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# Metabolic syndrome in healthcare personnel at the University of Antioquia-Colombia; LATINMETS study

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**Abstract**

***Introduction:*** **Hypertension (HTN), atherogenic dyslipidemia, an increased glycemia in a fasting state, and abdominal obesity (AO), constitute a cluster of risk factors for cardiovascular disease named metabolic syndrome (MS).**

***Objective:*** **To analyze the prevalence and distribution of MS and its components in healthcare personnel from the University of Antioquia.**

***Methodology:*** **Cross-sectional study conducted between 2010 and 2011. The collected data included anthropometrical, biochemical, socio-demographic, and lifestyle variables. The MS was diagnosed using the harmonized IDF/AHA definition. Descriptive and analytical statistical analyses were performed, including $\chi^2$ tests, and $\alpha = 0.05$.**

***Results:*** **285 volunteers (29.1% men) with ages between 20 and 61 years were included. 31.6% of participants were overweight with a Body Mass Index higher than 25 kg/m² (BMI). AO (29.8%) and HTN (29.8%) were the most frequent components of MS. Global prevalence of MS was 17.5% (95%CI: 13.1; 22). There was a lower presence of MS among women (OR 0.328; 95%CI: 0.175; 0.614; $p < 0.05$), and a positive gradient with age and income. Likewise, the prevalence of MS was higher among smokers and those who are overweight ($p < 0.05$). After adjusting for age, MS was associated with sex (OR 0.348; 95%CI: 0.178; 0.680) and being overweight (OR 14.592; 95%CI: 6.343; 33.570).**

***Conclusion:*** **The most frequently observed components of MS in the studied sample were AO and HTN. BMI, sex, and socio-economic status are important independent risk factors associated with MS.**

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Key words: *Metabolic syndrome. Cardiovascular disease. Socio-demographic risk factors. Body mass index. Healthcare personnel.*

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**SÍNDROME METABÓLICO EN PERSONAL DEL ÁREA DE LA SALUD DE LA UNIVERSIDAD DE ANTIOQUIA-COLOMBIA; ESTUDIO LATINMETS**

**Resumen**

***Introducción:*** **La hipertensión arterial (HTA), la dislipidemia aterógena, una glucemia en ayunas aumentada y la obesidad abdominal (OA), constituyen un clúster de factores de riesgo para la enfermedad cardiovascular llamado síndrome metabólico (SM).**

***Objetivo:*** **Analizar la prevalencia y distribución del SM y sus componentes en personal del área de la salud de la Universidad de Antioquia.**

***Metodología:*** **Estudio transversal realizado entre 2010 y 2011. Se recolectaron datos antropométricos, bioquímicos, sociodemográficos y de estilo de vida. El SM se diagnosticó empleando la definición IDF/AHA armonizada. Se realizó análisis descriptivo y analítico con pruebas $\chi^2$ y $\alpha = 0,05$.**

***Resultados:*** **Se incluyeron 285 voluntarios (29,1% hombres), con edades entre 20 a 61 años. El 31,6% de los participantes presentó exceso de peso por índice de masa corporal mayor a 25 kg/m² (IMC). Los componentes del SM más frecuentes fueron la OA (29,8%) y la HTA (29,8%). La prevalencia global de SM fue del 17,5% (IC 95% 13,1-22%). Se observó una menor frecuencia de SM entre las mujeres (OR 0,328; IC 95% 0,175-0,614; $p < 0,001$), un gradiente positivo con la edad y los ingresos económicos, así como una mayor prevalencia entre fumadores y quienes presentaron exceso de peso ($p < 0,05$). Después de ajustar por edad, el SM mostró asociación con sexo (OR 0,348; IC 95% 0,178-0,680) y exceso de peso (OR 14,592; IC 95% 6,343-33,570).**

***Conclusión:*** **Los componentes del SM más frecuentemente observados en la muestra estudiada son la OA y la HTA. El IMC, el sexo y el nivel socioeconómico constituyen importantes factores de riesgo independientes asociados con SM.**

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Palabras clave: *Síndrome metabólico. Enfermedad cardiovascular. Factores de riesgo sociodemográficos. Índice de masa corporal. Personal de salud.*

## Abbreviations

ATP III: Adult Treatment Panel III.
RDC: Research Development Committee.
SND: School of Nutrition and Dietetics.
FN: Faculty of Nursing.
FM: Faculty of Medicine.
FD: Faculty of Dentistry.
FPC: Faculty of Pharmaceutical Chemistry.
HTN: Hypertension.
IDF: International Diabetes Federation.
BMI: Body Mass Index.
UIPE: University Institute of Physical Education.
LATINMETS: Latin-America metabolic syndrome.
NHANES: National Health and Nutrition Examination Survey (USA).
AO: Abdominal obesity.
WHO: World Health Organization.
WP: Waist perimeter.
MS: Metabolic syndrome.
MMW: Minimum monthly wage.
UDEA: University of Antioquia.

## Introduction

During the last years the prevalence of atherogenic dyslipidemia (high triglycerides and low levels of HDL), insulin resistance or diabetes, hypertension (HTN), and abdominal obesity (AO) have increased in most of the developed or in-transition countries. The presence of three or more of these disorders is currently known as metabolic syndrome (MS), which implies a higher risk of developing diabetes, cardiovascular disease, and other chronic conditions.[1-4]

The global prevalence of MS is noteworthy. A systematic review conducted in 2011 found that in European countries like Switzerland, Spain, Netherlands, Italy, France, United Kingdom, and Denmark, the prevalence of MS among those younger than 40 years old was between 14 and 41%, depending on the studied age range[5]. The National Health and Nutrition Examination Survey (NHANES) on American adults 2003-2006, using the diagnostic criteria from the Adult Treatment Panel III[8] (ATP III), found a prevalence of MS of 34.4%, with a value of 17.9% in individuals between 20 and 39 years old, 39% in people between 40 and 59 years old, and 52.9% in individuals over 60 years old[6]. The CARMELA study used ATP III[8] in seven capital cities In Latin America (11,502 individuals aged 25 to 64 years old) and found an MS prevalence of 27% in Mexico City (Mexico), 26% in Barquisimeto (Venezuela), 21% in Santiago de Chile (Chile), 20% in Bogotá (Colombia), 18% in Lima (Peru), 17% in Buenos Aires (Argentina), and 14% in Quito (Ecuador).[7]

A study among professors and administrative personnel of a Faculty of medicine in Bucaramanga, Colombia, used the ATP III[8] criteria and found a MS prevalence of 34,8%.[9] Another study, among users of a health care center in Medellín, Colombia, found a prevalence of 19.2% using ATP III,[8] and of 25.8% using the criteria from the International Diabetes Federation (IDF)[10]; there was no significant difference between those two MS estimations.[11]

Health care professionals are an important population because they are committed to promoting health, preventing illnesses, and treating diseases, all of which not only affects their own health status, but also affects the communities, families, and individuals with whom they work and by whom they are regarded as highly credible.[12] However, there are scarce studies aimed at identifying if this group has the basic knowledge to participate actively in the prevention, identification, and treatment of MS.[13] Therefore, it is of great importance to deepen consideration of this subject in order to improve the strategies proposed by the authorities to face this public health problem.

The increase of MS and its constituent pathologies has important consequences for society; therefore it is necessary to have current information based on recently agreed-upon diagnostic criteria, obtained in a population that expresses the studied variables. The objective of this research was to determine the prevalence of MS in the healthcare population at the University of Antioquia (UdeA), and to analyze its distribution for each component of MS according to anthropometrical, socio-demographic, and lifestyle variables.

## Methodology

### *Type of study and population*

A cross-sectional study was conducted with the data collected in the study, “Prevalence of Metabolic Syndrome and its Environmental Determinants in Health Care Professors and Students from the University of Antioquia (UdeA): Latinmets-Colombia”, which was part of a multicentric study coordinated by the University Rovira i Virgili en Reus, Spain, in five Latin American countries (Mexico, Brazil, Argentina, Paraguay, and Colombia) that form the RIBESMET network (www.ribesmet.org).

### *Subjects of study*

285 volunteers aged 18-65 years old (professors and students of the last two academic periods from the health care faculties from UdeA). The following individuals were not included in the study: pregnant or breastfeeding women; people taking antibiotics or corticoids; people with an illness requiring hospitalization at the moment of collecting data; people with cancer or who had it in the last three years; people from whom it was not possible to take measurements of height, weight, or blood pressure; and those who

refused a blood test. Data was collected between October 2010 and July 2011.

*Variables and information sources*

Figure 1 shows the data collection process.

The following tests and measurements were obtained in the study:

*Metabolic syndrome definition:* The prevalence of MS was determined by the presence of three or more of the five criteria recently harmonized by the International Diabetes Federation Task Force on Epidemiology and Prevention; the National Heart, Lung, and Blood Institute; the American Heart Association; the World Heart Federation; the International Atherosclerosis Society; and the International Association for the Study of Obesity[4] (table I).

*Biochemical variables:* The analyses were performed in a centralized laboratory using frozen blood serum samples collected in a fasting state. Standardized enzymatic methods were used to measure plasma glucose concentrations in fasting state, total serum cholesterol, HDL cholesterol, and triglycerides.

*Blood pressure:* Readings were recorded twice with a semi-automatic sphygmomanometer (OMRON HEM 742 INT), following the procedure recommended by the *European Society of Hypertension and the European Society of Cardiology.*[14]

*Socio-demographic variables:* Age; sex; monthly income in Colombian pesos (COP) (estimated according to the minimum monthly wage for 2011 of 535,600 COP, US$267.8 approx.); social strata of the household (classification that in Colombia divides the population into six groups according to the household's characteristics and social environment, and that, for purposes of the study, were grouped into: a) lower

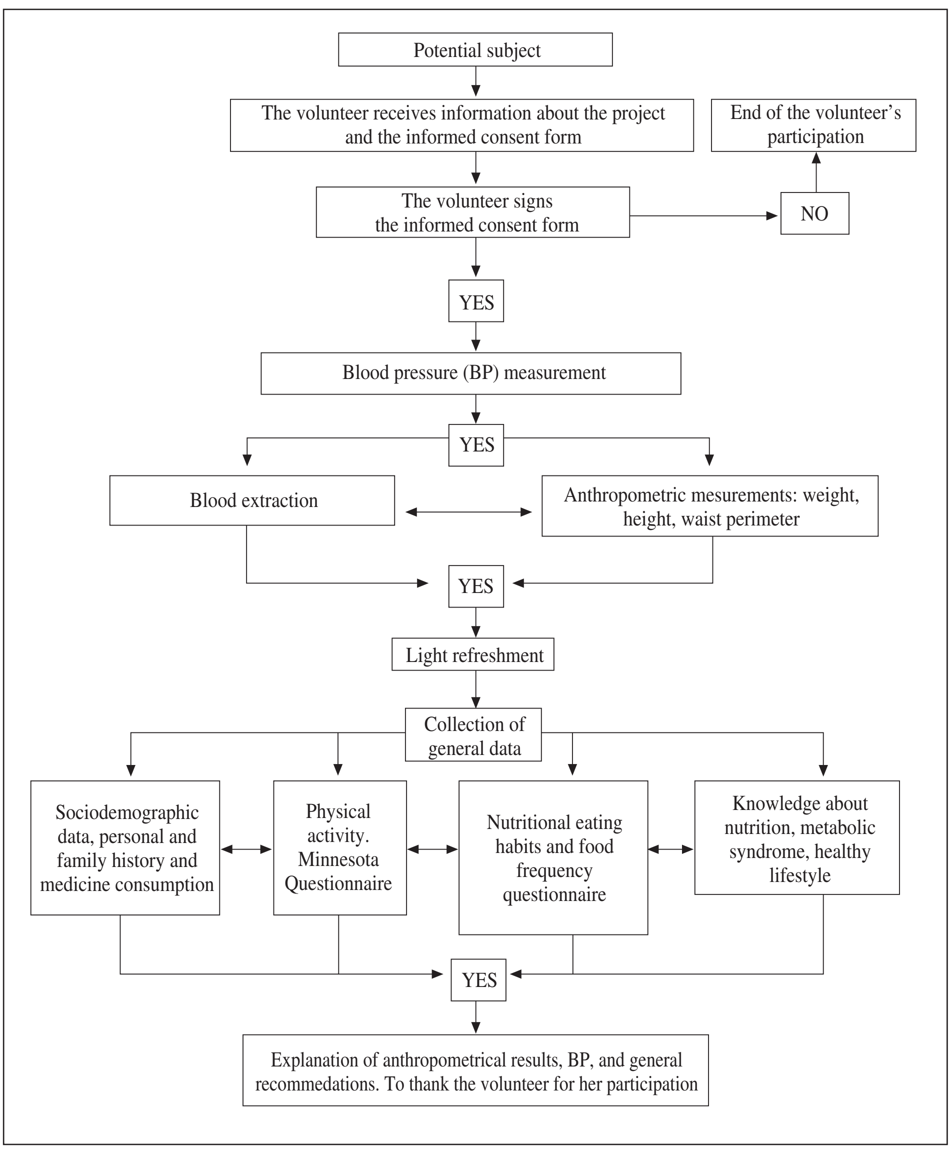


*Fig. 1.—Flow diagram of data collection.*

**Table I**
*Harmonized ATP III criteria* for diagnosis and metabolic syndrome*

| *Waist perimeter*[†] | *Triglycerides* | *HDL cholesterol* | *Hypertension* | *Glucose in fastin state* |
|---|---|---|---|---|
| Men: ≥ 90 cm<br>Women: ≥ 80 cm | ≥ 150 mg/dl or<br>≥ 1.7 mmol/L or<br>pharmacological treatment | Men: < 40 mg/dl,<br>Women: < 50 mg/dl or<br>pharmacological treatment | ≥ 130/ ≥ 85 mmHg or<br>pharmacological treatment | ≥ 100 mg/dl or<br>≥ 5.56 mmol/l or<br>pharmacological treatment |

*From: Alberti KG, Eckel R, Grundy S, Zimmet P, Cleeman J, Donato K et al. Harmonizing the metabolic syndrome: a joint interim statement of the International Diabetes Federation Task Force on Epidemiology and Prevention; National Heart, Lung, and Blood Institute; American Heart Association; World Heart Federation; International Atherosclerosis Society; and International Association for the Study of Obesity. *Circulation* 2009; 120: 1640-45.
[†]Using the threshold values recommended by Alberti et al. for ethnic population from Central and South America.

class, strata 1 and 2, b) middle class, strata 3 and 4, c) upper class, strata 5 and 6); type of participant (professional or student); and area of education: University Institute of Physical Education (UIPE), Faculty of Nursing (FN), Faculty of Medicine (FM), School of Nutrition and Dietetics (SND), Faculty of Dentistry (FD), and Faculty of Pharmaceutical Chemistry (FPC).

*Lifestyle variables:* Smoking habits (smoker, non-smoker, former smoker), and frequency of physical activity according to the participant's perception.

*Anthropometrical variables:* Anthropometrical measurements were taken after a 12-hour fasting state, and were: weight in kg, and height and waist perimeter (WP) in cm. Body weight was measured with a digital scale (Tanita HD314) with capacity of 150 kg and a sensitivity of 0.1 kg; participants wore light clothes and a minimum amount of accessories. Height was recorded with a SECA metallic measuring tape, with plastic casing, mobile measuring tongue, measuring range of 220 cm, and a sensitivity of 0.1 cm; participants were measured while barefoot and without accessories on their heads. WP was recorded with a non-extensible MABIS measuring tape, maximum length of 150 cm and a sensitivity of 0.1 cm; this measurement was obtained placing the measuring tape, without pressing on the skin, in the middle point between the last rib and the cranial ridge of the iliac crest; the measurement was taken at the moment of exhalation. Abdominal obesity was defined on women with WP ≥ 80 cm, and on men with WP ≥ 90 cm[4]. Body Mass Index (BMI) was estimated as the ratio between weight (kg) and height ($m^2$), and was interpreted according to the World Health Organization (WHO) criteria;[15] for purposes of this study, the overweight category was defined for those with BMI ≥ 25.

### *Ethical considerations*

Before data collection, the study obtained approval from the Bioethics Committee of the Medical Research Institute of the Faculty of Medicine of UdeA, certificate 008-29 from April 2010, and approval from the Research Development Committee (RDC), certificate 580-23 from July 2010. All of the participants signed an informed consent form, and received a document with information about the project, its implications, scopes, risks, and benefits.

### *Data analysis*

Results are presented as means ± standard deviations (quantitative variables) or as frequencies (n) for qualitative variables. MS was codified as a dichotomic variable (Yes/No), and the number of criteria present on each participant was treated as a discrete variable. All the analyses were performed as a function of the presence or absence of MS and its components. The general characteristics of the participants were analyzed with descriptive statistics; the independence hypothesis was tested with a $\chi^2$ test; 95% confidence intervals were estimated for each of the components; a significance level of 0.05 was used, and the analysis were performed using SPSS version 18 (SPSS Inc., Chicago, EEUU).

## Results

A total of 285 health care volunteers were included (29.1% men). 42.8% were professors with an average age of 43 ± 9 years old, and 57.2% were students, in their last two years in college, with an average age of 24 ± 4 years old. According to academic departments, the sample was distributed as follows: UIPE 5.3%, FN 19.6%, FM 30.2%, SND 24.2%, FD 12.6%, and FPC 8.0%.

Table II describes the studied sample according to the number of components of MS in function of the studied variables. Analyzing sex, 63.8% of men and 50.9% of women had one or two components. Having three or more components was more frequent in the group of 45 to 65 years old (40%). On the other hand, 9.2% of participants between 20 and 24 years old, and 13.1% of those between 25 and 30 years old had three or more components. 27.7% of the participants did not have any component of MS.

Analyzing the level of education, the professionals more frequently had two or more components. There were twice as many professionals as students with three components, and three times as many professionals as students with four or more components. Analyzing by academic departments, participants from the UIPE had higher frequencies of three or more components (33.3%), followed by the FN (21.5%), while the SND had the highest percentage of people with any component (43.5%). In all of the academic departments, except for the SND, at least half of the

**Table II**
*Number of components of metabolic syndrome according to characteristics of the population*

| Variable | Total | Number of components 0 % | 1 % | 2 % | 3 % | 4 % | 5 % |
|---|---|---|---|---|---|---|---|
| *Sex* | | | | | | | |
| Man | 83 | 6.0 | 36.1 | 27.7 | 14.5 | 14.5 | 1.2 |
| Woman | 202 | 36.6 | 35.1 | 15.8 | 6.9 | 4.5 | 1.0 |
| *Age* | | | | | | | |
| 20 to 24 | 109 | 36.7 | 38.5 | 15.6 | 5.5 | 3.7 | 0.0 |
| 25 to 30 | 54 | 25.9 | 42.6 | 18.5 | 9.3 | 1.9 | 1.9 |
| 31 to 44 | 66 | 27.3 | 34.8 | 22.7 | 4.5 | 9.1 | 1.5 |
| 45 to 65 | 55 | 12.7 | 23.6 | 23.6 | 21.8 | 16.4 | 1.8 |
| *Level of education* | | | | | | | |
| Professional | 122 | 21.3 | 31.1 | 20.5 | 13.1 | 12.3 | 1.6 |
| Student | 163 | 32.5 | 38.7 | 18.4 | 6.1 | 3.7 | 0.6 |
| *Area* | | | | | | | |
| Nursing | 56 | 23.2 | 33.9 | 21.4 | 5.4 | 14.3 | 1.8 |
| Medicine | 86 | 25.6 | 33.7 | 23.3 | 10.5 | 7.0 | 0.0 |
| Nutrition | 69 | 43.5 | 31.9 | 11.6 | 8.7 | 1.4 | 2.9 |
| Pharmaceutical chemistry | 23 | 26.1 | 47.8 | 13.0 | 8.7 | 4.3 | 0.0 |
| Physical education | 15 | 13.3 | 33.3 | 20.0 | 13.3 | 20.0 | 0.0 |
| Dentistry | 36 | 16.7 | 41.7 | 25.0 | 11.1 | 5.6 | 0.0 |
| *Social strata of the household* | | | | | | | |
| Lower | 44 | 27.3 | 43.2 | 22.7 | 2.3 | 4.5 | 0.0 |
| Middle | 177 | 29.4 | 34.5 | 18.1 | 10.2 | 6.8 | 1.1 |
| Upper | 63 | 23.8 | 33.3 | 20.6 | 11.1 | 9.5 | 1.6 |
| *Income in MMW** | | | | | | | |
| Less than 1 | 132 | 31.8 | 41.7 | 17.4 | 5.3 | 3.0 | 0.8 |
| 1-4 | 57 | 35.1 | 28.1 | 17.5 | 8.8 | 10.5 | 0.0 |
| 4.1-8 | 68 | 22.1 | 30.9 | 23.5 | 13.2 | 10.3 | 0.0 |
| More than 8 | 27 | 7.4 | 33.3 | 22.2 | 18.5 | 11.1 | 7.4 |
| *Smoking habit* | | | | | | | |
| Non-smoker | 250 | 30.8 | 34.8 | 19.2 | 8.4 | 6.0 | 0.8 |
| Smoker | 34 | 5.9 | 41.2 | 20.6 | 14.7 | 14.7 | 2.9 |
| *Physical activity* | | | | | | | |
| Almost never | 89 | 34.8 | 31.5 | 22.5 | 4.5 | 6.7 | 0.0 |
| Sometimes | 103 | 25.2 | 38.8 | 17.5 | 12.6 | 4.9 | 1.0 |
| Almost always | 53 | 30.2 | 26.4 | 20.8 | 11.3 | 9.4 | 1.9 |
| Always | 39 | 15.4 | 48.7 | 15.4 | 7.7 | 10.3 | 2.6 |
| *BMI*† | | | | | | | |
| Normal/slimness | 195 | 40.0 | 41.0 | 14.4 | 2.6 | 1.5 | 0.5 |
| Excess | 90 | 1.1 | 23.3 | 30.0 | 23.3 | 20.0 | 2.2 |

*MMW: Minimum monthly wage for 2011.
†Body mass index.

participants had one or two of the components of MS (table II).

Considering social strata and income, it is worth noting that participants with one or two components were mostly classified in a lower social class and in the group with an income below the minimum wage. The situation gets reversed with three or more components; the higher frequencies were observed in the higher social class and among those with the higher income (table II).

Taking into account lifestyle variables, only 5.9% of the smokers did not have any of the components of MS. There were twice as many smokers as non-smokers in the category of three or more components (32.3% *vs.* 15.2%, respectively), and three times as many smokers as non-smokers in the category of five components. Volunteers who valued their physical activity as "almost always" or "always" had highest frequencies of MS. Analyzing nutritional status by BMI, 45.5% of participants who were overweight had three or more components of MS, and 30% had two of those components (table II).

Table III shows the prevalence of the five components of MS according to the studied variables. The frequencies were distributed as follows: AO 29.8%, HTN 29.8%, high triglycerides 22.5%, high levels of glycemia 26.7%, and low HDL 27.4%. AO showed a positive gradient with age, social strata, and income. The prevalence of AO also was higher among those who were overweight ($p < 0.05$). The highest frequencies of AO were observed in the FD, the UIPE, and the FN ($p < 0.05$) (table III).

The HTN component of the MS had a significant association with all the studied variables, except for social strata ($p = 0.337$). It is noticeable that there was a higher prevalence of HTN in men (62.7%) than in women (16.3%). Other values of HTN worth noting: personnel of the UIPE (60%), personnel of the FN (37.5%), smokers (47.1%), and in participants who where overweight the prevalence of HTN was triple the amount found in those with a normal BMI (54.4% *vs.* 18.5%) (table III).

The prevalence of the high triglyceride component of the MS was associated with all the variables, except for social strata, area of education, and frequency of physical activity. The academic departments with higher prevalence of this component were the UIPE (40%), the FD (38.9%), and the FPC (26.1%). It is important to note the positive gradient associated with a higher income, and the higher prevalence among smokers and those who were overweight by BMI ($p < 0.05$). On the other hand, prevalence of the elevated glycemia component of the MS was associated with sex, level of education, being a smoker, and being overweight ($p < 0.05$) (table III).

Even though there were no significant differences in terms of low HDL for any of the studied variables, which reflects the homogeneous quality of this condition, the analysis by social strata shows a slight tendency to a higher frequency of low HDL in the lower class (34.1%) than in the upper class (20.6%).

Finally, table IV presents the characteristics of the studied sample according to the presence or absence of MS. The global prevalence of MS was 17.5% (95% CI: 13.1; 22). There was a lower frequency of MS among women (OR 0.328; 95% CI: 0.175; 0.614), and a positive gradient with age.

Even though the analysis of the household's social strata, used as an approximation to an individual's social status, only showed an association with MS in the higher strata (OR 3.905; 95% CI: 1.049; 14.532), income did have a positive gradient with MS, 9.1% in the group with a lower income and 37% in the group with the higher income (OR 5.882; 95% CI: 2.206; 15.688). The prevalence of MS was double in smokers, and higher among those overweight than in the group with normal BMI (45.6% *vs.* 4.6% respectively; $p < 0.05$) (table IV).

After adjusting for age, there was still a significant association of MS with sex (OR 0.348; 95% CI: 0.178; 0.680) and BMI (14.592; 95%CI: 6.343; 33.570), but any association with the other variables were observed after adjusting by age and BMI.

**Discussion**

In this study there was no significant difference between men and women in terms of the prevalence of AO (women 30.7%, men 27.7%; $p > 0.05$), and low HDL (women 28.7%, men 24.1%; $p > 0.05$), but the other diagnostic components of MS were more prevalent in men. Except for the HDL, all the diagnostic components of MS were associated with being overweight by BMI.

The global prevalence of MS was 17.5% (men 30.1%, women 12.4%), which is slightly lower than the value of 20.4% (men 18.7%, women 21.7%) reported in 2008 by the CARMELA study for Bogotá.[7,16] However, in our study the proportion of men with MS was considerably higher than that of women with MS. The prevalence of MS in our study is also lower than the value of 34.8% reported in 2007 for professors and administrative personnel in a faculty of medicine in Bucaramanga[9]. Another study from 2000 in the town of El Retiro (East of Medellín) reported a global prevalence of 33.9% (23.6% after adjusting by age), with no significant differences by sex.[17] It is important to keep in mind that there are limitations when comparing these studies: the different years of execution, the characteristics of the studied population, and the location's own socio-demographic and environmental variables. However, these data reveal an important public health problem that becomes evident with the constant rise of mortality and morbidity by cardiovascular disease, which is increasingly appearing at earlier ages.[3]

Our findings are in line with other studies that discovered evidence of an association between socio-demographic variables and MS prevalence. As has been observed in population studies in different countries, this study found that age is a risk factor positively associated with an increase in the prevalence of MS and its components.[11,18,19] This association can be explained not only by multiple risk factors that come along with aging, such as hormonal changes around the climacteric, the presence of associated chronic diseases, immunological and osteoarticular diseases, but also by genetic predisposition, the accumulated effect of nutritional changes to inadequate diets (high in energy and low in nutrients), sedentary lifestyles, or by the effect of other harmful factors during a lifetime.[3,11,20,21]

The fact that women had a significantly lower frequency of MS is also consistent with the reports from other studies.[19,22,23] However, it is important to mention that our results could have been affected by the fact that in our population there was a higher proportion of women of childbearing age, who have the protective effect of metabolic and hormonal factors against cerebrovascular diseases.[11,24,25]

Additionally, the participants from the SND had the lowest prevalence of MS, and the highest percentage of people with none of the components of MS. Although this can be partially explained by the fact that this is an academic department with a predominant female population (with the advantages aforementioned), this

**Table III**
*Distribution of the components and metabolic sundrome acording to characteristics of the population*

| | Total | AO* | | HTN† | | High TGs‡ | | Increased Glycemia in fasting state | | Low HDL§ | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | % | 95% CI | % | 95% CI | % | 95% CI | % | 95% CI | % | 95% CI |
| *Sex* | | | | | | | | | | | |
| Man | 83 | 27.7 | 18.0 ; 37.4 | 62.7 | 52.1 ; 73.2 | 39.8 | 29.1 ; 50.4 | 44.6 | 33.8 ; 55.4 | 24.1 | 14.8 ; 33.4 |
| Woman | 202 | 30.7 | 24.3 ; 37.1 | 16.3 | 11.2 ; 21.5 | 15.3 | 10.3 ; 20.4 | 19.3 | 13.8 ; 24.8 | 28.7 | 22.4 ; 35 |
| Total | 285 | 29.8 | | 29.8 | | 22.5 | | 26.7 | | 27.4 | |
| p (Chi²)‖ | | 0.617 | | 0.000 | | 0.000 | | 0.000 | | 0.427 | |
| *Age* | | | | | | | | | | | |
| 20 to 24 | 109 | 15.6 | 8.7 ; 22.5 | 22,9 | 15.0 ; 30.9 | 12.8 | 6.5 ; 19.2 | 20.2 | 12.6 ; 27.8 | 29.4 | 20.7 ; 38 |
| 25 to 30 | 54 | 20.4 | 9.5 ; 31.3 | 24,1 | 12.5 ; 35.6 | 20.4 | 9.5 ; 31.3 | 27.8 | 15.7 ; 39.9 | 31.5 | 18.9 ; 44.0 |
| 31 to 44 | 66 | 36.4 | 24.6 ; 48.1 | 30.3 | 19.1 ; 41.5 | 25.8 | 15.1 ; 36.4 | 28.8 | 17.7 ; 39.8 | 16.7 | 7.6 ; 25.8 |
| 45 to 65 | 55 | 58.2 | 45.0 ; 71.4 | 47.3 | 33.9 ; 60.6 | 38.2 | 25.2 ; 51.2 | 34.5 | 21.8 ; 47.3 | 32.7 | 20.2 ; 45.3 |
| Total | 284 | 29.6 | | 29.6 | | 22.2 | | 26.4 | | 27.5 | |
| p (Chi²)‖ | | 0.000 | | 0.010 | | 0.003 | | 0.232 | | 0.154 | |
| *Level of education* | | | | | | | | | | | |
| Professional | 122 | 42.6 | 33.8 ; 51.5 | 37.7 | 29.0 ; 46.4 | 31.1 | 22.9 ; 39.4 | 33.6 | 25.2 ; 42.1 | 23.8 | 16.2 ; 31.4 |
| Student | 163 | 20.2 | 14.0 ; 26.5 | 23.9 | 17.3 ; 30.5 | 16.0 | 10.3 ; 21.6 | 21.5 | 15.1 ; 27.8 | 30.1 | 23.0 ; 37.2 |
| Total | 285 | 29.8 | | 29.8 | | 22.5 | | 26.7 | | 27.4 | |
| p (Chi²)‖ | | 0.000 | | 0.012 | | 0.002 | | 0.022 | | 0.239 | |
| *Area* | | | | | | | | | | | |
| Nursing | 56 | 39.3 | 26.3 ; 52.2 | 37.5 | 24.7 ; 50.3 | 19.6 | 9.1 ; 30.2 | 26.8 | 15.0 ; 38.5 | 35.7 | 23 ; 48.4 |
| Medicine | 86 | 33.7 | 23.6 ; 43.8 | 30.2 | 20.4 ; 40.0 | 18.6 | 10.3 ; 26.9 | 29.1 | 19.4 ; 38.8 | 27.9 | 18.3 ; 37.5 |
| Nutrition | 69 | 11.6 | 4.0 ; 19.2 | 18.8 | 9.5 ; 28.2 | 15.9 | 7.2 ; 24.7 | 30.4 | 19.5 ; 41.4 | 24.6 | 14.4 ; 34.9 |
| Pharmaceutical chemistry | 23 | 21.7 | 4.4 ; 39.0 | 26.1 | 7.7 ; 44.5 | 26.1 | 7.7 ; 44.5 | 21.7 | 4.4 ; 39.0 | 21.7 | 4.4 ; 39 |
| Physical education | 15 | 40.0 | 14.2 ; 65.8 | 60.0 | 34.2 ; 85.8 | 40.0 | 14.2 ; 65.8 | 33.3 | 8.5 ; 58.1 | 20.0 | -1 ; 41 |
| Dentistry | 36 | 41.7 | 25.3 ; 58.1 | 27.8 | 12.9 ; 42.7 | 38.9 | 22.7 ; 55.1 | 13.9 | 2.4 ; 25.4 | 25.0 | 10.6 ; 39.4 |
| Total | 285 | 29.8 | | 29.8 | | 22.5 | | 26.7 | | 27.4 | |
| p (Chi²)‖ | | 0.003 | | 0.031 | | 0.050 | | 0.495 | | 0.683 | |
| *Social strata* | | | | | | | | | | | |
| Lower | 44 | 9.1 | 0.5 ; 17.7 | 36.4 | 21.9 ; 50.8 | 15.9 | 4.9 ; 26.9 | 18.2 | 6.6 ; 29.8 | 34.1 | 19.9 ; 48.3 |
| Middle | 177 | 29.4 | 22.6 ; 36.1 | 26.6 | 20.0 ; 33.1 | 22.6 | 16.4 ; 28.8 | 27.1 | 20.5 ; 33.7 | 28.2 | 21.6 ; 34.9 |
| Upper | 63 | 44.4 | 32.0 ; 56.9 | 33.3 | 21.5 ; 45.1 | 25.4 | 14.5 ; 36.3 | 30.2 | 18.7 ; 41.6 | 20.6 | 10.5 ; 30.8 |
| Total | 284 | 29.6 | | 29.6 | | 22.2 | | 26.4 | | 27.5 | |
| p (Chi²)‖ | | 0.000 | | 0.337 | | 0.497 | | 0.362 | | 0.287 | |
| *Income in MMW* | | | | | | | | | | | |
| Less than 1 | 132 | 17.4 | 10.9 ; 23.9 | 22.0 | 14.8 ; 29.1 | 15.9 | 9.6 ; 22.2 | 21.2 | 14.2 ; 28.2 | 31.8 | 23.8 ; 39.8 |
| 1-4 | 57 | 33.3 | 20.9 ; 45.7 | 31.6 | 19.4 ; 43.8 | 21.1 | 10.3 ; 31.8 | 22.8 | 11.8 ; 33.8 | 22.8 | 11.8 ; 33.8 |
| 4.1-8 | 68 | 38.2 | 26.5 ; 49.9 | 38.2 | 26.5 ; 49.9 | 26.5 | 15.9 ; 37.1 | 35.3 | 23.8 ; 46.8 | 20.6 | 10.9 ; 30.3 |
| More than 8 | 27 | 59.3 | 40.3 ; 78.2 | 40.7 | 21.8 ; 59.7 | 44.4 | 25.3 ; 63.6 | 37.0 | 18.4 ; 55.7 | 33.3 | 15.1 ; 51.5 |
| Total | 284 | 29.6 | | 29.6 | | 22.2 | | 26.4 | | 27.5 | |
| p (Chi²)‖ | | 0.000 | | 0.049 | | 0.009 | | 0.088 | | 0.266 | |
| *Smoking habit* | | | | | | | | | | | |
| Non-smoker | 250 | 29.2 | 23.5 ; 34.9 | 27.2 | 21.6 ; 32.8 | 19.2 | 14.3 ; 24.1 | 24.0 | 18.7 ; 29.3 | 26.8 | 21.3 ; 32.3 |
| Smoker | 34 | 32.4 | 16.3 ; 48.4 | 47.1 | 30.0 ; 64.2 | 44.1 | 27.1 ; 61.1 | 44.1 | 27.1 ; 61.1 | 32.4 | 16.3 ; 48.4 |
| Total | 284 | 29.6 | | 29.6 | | 22.2 | | 26.4 | | 27.5 | |
| p (Chi²)‖ | | 0.705 | | 0.017 | | 0.001 | | 0.013 | | 0.496 | |
| *Physical activity* | | | | | | | | | | | |
| Almost never | 89 | 38.2 | 28 ; 48.4 | 20.2 | 11.8 ; 28.7 | 12.4 | 5.5 ; 19.3 | 23.6 | 14.7 ; 32.5 | 22.5 | 13.7 ; 31.2 |
| Sometimes | 103 | 25.2 | 16.8 ; 33.7 | 29.1 | 20.3 ; 38.0 | 26.2 | 17.6 ; 34.8 | 26.2 | 17.6 ; 34.8 | 29.1 | 20.3 ; 38 |
| Almost always | 53 | 28.3 | 16 ; 40.6 | 32.1 | 19.3 ; 44.8 | 28.3 | 16 ; 40.6 | 28.3 | 16.0 ; 40.6 | 32.1 | 19.3 ; 44.8 |
| Always | 39 | 23.1 | 9.6 ; 36.5 | 48.7 | 32.8 ; 64.7 | 25.6 | 11.7 ; 39.6 | 30.8 | 16.0 ; 45.5 | 28.2 | 13.8 ; 42.6 |
| Total | 284 | 29.6 | | 29.6 | | 22.2 | | 26.4 | | 27.5 | |
| p (Chi²)‖ | | 0.176 | | 0.013 | | 0.061 | | 0.839 | | 0.608 | |
| *BMI* | | | | | | | | | | | |
| Normal/slimness | 195 | 9.7 | 5.6 ; 13.9 | 18.5 | 13.0 ; 23.9 | 14.9 | 9.8 ; 19.9 | 16.9 | 11.6 ; 22.2 | 26.2 | 19.9 ; 32.4 |
| Excess | 90 | 73.3 | 64.1 ; 82.6 | 54.4 | 44.1 ; 64.8 | 38.9 | 28.7 ; 49.1 | 47.8 | 37.4 ; 58.2 | 30.0 | 20.4 ; 39.6 |
| Total | 285 | 29.8 | | 29.8 | | 22.5 | | 26.7 | | 27.4 | |
| p (Chi²)‖ | | 0.000 | | 0.000 | | 0.000 | | 0.000 | | 0.498 | |

*Abdominal obesity; †Hypertension; ‡Triglycerides; §High-density lipoprotein; ‖Chi-squared test; ¶Body mass index.

**Table IV**
*Prevalence of metabolic syndrome according to characteristics of the population*

| Variable | Total | Metabolic syndrome (%) Yes | Metabolic syndrome (%) No | OR* (95% CI) | Adjusted OR† (95% CI) | Adjusted OR‡ (95% CI) |
|---|---|---|---|---|---|---|
| *Sex* | | | | | | |
| Man | 83 | 30.1 | 69.9 | 0.328 | 0.348 | 0.542 |
| Woman | 202 | 12.4 | 87.6 | (0.175; 0.614) | (0.178; 0.680) | (0.256; 1.149) |
| *Level of education* | | | | | | |
| Professionals | 122 | 27.0 | 73.0 | 0.314 | 0.880 | 0.674 |
| Students | 163 | 10.4 | 89.6 | (0.165; 0.597) | (0.221; 3.504) | (0.159; 2.857) |
| *Area* | | | | | | |
| Nursing | 56 | 21.4 | 78.6 | 1.818 (0.705; 4.691) | 1.290 (0.461; 3.609) | 0.885 (0.277; 2.826) |
| Medicine | 86 | 17.4 | 82.6 | 1.408 (0.575; 3.447) | 2.318 (0.837; 6.418) | 1.124 (0.359; 3.517) |
| Nutrition | 69 | 13.0 | 87.0 | 1 | 1 | 1 |
| Pharmaceutical chemistry | 23 | 13.0 | 87.0 | 1.000 (0.246; 4.060) | 1.132 (0.248; 5.159) | 1.174 (0.204; 6.769) |
| Physical education | 15 | 33.3 | 66.7 | 3.333 (0.925; 12.012) | 3.220 (0.784; 13.224) | 1.501 (0.323; 6.970) |
| Dentistry | 36 | 16.7 | 83.3 | 1.333 (0.434; 4.095) | 0.483 (0.140; 1.665) | 0.355 (0.086; 1.460) |
| *Social strata of the household* | | | | | | |
| Lower | 44 | 6.8 | 93.2 | 1 | 1 | 1 |
| Middle | 177 | 18.1 | 81.9 | 3.016 (0.879; 10.352) | 2.195 (0.607; 7.937) | 1.952 (0.491; 7.764) |
| Upper | 63 | 22.2 | 77.8 | 3.905 (1.049; 14.532) | 1.530 (0.354; 6.616) | 1.408 (0.286; 6.931) |
| *Income in MMW§* | | | | | | |
| Less than 1 | 132 | 9.1 | 90.9 | 1 | 1 | 1 |
| 1-4 | 57 | 19.3 | 80.7 | 2.391 (0.986; 5.799) | 1.749 (0.595; 5.140) | 1.219 (0.356; 4.178) |
| 4.1-8 | 68 | 23.5 | 76.5 | 3.077 (1.360; 6.959) | 1.334 (0.340; 5.229) | 1.109 (0.235; 5.236) |
| More than 8 | 27 | 37.0 | 63.0 | 5.882 (2.206; 15.688) | 1.684 (0.350; 8.099) | 0.902 (0.150; 5.427) |
| *Smoking habit* | | | | | | |
| Non-smoker | 250 | 15.2 | 84.8 | 1.715 | 1.334 | 1.345 |
| Smoker | 34 | 32.4 | 67.6 | (1.121; 2.624) | (0.843; 2.112) | (0.739; 2.280) |
| *Physical activity* | | | | | | |
| Almost never | 89 | 11.2 | 88.8 | 1 | 1 | 1 |
| Sometimes | 103 | 18.4 | 81.6 | 1.787 (0.783; 4.078) | 1.397 (0.590; 3.306) | 1.854 (0.711; 4.836) |
| Almost always | 53 | 22.6 | 77.4 | 2.312 (0.921; 5.803) | 1.531 (0.575; 4.076) | 2.415 (0.782; 7.459) |
| Always | 39 | 20.5 | 79.5 | 2.039 (0.736; 5.644) | 1.265 (0.426; 3.755) | 1.861 (0.555; 6.245 |
| *BMI¶* | | | | | | |
| Normal/slimness | 195 | 4.6 | 95.4 | 17.293 | 14.592 | |
| Excess | 90 | 45.6 | 54.4 | (7.871; 37.993) | (6.343; 33.570) | |

*Crude Odds Ratio; †Age-adjusted Odds Ratio; ‡Age-and-BMI-adjusted Odds Ratio; §Monthly minimum wage; ¶Body mass index.

explanation is not satisfactory because there was another academic department with the same characteristics, the FN, that had a high prevalence of MS. In that respect, we consider that better eating habits, incorporated through specific education, could represent a preventive factor for MS in this population, as it has been proven in studies that evaluate the effects of the Mediterranean diet.[19] Therefore, keeping in mind that the presence of one or two components of MS increases total mortality, and that an estimated 65% excess risk of cardiovascular disease exists in people with MS,[26] this finding is especially interesting in the preparation of intervention proposals.

On the other hand, our findings differ from those of other studies that reported an association between MS and social class or other related factors, such as education level or household income.[27,28] The CARMELA study found that in cities with a medium Human Development Index, like Bogotá-Colombia, women from the lower social class and with a lower educational level have more MS, AO, and obesity by BMI; the study also suggests that this results could be due to the fact of motherhood, and to depression associated to the low socioeconomic status.[7,29] In Colombia, the National Survey of Nutritional Status 2010 (ENSIN 2010)[30] found the highest values of being overweight, obesity, and AO among women (55.2% of women, and 45.6% of men were overweight; 62% of women, and 39.8% of men had abdominal obesity). Additionally, the BMI was higher among the lower educational levels, while the highest prevalence of AO was found in the highest educational level. Besides, it should be kept in mind that a country's degree of development might influence the conformation of certain social structures that have been associated with differential effects on the nutritional status and on the classic risk factors for cardiovascular disease.[3,31]

It is also important to remember that our study is based on university population, therefore a homogenous population in terms of educational level. Consequently, the social inequities that affect the general population,[32,33] which can lead, among other things, to less educational opportunities for women, could be underestimated compared to the other factors in study. In Colombia, according to the ENSIN,[30] there is a positive relationship between educational level and prevalence of AO among men, while for women the same variables have an inverse relationship. Besides, there are differences in consumption according to the type of relationship with the university, income, and the household's social strata,[34] and that is why it is important that those strategies against cardiovascular disease also consider the social problems as part of the strategy.

In regard to lifestyle variables, the frequency of MS was much higher among smokers, which was the expected result[20]. The prevalence of MS for those who were overweight was ten times higher than the MS of the participants with a normal BMI (45.6% and 4.6%, respectively); these results are consistent with the findings of other studies carried out in the city,[11] and are also comprehensible given the high correspondence between BMI and AO to establish the condition of being overweight and/or adiposity in adult population.[35] Even though BMI and AO are not identical in terms of their physiopathological role with MS, the results of this study made evident that BMI is an important factor to consider in interventions against MS.

The main limitation of this study is inherent in the characteristics of a cross-sectional study, that is, the associations between MS and the studied variables can't be interpreted as causal associations. Also, because participation was voluntary, the results can't be inferred to the healthcare population from UdeA.

In conclusion, there was a higher prevalence of MS among the older participants, men, smokers, those with higher income, and those overweight by BMI. After adjusting for age, the frequency of MS was associated with sex and BMI. Almost one fifth of the healthcare personnel from the University of Antioquia has at least two of the components of MS. In view of this situation, implementing specific actions towards the improvement of the life style and to reaching or maintaining a healthy nutritional status could contribute to the prevention of this problem in the population.

## Conflict of interest

None.

## Contributions of the authors to the document

All the authors fulfill the criteria for authorship. Jordi Salas and Nancy Babio designed the original version of the project in the format of a multicentric study. They also executed the laboratory tests to obtain the biochemical data. Laura I. González-Zapata, Gloria Cecilia Deossa, Julia Monsalve-Álvarez, and Juliana Díaz-García adapted the project for its application in the University of Antioquia; they also participated in the survey takers' training, the collection of data, and the evaluation of the participants. Laura I. González-Zapata coordinated the study, led the analysis, and finished the manuscript. All of the authors approved the final version of the article.

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