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Prevalence of Metabolic Syndrome and Its Components in Workers of a High-Level Educational Institution, Cartagena-Colombia

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Abstract

To determine the prevalence of metabolic syndrome, components and their relationship in workers of a higher education institution of Cartagena-Colombia. An analytical cross-sectional study was carried out, with a probabilistic sample of 162 workers in a higher education institution. Sociodemographic data were recorded, physical examination including abdominal circumference, blood pressure, height, weight, as well as clinical tests of lipid laboratory (total cholesterol, HDL cholesterol and triglycerides) and fasting glycemia determined by colorimetric and enzymatic methods. The parameters established by the American Heart Association-AHA were used to identify metabolic syndrome. A prevalence of metabolic syndrome of 11.1% was estimated. The most frequent components among individuals with metabolic syndrome were: increase in abdominal circumference (83.3%), hypertriglyceridemia (66.7%) and low levels of HDL-c (50.0%). The elevation of the abdominal perimeter was the most frequent component. No statistical evidence of association between any of the components of the syndrome was found. These evidences suggest to improve the life habits of the workers evaluated, in terms of their nutrition and physical activity.

Keywords: metabolic syndrome, obesity, abdominal, lipoprotein, HDL, triglycerides, blood glucose, arterial pressure

1. Introduction

Metabolic syndrome-MS is a group of cardiometabolic disorders, recognized as independent risk factors that when associated predispose to develop cardiovascular disease, diabetes mellitus type 2, cerebrovascular disease and other health problems (Tsai, Chu, Chen, & Chu, 2018).

There is still controversy to establish the number of components of the MS, the International Diabetes Federation-IDF), Lung, and Blood Institute and American Heart Association / National Heart-NHLBI / AHA define three components, the abdominal perimeter being the fundamental indicator of the syndrome, taking into account the population and the specific country (Aykan et al., 2014; Basol et al., 2011; Maksimovic, Vlajinac, Radak, Marinkovic, & Jorga, 2012).

The epidemiological transition of Latin American countries presents a change to chronic noncommunicable diseases, the main cause of morbidity and mortality, with obesity classified among the ten main risk factors attributable to mortality in these countries (Chávez Canaviri, Mamani, & Phillco Lima, 2016; Pinzón Duque, 2015).

According to the unification of criteria, expressed in the joint statement (Harmonizing the Metabolic Syndrome), it includes: increase in abdominal circumference, specifically waist circumference > 40 inches in men and > 35 inches in women, triglycerides > 150 mg/dL; high-density lipoprotein cholesterol (c-HDL) <40 mg/dL or <50 mg/dL in men and women, respectively; blood pressure > 130/85 systolic/diastolic, respectively, and fasting blood glucose> 100 mg/dL. Similarly, the presence of the component or risk factor is defined if the individual is under antihypertensive treatment, drugs for dyslipidemia or medicated for glucose elevation (Lizarzaburu Robles, 2014; Silva, Stanton, & Grande, 2013).

Each of the components mentioned plays an individual role as a cardiovascular risk factor, which together increase this risk and explain the alterations that make up the metabolic syndrome. Central obesity involves the deposit of fatty tissue mainly in the liver, muscle and pancreas, considered as the physiological basis or the basic component for the development of MS, due to a close correlation with the components that define it, especially hyperglycemia, and an association between obesity and insulin resistance-IR (Laclaustra Gimeno, Bergua Martínez, Pascual Calleja, & Casasnovas Lenguas, 2005; Yang et al., 2016).

The above is a condition that involves a proinflammatory state decreasing the ability of insulin to exert actions on target organs that, ultimately leads to diabetes mellitus type 2, through several stages, beginning with the increase of levels of blood glucose and cardiovascular risk begins with microvascular complications progressing from an euglycemia to the onset of the disease (Zadhoush, Sadeghi, & Pourfarzam, 2015).

Dyslipidemias characterized by low levels of HDL-c and high triglycerides are the main risk factors for developing arteriosclerosis, being independent predictors of cardiovascular disease-CVD (Ama Moor et al., 2017; Tobert & Newman, 2016). In MS, the low density and altered structure of LDL cholesterol particularly promotes the development of arteriosclerosis, causing inflammation within the vascular wall (Khan et al., 2018). Another of the determining components of the metabolic syndrome are the high blood pressure or hypertension-HT, systolic and diastolic values, which show an independent relationship with heart failure, peripheral arterial disease and renal failure (Ding, Yang, Wang, Sun, & Zhan, 2018).

Currently, MS has taken great importance because of its high prevalence, which varies according to age, sex, ethnic origin, lifestyle and quality of life; It is estimated that about 34% of adults in the United States are diagnosed with this syndrome and that these figures are increasing in the world. In Latin America, a prevalence of 24.9% has been found (range: 18.8% to 43.3%) (Lizarzaburu Robles, 2014). In Venezuela, 31.2%, 25.0% in Peru and 37.2% in Mexico; whereas in Colombia the prevalence varies according to the classification used for the diagnosis, with values between 17.0% and 28.0% (Chávez Canaviri et al., 2016; Parra et al., 2015). In the study conducted in Bucaramanga Colombia, a good agreement was obtained when comparing the prevalence of the syndrome from the International Diabetes Federation (32.9%) with Adult treatment Panel-IIIa (34.0%) (Chávez Canaviri et al., 2016)

The MS is, therefore, a conglomerate of components or risk factors, which together lead to the development of CVD and type 2 diabetes, entities classified within the group of noncommunicable diseases, with greater impact due to their global morbidity and mortality figures, both estimated as projected over time (Aykan et al., 2014; Mathers & Loncar, 2006).

In Colombia, according to the figures issued by the Ministry of Health, cardiovascular diseases were the main cause of death between 2005 and 2014, accounting for 30.1% of deaths at the national level, with a variable and dependent national prevalence of both the population range evaluated as the diagnostic criterion used, reporting figures ranging from 4.0% to 8.4% (Aschner, 2010; Vargas-Uricoechea & Casas-Figueroa, 2016).

Taking into account this epidemiological panorama and recognizing that the evidence obtained from robust predictive models indicates that MS can double the risk of developing CVD or of presenting type 2 diabetes, regardless of the ethnicity or sex of the individual (Guo et al., 2018), it is relevant to determine the prevalence of MS and its components, as well as their possible associations, in order to find possible alarm indicators in sensitive populations, so that prevention and control measures can be directed for each of these risk conditions.

In this context, the present study determined the prevalence of metabolic syndrome, components and their relationship with sociodemographic variables, anthropometric and biochemical characteristics in workers of a higher education institution of Cartagena-Colombia.

2. Methods

An analytical cross-sectional study was conducted, with a probabilistic sample of 162 workers of both sexes, from a higher education institution in the city of Cartagena-Colombia. All individuals linked as workers were included, who consented to their participation in the study. Those workers with a medical or clinical diagnosis of major systemic disease, such as diabetes mellitus II, hypo/hyperthyroidism, a history of drug or alcohol abuse and suffering from inflammatory or infectious processes were excluded.

The sociodemographic data of each individual was recorded and a physical examination was performed that included the abdominal circumference by using a peripheral tape (II & SB) with pressure control and blood pressure. Size was recorded with digital height gauge calibrated in centimeters (II & SB, range between 40-600 cm) and weight was measured with Tanita® floor scale (model BC552, Continental Scale Corp., Bridgeview, III, USA) with resolution 0.100 kg. Also, clinical laboratory tests were performed for the analysis of the lipid profile (total

cholesterol, HDL cholesterol and triglycerides) and fasting glycemia, determined by enzymatic colorimetric and automated methods (HumaStar 100, Human Diagnostic, USA).

The parameters established by the American Heart Association (AHA) [19] were used to determine the presence of risk factors associated with metabolic syndrome, which included: waist circumference> 40 inches in men and> 35 inches in women; triglyceride levels> 150 mg/dL; HDL cholesterol <40 mg/dL for men and <50 mg/dL in women; systolic and diastolic blood pressure> 130/85 mm Hg, respectively, and fasting blood glucose levels> 100 mg/dL (Kramer, 2015).

Regarding the data analysis plan, the categorical variables were expressed in proportions and in their respective 95% confidence intervals. For the numerical variables, the measures of central tendency and dispersion were estimated according to the result of the goodness of fit test (Shapiro-Wilk test). The Chi-square independence test was used to identify the statistical associations between variables. To establish statistically significant differences between two independent groups, we interpreted the 95% confidence intervals of the difference ($CI95\%_{diff}$) between the estimated independent proportions.

All these procedures were performed with the statistical programs IBM® SPSS® Statistics version 23.0 (IBM Corp, Armonk, New York), GraphPad PRISM® version 6.01 (GraphPad software, San Diego, CA), EpiDat 3.1® (General Directorate of Innovation and Xestión da Saúde Pública, Xunta de Galicia, Spain, Pan American Health Organization and Higher Institute of Medical Sciences of Havana).

3. Results

The total population of workers consisted of 162 individuals, with a predominance of females (108/162, 66.7%, CI95% 59.1% to 73.5%). The median age of the population was 40 years (IQR: 32.8 to 47.0). Likewise, the median length of service and seniority corresponded to 6 years (IQR: 2.0 to 13.3) and 7 years (IQR: 2.8 to 16.0), respectively.

As for the socioeconomic stratum, the population studied (120/162, 74.1%, CI95% 66.8% to 80.2%) belonged to the first, second and third level, in addition their place of origin and residence was Cartagena-Colombia (82/162; 50.6%; CI95% 43.0% to 58.2%).

Table 1 shows the anthropometric and biochemical characteristics of the population evaluated.

We estimated an overall prevalence of MS of 11.1% (18/162, CI95% 7.1% to 16.9%). The risk profiles of metabolic syndrome are presented in Table 2. No significant difference could be found between the prevalence of MS estimated in men and women ($CI95\%_{diff}$ -11.9% to 8.9%, p=0.596). None of the five risk profiles of MS was related to the sex of the worker (p=0.291).

Table 1. Anthropometric and biochemical characteristics of the study subjects

Anthropometric characteristics	*Median*	CI95%	
		LL	UL
BMI (Kg/m^2)	26.5	23.9	28.5
Waist circumference (cm)	89.4	82.8	92.3
	n (%)	CI95%	
		LL	UL
Normal	61 (37.7)	30.6	45.3
Overweight	80 (49.4)	41.8	57.0
Obese	21 (13.0)	8.6	19.0
Biochemical characteristics	*M*edian	IQR	
		LL	UL
Total cholesterol (mg/dL)	175.0	148.0	204.0
Triglycerides (mg/dL)	90.0	74.0	141.0
HDL cholesterol (mg/dL)	48.0	41.0	57.0
Fasting glucose (mg/dL)	83.0	78.0	89.0

BMI: body mass index; LL: lower limit; UL: upper limit; IQR: interquartile range

Table 2. Risk profiles for metabolic syndrome in study subjects

Components	Female n (%)	Male n (%)	$CI95\%_{diff}$
0	23 (21.3)	20 (37.0)	1.3% to 30.7%
1	38 (35.2)	17 (31.5)	-18.0% to 12,0%
2	34 (31.5)	12 (22.2)	-22.2% to 5.8%
3	9 (8.3)	3 (5.6)	-10.5% to 7,5%
4	4 (3.7)	2 (3.7)	-6.1% to 9,1%
5	0 (0.0)	0 (0.0)	-3.4% to 6.6%

$CI95\%_{diff}$: 95% confidence interval for the difference of two independent proportions

The most frequent components among individuals with metabolic syndrome were: increase in abdominal circumference (15/18, 83.3%, CI95% 60.8% to 94.2%), hypertriglyceridemia (12/18, 66.7%, CI95% 43.8% to 83.7%), high blood pressure (10/18, 55.6%: CI95% 33.7% to 75.4%) and low levels c-HDL (9/18, 50.0%, CI95% 29.0% to 71.0%). The combinations between the MS components found in the study population are shown in Table 3. No statistical evidence of association between any of these components was found (Table 4).

Table 3. Distribution of different combinations of components of metabolic syndrome

Three components	n	%
HWC + HBP + HFG	1	4.2
HWC + HBP + L-HDL-c	6	25.0
HWC + HBP + HTG	5	20.8
HWC + HFG + L-HDL-c	2	8.3
HWC + HFG + HTG	1	4.2
HWC + L-HDL-c + HTG	5	20.8
HBP + HFG + L-HDL-c	1	4.2
HBP + L-HDL-c + HTG	3	12.5
Four components		
HWC + HBP + HFG + L-HDL-c	1	33.3
HWC + HBP + L-HDL-c + HTG	2	66.6

HWC: high waist circumference; HBP: high blood pressure;

HFG: high fasting glucose; L-HDL-c: low HDL cholesterol levels;

HTG: hypertriglyceridemia.

Table 4. Association among metabolic syndrome components

Components	Abdominal obesity	High fasting glucose	Low HDL-c	Hypertriglyceridemy
High fasting glucose	0.193			
Low HDL-c	0.963	0.677		
Hypertriglyceridemy	0.949	0.897	0.427	
High blood pressure	0.639	0.936	0.230	0.488

HDL-c: HDL cholesterol.

4. Discussion

In the population of workers studied, a prevalence of metabolic syndrome of 11.1% was reported, comparable with occurrences published in similar studies (Alegría, 2005; Kim, 2009), but lower than those reported in workers from different productive sectors (Benet Rodríguez, 2007; Coniglio et al., 2009; Sirit, Acero, Bellorin, & Portillo, 2008), including workers at university institutions (Dosman, Triviño, Uribe, Agredo, & Jerez, 2009; Espinosa, 2014; Lizarazu Díazgranados, Rossi Trespalacios, Iglesias Acosta, & Mendoza Torres, 2010; Martínez, Leiva, & Celis-Morales, 2016; Sandoval, 2016).

The similarity between estimated prevalence in men and women is consistent with that reported by other authors (Li, Zhao, Yu, Wang, & Ding, 2018; Song et al., 2015; Soto, Vergara, & Neciosup, 2005), although it should be noted that there are studies with discordant results, which present a higher occurrence of MS in women compared to men (Álvarez Gasca, Hernández Pozo, Jiménez Martínez, & Durán Díaz, 2014; Ogbu, 2012; Tadewos, Egeno, & Amsalu, 2017; Yu, Guo, Yang, Zheng, & Sun, 2015) or vice versa (Morejón Giraldoni et al., 2011; Schettini, 2004).

These discrepancies observed between the prevalence reports of MS and its possible relationship with the sex of the worker could be explained, in part, by: the diagnostic criteria used (Basol et al., 2011) and by the requirements of working conditions.

In relation to the estimated prevalence for the components of the metabolic syndrome, several studies stand out among the highest figures, the increase in abdominal perimeter, hypertriglyceridemia and the decrease in HDL cholesterol (Ansarimoghaddam et al., 2018), with some differences in order according to sex (Sandoval, 2016). The differences found when comparing the prevalence of the components of the syndrome with that reported in the literature could be explained from the heterogeneity of the studied populations in terms of cultural aspects, lifestyles, profession, occupation, morphology, beliefs, etc.,

As described, the MS defines the presence of three or more components, which are related to each other for the development of various pathologies especially cardiovascular and hepatic (Katsiki, Perez-Martinez, Anagnostis, Mikhailidis, & Karagiannis, 2018; Lee et al al., 2018). The component with the highest prevalence found in the evaluated workers was the abdominal adipose tissue, in this sense, the literature states that the tissue participates in the release of different substances favoring the appearance of a proinflammatory state, insulin resistance or endothelial damage. In addition, the increase of fatty acids in the liver, produces gluconeogenesis, increasing the production of triglycerides, lowering HDL cholesterol and therefore generating greater prothrombotic activity, leading to hepatic steatosis which is the first condition that has to be given so that Oxidative stress occurs, which is the genesis of the inflammatory process in non-alcoholic fat disease of the liver (Pinzón Duque, 2015; Starkova & Dvoriashina, 2004).

A related limitation of this study is in their inability to demonstrate a temporal relationship which limits the ability to infer causation. Another limitation is that the survey is a self- report of behavior.

5. Conclusions

The prevalence of metabolic syndrome estimated in the study population is lower than other studies conducted in similar populations. The three most frequent components were: increased abdominal circumference, hypertriglyceridemia, and low HDL-C levels. However, when establishing the associations between the possible combinations of all the components of the metabolic syndrome, no statistically significant findings were obtained. In short, the evidence found in this population of workers suggests improving their life habits, in terms of nutrition and physical activity.

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Competing Interests Statement

The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

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