular disease. This report presents the prevalence data for the first workers studied, together with their association with MS and their different jobs performed.

SUBJECTS AND METHOD

Selection and Inclusion and Exclusion Criteria

The description of the prevalence of MS in the MESYAS Registry was planned as a cross-sectional, epidemiological study. The workers were selected from annual medical checkups given during 2003 by

the benefit organizations of the 2 separate institutions: el Corte Inglés in Valencia (mostly shop and office workers) and the Ford factory in Almussafes, Valencia (with manual labor workers, supervisors, and managers). The prevalence of the CVRF in the second of these cohorts has already been published.[16]

Data concerning the annual medical checkups were available for 8169 workers. We excluded 913 workers whose data lacked some of the laboratory measurements required for the diagnosis of MS. The final analysis therefore included 7256 persons (88.8%).

Data Collection and Diagnosis of the Metabolic Syndrome

We designed a uniform database for the collection of data from both benefit organizations. All persons included, as well as the chief representatives of the companies, signed an informed consent document in which they approved the use of their data, with the guarantee of anonymity, and with no chance of being identified by name, worker number or any other such information. The protocol was passed by the ad hoc ethics committee of the Section of Preventive Cardiology of the Spanish Society of Cardiology.

A person was considered to have MS if 3 of the following 5 diagnostic criteria were present (modified ATP-III)[5]: body mass index (BMI) >28.8; blood pressure (BP) ≥130/85 mm Hg; high-density lipoprotein (HDL) cholesterol <40 mg/dL in men or <50 mg/dL in women; triglycerides ≥150 mg/dL; baseline fasting blood glucose ≥110 mg/dL, or receiving antidiabetic treatment, or the presence of previously diagnosed diabetes mellitus. Abdominal obesity was measured using a BMI≥28.8 instead of the abdominal circumference, a modification that has already been validated in large cohorts.[8,9] An oral glucose tolerance test was given to all persons with an altered glucose level (from 110-125 mg/dL) in order to make a correct diagnosis of diabetes.

Blood samples were drawn after a 12 hour fast and processed in the same laboratory. The concentration of low density lipoprotein (LDL) cholesterol was obtained from the Friedewald equation and the non-HDL cholesterol, by calculating the total cholesterol minus the HDL cholesterol. The pulse pressure was obtained by calculating the difference between the systolic BP and the diastolic BP; the mean BP was calculated as one third of the sum of the systolic BP plus double the diastolic BP. Smoking was classified as follows: active smokers, ex smokers (those who had quit smoking more than one year prior to entering the registry), and non-smokers. According to their position, the participants were classified as manual laborers, office or customer service workers, and managers, in accordance with the level of physical exercise and preparation required to perform the job.[16]

Statistical Study

The data were analyzed using Access 2000 and SPSS 11.0 programs. The quantitative variables are presented as the mean ± standard deviation (SD); all variables were considered normal. Adjustment for prevalence and means was made in a simple population, with an age distribution by decade. The Student t and the χ^2 tests were used to evaluate the statistical differences between the characteristics of the participants, with the variance analysis of 1 factor to account for the differences among the job categories. The odds ratio (OR) was calculated by a multivariate, logistic regression analysis with the presence of the MS as the dependent variable and age and sex, together with the study variables (job category, obesity, hypertension), as covariables. The specific analyses state which variables were included. Values were considered to be statistically significant if the P was ≤05.

RESULTS

Prevalence of the Metabolic Syndrome

Of the 7256 persons included in the study, 82.4% were men and the mean age was 45.4±8.9 years. Table 1 shows the general characteristics of the participants, as well as the means of the CVRF and the different components of the MS. The men were significantly older than the women.

The overall prevalence of MS was 10.2% (743 of the 7256 workers; 95% confidence interval [CI], 9.6%-10.8%); after adjusting for age and sex, the prevalence was 5.8% (95% CI, 4.1%-7.6%), and it was significantly higher in men (8.7%; 95% CI, 7.3%-10.0%) than in women (3.0%; 95% CI, 0.8%-5.1%). The prevalence of the diagnostic criteria was: BP≥130/85 mm Hg in 40% of the workers; BMI≥28.8 in 28.5%; hypertriglyceridemia in 18.3%; low HDL cholesterol in 12.6%; and abnormal blood glucose levels in 7.5%. The workers with the MS were significantly older and more often male; they had higher levels of blood glucose, BMI, systolic BP, diastolic BP, pulse pressure, mean BP, total cholesterol, triglycerides, and non-HDL cholesterol, and lower levels of HDL cholesterol (P<.001 for all the differences). All the components of the MS were significantly more prevalent in the men from our sample, except the criteria for low HDL cholesterol, which was more common in the women (Figure 1). The numbers and percentages of persons who had some of the components of the MS were as follows: 2501 (34.5%) with no component, 2489 (34.3%) with 1 component, 1523 (21%) with 2 components, 589 (8.1%) with 3 components, 140 (1.9%) with 4 components, and just 14 persons (0.2%) with all 5 criteria.

TABLE 1. **General Characteristics of the Whole Sample and According to the Presence or Absence of the Metabolic Syndrome***

	Total (n=7256)	Without MS (n=6513)	With MS (n=743)	P†
Men, %	82.4	81.0	96.4	<.001
Age, years (mean±SD)	45.4±9.8	44.9±9.9	50.2±7.3	<.001
BMI, mean±SD	26.6±6.3	26.1±5.3	31.0±4.2	<.001
Blood pressure, mm Hg (mean±SD)				
Systolic BP	125.8±30.3	124.0±28.9	142.9±37.2	<.001
Diastolic BP	80.5±12.1	76.7±11.7	89.1±9.5	<.001
Pulse pressure	47.7±17.1	47.2±16.2	52.1±12.1	<.001
Mean BP	93.9±15.0	92.5±14.7	106.2±10.1	<.001
Baseline glucose, mg/dL (mean±SD)	90.5±21.0	88.2±15.7	112.7±40.5	<.001
Cholesterol, mg/dL (mean±SD)				
Total cholesterol	203.7±36.1	202.4±35.7	214.2±38.2	<.001
HDL cholesterol	49.8±8.0	50.2±7.8	46.2±8.4	<.001
LDL cholesterol	130.0±33.0	130.4±32.6	137.8±35.3	.251
Triglycerides, mg/dL (mean±SD)	117.6±73.3	109.6±62.7	193.2±108.2	<.001
Non-HDL cholesterol, mg/dL (mean±SD)	153.9±35.3	152.3±34.8	168.2±36.3	<.001
Smoking, %				
Non smokers	27.8	27.9	21.8	<.001
Smokers	51.4	51.9	48.5	.096
Ex smokers	20.8	20.2	29.7	<.001

*HDL indicates high-density lipoprotein; LDL, low-density lipoprotein; SD, standard deviation; BMI, body mass index; BP, blood pressure; MS, metabolic syndrome.
†Comparing the presence of the metabolic syndrome with the absence of the metabolic syndrome.

As shown in Figure 2, the prevalence of MS increased in parallel with age. Among persons younger than 60 years of age, MS was more common in the men, with no marked difference in those above this age.

After stratifying for BMI (Figure 3), the prevalence of MS increased markedly in persons with a BMI>30 (35% in men and 42.8% in women) or a BMI≥35 (43% in men and 57.2% in women). The women with a BMI≥35 had the greatest prevalence of the whole cohort (57.2%). Most persons in the study were normoglycemic, with only 3.5% having altered blood glucose levels and 4.2% diabetes mellitus. The greatest prevalence of MS was seen in the workers with diabetes (58.4%), followed by those with abnormal blood glucose levels (50.4%). The workers with normal blood glucose levels had a low prevalence of the MS
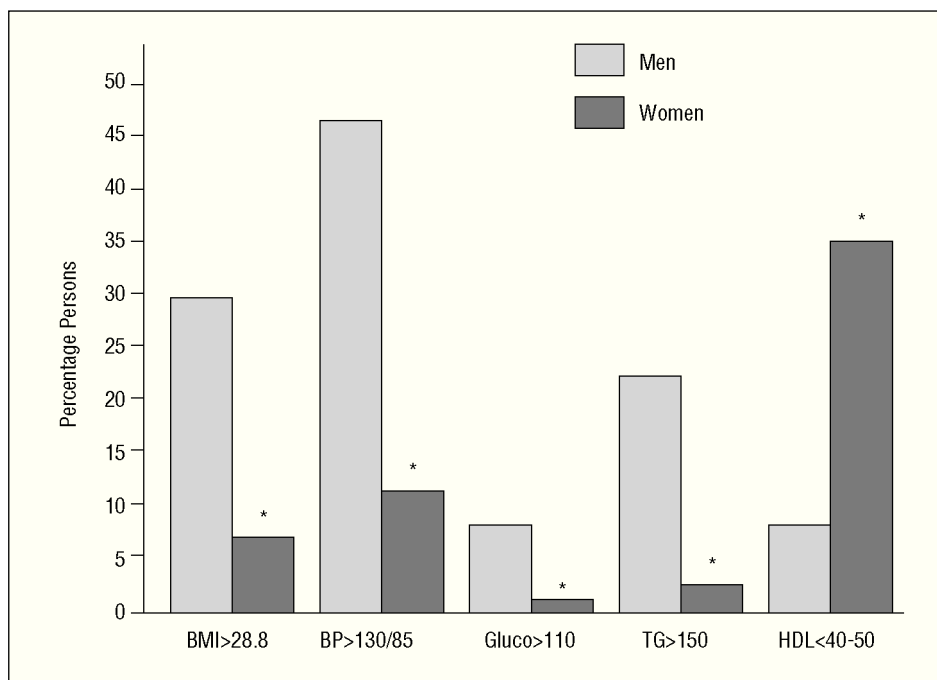

Figure 1. Percentage of persons with at least one of the 5 components of the metabolic syndrome, according to the modified ATP-III criteria.[5]
*P<.01 men versus women. BMI indicates body mass index; BP, blood pressure (mm Hg); Gluco, baseline glucose (mg/dL); HDL, high-density lipoprotein (mg/dL); TG, triglycerides (mg/dL).
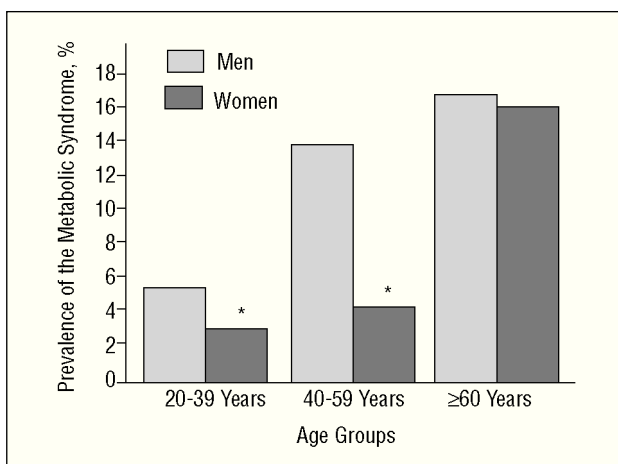
Figure 2. Prevalence of the metabolic syndrome according to age and sex.
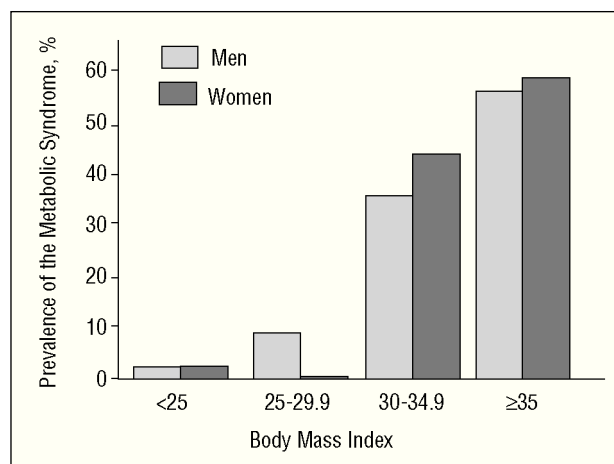*P<.01 men versus women.

Figure 3. Prevalence of the metabolic syndrome according to the body mass index.
P>.05 for all comparisons.

(6.5%).

In order to study the effect of high blood pressure, obesity, and diabetes on the presence of MS we undertook a multivariate, logistic regression analysis, adjusted for age and sex. The men had a higher tendency to have the MS (OR=3.2; 95% CI, 2.2-4.7) on the base model (age and sex). The independent incorporation to the base model of the different factors showed that, after adjusting for age and sex, the presence of high blood pressure (BP>140/90 mm Hg) conferred a high risk for the MS (OR=4.4; 95% CI, 3.85.2), although lower than the risk conferred by obesity (BMI>30) (OR=9.9; 95% CI, 8.4-11.8), with both these factors being lower than the risk conferred by diabetes (baseline blood glucose >126 mg/dL) (OR=11.1; 95% CI, 8.6-14.5). Figure 4 shows the increase in the prevalence of MS depending on the presence of obesity and high blood pressure. Table 2 gives the independent OR for each factor after considering the independent influence of each of these factors in a joint model adjusted for age as a continuous variable.
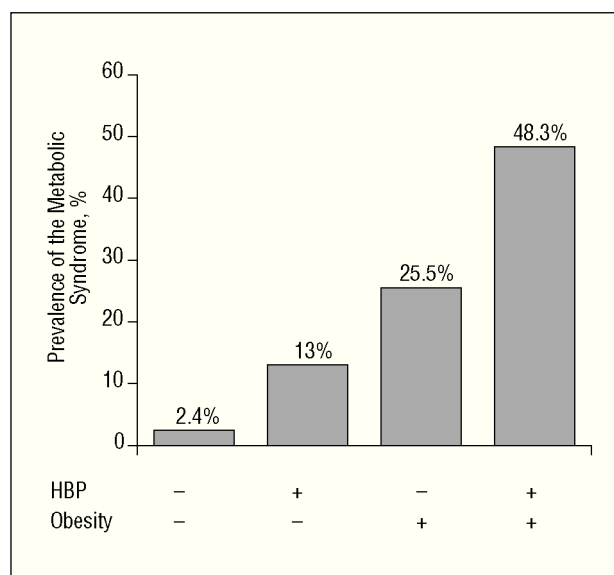
Job Category and the Metabolic Syndrome

Table 3 shows the overall characteristics of all the participants, classified according to the three job categories. The manual laborers, who represented two thirds of the total, were mainly men, were older, had a higher BMI, systolic BP, diastolic BP, and triglyceride concentrations, and were more often smokers. The office workers were the youngest, with both sexes equally represented, and had the highest HDL cholesterol, and lowest total cholesterol and non-HDL cholesterol levels of all the participants. The managers, who were also older and mainly men, were the group with the highest blood glucose, total cholesterol, and LDL cholesterol levels, whereas they were the group

Figure 4. Prevalence of the metabolic syndrome according to the presence of high blood pressure and obesity. HBP indicates high blood pressure; +, presence; −, absence.

that smoked least.

The crude prevalence of MS was 12.5% in the manual laborers, 7% in the managers, and 5.7% in the office workers. However, the age differences and sex proportion warranted adjustment of the prevalences and means. According to job category, the adjusted results were only calculated for the men ages 30-60 years, due to the low number of women and persons with ages above or below these limits in some categories. The prevalence of MS in men in the 30-60 year age range was 11.3 (95% CI, 9.8-12.7). The adjusted prevalences in each job category were as follows: manual laborers, 11.8 (95% CI, 10.2-13.4); office workers, 9.3 (95% CI, 6.1-12.5), and managers,

TABLE 2. Adjusted Odds Ratio of Having the Metabolic Syndrome*

	OR (95% CI)	P
Male	1.7 (1.1-2.6)	.010
High blood pressure	3.4 (2.8-4.1)	<.002
Obesity	9.6 (7.9-11.6)	<.001
Diabetes	15.4 (11.4-20.9)	<.003

*OR indicates odds ratio; CI, confidence interval.

7.7 (95% CI, 2.6-12.8). Despite the variation in the prevalence, the differences were not statistically significant because the 95% CI overlapped. The multivariate, logistic regression analysis of the influence of job category on the presence of MS, adjusted for age and sex, and considering an incremental influence (managers, office workers, and manual laborers), only showed significant differences in the last increment, probably owing to the low number of managers in the sample. We therefore calculated the influence considering the managers and office workers jointly, which showed that the fact of belonging to the category of manual laborer increased the likelihood of having MS (OR=1.3; 95% CI, 1.1-1.6) as compared with the other 2 job categories. Individual inclusion of the BMI, BP, or HDL cholesterol in the model failed to make the significance disappear, which did occur when the triglycerides were included, thus suggesting that the greater prevalence in the manual laborers depended on the differences in these concentrations.

Other Risk Factors and the Metabolic Syndrome

Over 50% of the sample was composed of active smokers. The prevalence of smoking was similar in the persons with and without MS. However, the workers with MS were more commonly ex smokers (30% vs 20%; *P*<.001). Although a similar percentage of men and women smoked, more men were ex smokers (24% vs 5%; *P*<.001).

Most of the participants were normoglycemic, with only 3.5% having an altered blood glucose level and 4.2% diabetes mellitus. Concerning this classification, the greatest prevalence of MS was found in workers with diabetes (58.4%), followed by those with abnormal blood glucose level (50.4%). The workers with normal blood glucose levels had a low prevalence of MS (6.5%). The multivariate analysis, adjusted for age, sex, and BP, showed that the risk for MS conferred by the presence of abnormal blood glucose levels was very high (OR=8.4; 95% CI, 6.6-11.0), although lower than that conferred by diabetes mellitus (OR=10.2; 95% CI, 7.8-13.4).

TABLE 3. Prevalence of the Metabolic Syndrome and its Components in the Study Population Classified Into 3 Job Categories*

	Manual (n=4841)	Office (n=2201)	Managers (n=214)	P
Total, %	66.8	30.3	2.9	
Men, %	97.0	50.2	84.6	<.001
Age, years (mean±SD)	47.5±8.9	41.0±10.4	45.0±8	<.001
Prevalence of MS, %	12.5	5.7	7.0	<.001†
BMI, mean±SD	31.9±2.2	24.7±3.7	25.7±3.2	.009†
Blood pressure, mm Hg (mean±SD)				<.001
Systolic BP	127.9±26.0	121.2±38.5	125.3±16.6	<.001†
Diastolic BP	80.2±11.4	73.2±12.1	76.2±11.4	<.001
Pulse pressure	47.6±18.7	47.7±13.6	49±10.8	.759
Mean BP	96 (13.2)	89.2±17.4	92.7±12.4	<.001
Baseline glucose, mg/dL (mean±SD)	90.5±22.5	90.4±17.6	92.7±15.7	.287
Cholesterol, mg/dL (mean±SD)				
Total cholesterol	205.4±35.7	199.4±35.9	211.3±42.2	<.001‡
HDL cholesterol	49.2±7.6	51.3±8.6	50.3±8.7	<.001†
LDL cholesterol	131.7±32.4	128.8±33.4	138.1±37.1	<.001
Triglycerides, mg/dL (mean±SD)	127.2±78.5	96.8±54.7	113.6±75	<.001
Non-HDL cholesterol, mg/dL (mean±SD)	156.2±34.6	148.1±35.3	161.4±41.2	<.001‡
Smoking, %				
Non smokers	20.7	41.2	50.4	<.001
Smokers	53.0	48.3	45.8	<.001
Ex smokers	26.3	10.5	3.8	<.001

*HDL indicates high-density lipoprotein; LDL, low-density lipoprotein; SD, standard deviation; BP, blood pressure; BMI, body mass index; MS, metabolic syndrome.
†Comparing the presence of the metabolic syndrome with the absence of the metabolic syndrome.
BMI, systolic BP and HDL cholesterol were only significant between manual workers and office workers.
‡The differences between total cholesterol and non-HDL cholesterol were not significant between manual workers and managers.
One-way, post-hoc ANOVA. Unless otherwise specified, the differences were significant between the 3 groups.

DISCUSSION

Prevalence of the Metabolic Syndrome

The MESYAS Registry describes the prevalence of MS in a large group of Spanish people. The results show that 1 in 10 active workers had the MS. Moreover, the prevalence of MS increased to 45% in certain subgroups of workers, despite the fact that the overall sample had low cardiovascular risk (with almost 70% of the subjects having none or only one component of the MS) as active workers who were supposedly healthy.

The most prevalent components of the MS in our study population were high blood pressure (44.4%) and a BMI>28.8 (25.5%), followed by hypertriglyceridemia (18.3%), low HDL cholesterol (13.6%) and altered blood glucose level (7.5%). Among the workers with MS, the most prevalent component was a BP>130/85 mm Hg (94.5%), although only 61.6% were truly hypertensive (BP>140/90 mm Hg). These results coincide with the findings of the WOSCOPS study, in which 95% of the participants who had MS fulfilled the criterion for high BP.[9] The finding of a small, but significant, difference in pulse pressure coincides with recent findings showing that the MS is accompanied by increased intima-media thickness and vascular stiffness.[12]

The prevalence of MS increased in parallel with increasing age and BMI, which agrees with all the large studies published to date.[6-9] The men had a significantly higher prevalence of MS in the age groups <60 years of age, though the difference disappeared above this age. This fact has not been previously reported and it agrees with the clinical experience that men have cardiovascular complications at earlier ages than women, who have these complications some 10 years later, or after menopause.

The increase in the number of overweight and obese persons in western countries and their association with cardiovascular diseases has led to the determination that these disorders are an important public health care problem of epidemic proportion[27]; the situation in Spain may well be similar if we consider the prevalence of overweight and obese persons in some series that were not specifically evaluating this fact.[16-18] The results of Ascaso et al[22] show the important predictive factor of abdominal obesity in the appearance of insulin resistance and MS. In our study we evaluated obesity from the BMI and saw that its presence considerably increased the prevalence of MS. Increased physical exercise, a balanced diet, and weight loss are the basic measures for the management of most CVRF, especially for MS.[28,29] The WOSCOPS study demonstrated the important predictive power of the MS in the onset of new cases of diabetes.[9] Adequate description and diagnosis of the MS thus assume more importance from a predictive viewpoint. Furthermore, the place of origin of our sample should also be considered. According to some of the most recent results from the IBERICA Study,[30] the autonomous community of Valencia is one of the areas with the highest rates of death and disease associated with acute myocardial infarction. These data are not at all promising and heighten interest in describing new risk factors and alternative preventive measures.

Assessment of the more atherogenic lipoproteins by calculating the non-HDL cholesterol has been shown to be highly predictive for cardiovascular death, even superior to valuation of the concentration of LDL cholesterol.[31] The workers with MS had far higher levels of non-HDL cholesterol, with the difference being much greater than that of other lipoproteins, such as LDL cholesterol or HDL cholesterol. Concentrations of apolipoprotein B have recently been shown to be associated with markers of insulin resistance and presence of MS.[32] The purpose of the MESYAS Registry is to describe the prevalence of MS and study the distribution of its components in a large sample of Spanish subjects, in an attempt to provide simple tools to identify this disorder. We believe that the calculation of non-HDL cholesterol is simple and will prove a useful enhancement to the daily systematic measurements for the evaluation of cardiovascular risk.

Other Risk Factors and the Metabolic Syndrome

The findings relating to the association between smoking and the prevalence of the MS are highly relevant. Furthermore, this is the first registry in Spain to study this association. The workers with MS were more often ex smokers. This may be because the higher number of associated classic CVRF may have stimulated more energetic measures to quit smoking. In the Whitehall II Study,[33] the likelihood of having MS was slightly increased in ex smokers. Alternatively, as MS was significantly associated with being a smoker or an ex smoker, never having smoked may be considered protective against the MS, if the other risk factors are discounted.

Although the prevalence of altered fasting glucose or an alteration in carbohydrate metabolism was less than in other studies,[8-11,17] our data nevertheless clearly show that having baseline glucose >110 mg/dL was associated with a series of clinical conditions that increased the prevalence of MS to 50%. In those workers who were diabetic, the mean BP was 137.1/85.6 mm Hg and the mean triglyceride concentration was 165 mg/dL.

Another very interesting finding was the difference in the levels of pulse pressure and mean BP. The capacity of MS to enhance the harmful effects of age on the vessel wall has recently been demonstrated, and

this might partly explain the greater pressure differential seen in our sample.[12] The prognostic value of the pulse pressure and the onset and course of cardiovascular diseases has been clearly shown[34] and this could be one more of the multiple causes of ischemic heart disease associated with MS. Additionally, the great difference found in the mean BP values in persons with MS as compared to those without MS is also of relevance, given the strong, independent association between mean BP and stroke.[35] These findings are in agreement with a recent subanalysis of the NHANES III, which showed the high prevalence of stroke in association with MS.[36]

Job Category and the Metabolic Syndrome

As far as we are aware, this is the first study to include an analysis of the various characteristics of the MS in different job categories. A study of Japanese factory workers found a higher overall prevalence of the MS than in our study (17.3% vs 10.2%).[37] The geographic, social, and cultural differences between the 2 studies are obvious. The fact that our study was undertaken in 2 companies with very different kinds of employees added heterogeneity to our sample. Furthermore, unlike the Japanese study, our study included workers with very different jobs, including assembly line workers, office workers, and supervisors or managers. Contrary to common belief, the manual laborers had a greater BMI, probably due to the stationary tasks, such as those of an assembly line, as a result of the incorporation of machinery to replace previous tasks involving intense physical activity. The office workers, on the other hand, had a lower cardiovascular risk profile (lower values of BMI, BP, LDL cholesterol, non-HDL cholesterol, and triglycerides). The fact that they were more often women and that they were younger resulted in the standardized prevalence of MS being greater than in the managers, despite the fact that they had a less favorable crude lipid profile. Finally, it is interesting to note that the managers had the highest mean levels of baseline glucose, total cholesterol, and LDL cholesterol, in spite of having a mean BMI of 25.7. The age-adjusted prevalence of MS in men showed an inverse social gradient, although these differences were not statistically significant. Nevertheless, the logistic regression analysis showed that the influence was significant. Given the small number of managers in the sample, it cannot be confirmed whether or not there are differences between them and the office workers, however the manual laborers clearly had a greater prevalence of MS. We believe that these findings reflect lifestyle and dietary habits, especially if we consider that the triglyceride concentrations were the component of the MS that best explained these differences in prevalence. Indeed, the results of the

Whitehall II Study[33] suggested that the MS might reflect social differences according to the level of education. In the Whitehall II Study, the figures for total cholesterol and LDL cholesterol were not associated with the level of education, though this was associated with HDL cholesterol and triglycerides, as was in our study. We noted that the association between social level and MS seemed to depend on the differences between the groups in the levels of triglycerides especially, and to a lesser extent, HDL cholesterol. The close association between overweight, BP, and glucose levels was also seen in our study.

Limitations

The main limitation of our registry is that it is a cross-sectional study with active workers, and thus it can describe associations but not causes. Furthermore, the results should be considered representative of a particular group of workers. The MESYAS Registry does not describe the profile of patients selected from health care centers or hospitals, but rather that of persons free from limiting disease. Further studies including persons of different ages, a greater proportion of women, and other working conditions could provide different results. For obvious reasons, the number of persons in the sample who were older than 60 years of age was limited. The use of BMI rather than abdominal circumference is a widely accepted modification,[6,8,9] although this modification is known to have a tendency to underestimate the prevalence of MS. Furthermore, this criterion was elaborated in study cohorts including persons from North America, and the value of 28.8 may not be very precise for Spanish people. It should be kept in mind that our results are limited to the risk conferred by obesity, as evaluated from the BMI, of having MS and not the risk conferred by abdominal obesity, as evaluated by the abdominal circumference. Moreover, the use of a single sample to measure the baseline glucose level may reduce the diagnostic rigor, though the large sample size would tend to attenuate this. No record was made of menopause, although 92.1% of the women were ≤50 years old. To date, collection of specific data concerning dietary habits has not been possible.

CONCLUSIONS

One in 10 active workers had MS. Although this prevalence may seem low in comparison to other series, it rose to 40% in certain groups of workers. The prevalence of MS increased with age, BMI, BP, and baseline fasting glucose. All the components of the MS were more common in the men, except for a low HDL cholesterol, which was more frequent in the wo-

men. High blood pressure (OR=3.4), obesity (OR=9.6), and diabetes (OR=15.4) were independently associated with a greater prevalence of MS. Being a manual laborer conferred a higher risk for MS, independently of age or sex (OR=1.3). This effect seems to depend on less favorable triglyceride concentrations.

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