The San José de Cúcuta Metabolic Syndrome Prevalence Study: Design and Scop

El Estudio de Prevalencia de Síndrome Metabólico de la Ciudad de San José de Cúcuta: Diseño y Alcance

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Abstract

The metabolic syndrome (MetS) is a cluster of interrelated risk factors -including obesity, atherogenic dyslipidemia, hypertension, and insulin resistance, which exponentially increase the risk of developing cardiovascular disease and type 2 diabetes mellitus. The purpose of this cross-sectional study is to determine the prevalence of MetS according to the International Diabetes Federation (IDF) and the last harmonizing MetS criteria in adult individuals of both sexes from San José de Cúcuta, Colombia, a medium-size city belonging to the North of Santander Department, with a population of 587.676 inhabitants according to the 2005 census information conducted by the National Statistic Administrative Department (DANE) with a projection by 2017 of 662.765 persons. Likewise, DANE projects that 68.5% (454.077 hab) of Cucutan population will be over 18 years by 2017, so that, using these data, the sample size for San José de Cúcuta is 2200 adult persons for a 95% confidence interval and a maximum accepted sampling error of 5%.

Data derived from both, medical and laboratory examination (smoking habit, socioeconomic status, ethnicity, alcohol consumption, nutritional habits, physical activity by IPAQ, blood pressure, anthropometry, and blood chemistry and endocrinology panel) will be conducted by trained health professionals and medical students.

There is a clear lack of evidence regarding the prevalence of cardio-metabolic risk factors and local cut-off points for biological quantitative variables i.e. abdominal circumference, body mass index, fasting insulin, Homeostasis Model Assessment, among others. In the near future, this study will contribute for new evidence, providing firsthand accurate evidence about MetS behavior in our country.

Keywords: metabolic syndrome, cardiovascular risk factors, hypertension, dyslipidemia, obesity.

Introduction

The metabolic syndrome (MetS) is a cluster of interrelated cardio metabolic risk factors -including abdominal obesity, atherogenic dyslipidemia, hypertension, and dysglycemia, driving to a 5-fold increase in T2DM risk, 2- to 4-fold increased risk of stroke, a 3 to 4-fold increased risk of myocardial infarction (MI), and 2-fold death risk when comparing with those without MetS[1-5]. The major risk factors for developing MetS are physical inactivity and a diet high in fats and carbohydrates, contributing to the two central clinical features, i.e. central obesity and insulin resistance (IR). Obesity is a key point to MetS development as it appears to precede the subsequent clustering of the other MetS components[6].

The results from both, the Third National Health and Nutrition Examination Survey (NHANES III) and NHANES continuous trends show an alarming prevalence increase in MetS and obesity among USA population[7]. Regrettably, this picture closely mirrors the epidemiological behavior of this condition in most of westernized life styles countries leading a comprehensive research effort with the aim to elucidate its pathophysiology, fine molecular events and developmental determinants, time-spatial and ethnic frames, clinical features, risk profiles, and both – the set of diagnostic criteria and its ethnic-specific cut-off points-impacting on MetS prevalence and predictive its impact[8]. In this context, it is particularly remarkable the lack of cut-off points and reference intervals in each MetS component for Latin American (LA) population, a fact extremely necessary when considering the different ethnic groups living in our countries, ranging from Hispanic-Whites, Amerindians, Afro-Americans to a well-recognized American blended race, limiting the applicability of any MetS definition, as well as any preventive measure in our region[9-13].

The main purpose of this project is to determine the MetS prevalence in adult individuals from San José de Cúcuta, Colombia, according to the criteria proposed by: a) The International Diabetes Federation[8], b) The Third Report of the National Cholesterol Education Program Expert Panel on Detection, Evaluation, and Treatment of High Blood Cholesterol in Adults (ATP III)[14], c) The harmonized MetS according IDF/AHA/ADA/IAS/NHLBI,IASO-2009 (IDF-2009)[15] d) a novel MetS set of criteria derived from an exhaustive variable analysis in our locality, namely, fasting blood glucose, abdominal circumference, blood pressure levels and Triacylglycerides/High density lipoproteins levels. Alongside, the specific objectives of the study are the following: A) to determine the prevalence of individual MetS components (T2DM, hypertension, hypertriacylglyceridemia, low c-HDL and abdominal obesity) B) To determine the cut-off points for waist circumference (WC), blood pressure, fasting blood glucose, Lipoprotein (a), serum triacylglycerides and high density protein (c-HDL), C) to analyze the behavior and determinants of psychobiologic habits like alcohol consumption, tobacco smoke, physical activity, total calories intake, feeding patterns and its relationship with MetS diagnosis. The association (or lack thereof) of family history of CVD with the occurrence of MetS and the calibrated Framingham-Wilson risk score equation construction will be also analyzed. This work is meant to add a more profound knowledge of this noxa in our geography, developing better tools for a proper preventive and curatives strategies.

Materials and methods

Study design, sample size calculation and sampling process

This research project is a cross-sectional study based in a representative sample from the San José de Cúcuta, North of Santander Department, Colombia. According to the last Colombian census conducted by the National Statistic Administrative Department (DANE) in 2005[16], San José de Cúcuta had a population of 587.676 inhabitants with a 2017 projection of 662.765 habitants, of which 68.5% will be over 18 years. Taking this information along with an expected prevalence of MetS in the adult population of 27% (derived of small regional studies), an absolute precision between of 5%, a confidence level of 95%, and a design size effect of 2, the sample size estimate for our city is 1986 adult individuals, which will be proportionally distributed among ten "comunas" (districts equivalent) of the city. For the purpose of this study, a complex, multi-stage probability sampling design will be applied to select participants' representative on the civilian (non-institutionalized) citizens, using a 4-stage sampling process with a similar methodology proposed by NHANES III[17]: During the first stage, the primary sampling units (PTU) are selected. These are geographic areas constituted by "barrios" (neighborhoods) with a probability proportional to a measure of size (PPS) approach. In the second sampling stage, the PTU will be divided in blocks or their equivalent. As with each PSU, sample segments are selected with PPS. In the Stage 3, households within each segment are listed, and a sample is randomly drawn. In the stage 4, individuals are chosen to participate in the study from a list of all adult residents in selected households. A sample weight is assigned to each sampled person as a measure of the number of people in the population represented by that sample person, reflecting the unequal probability of selection, non-response adjustment, and adjustment to independent population controls. When unequal selection probability is applied, the sampling weights are used to produce an unbiased estimated. Finally, the selected individuals from each family unit who fulfill the inclusion criteria will be invited to participate and interviewed prior written consent sign, and subjected to a routine medical examination using a clinical chart as a data collecting tool.

Measures to improve enrollment process

The following measures will be taken to facilitate and encourage the participation of the selected individuals: a) paperwork explaining all process involved in patient evaluation will be performed and given to the participants; b) involvement of local health professionals will be guaranteed; c) invitations will be sent directly through the local community leaders, or through a professional social worker in primary health centers whom are part of the communities; d) the invitations will be confirmed by telephone; e) the evaluation site and blood samples will be taken as near as possible of the participant home (either in a school, local community center, or primary care center). All data collection will be conducted by health professionals, medical students, nutritionists, sociologist, psychologist, and nurses (previously trained), belonging to the "Endocrine and Metabolic Diseases Research Center" (CIEM), University of Zulia, Venezuela, and the Altos Estudios de la Frontera (ALEF) research group, Cúcuta – Colombia.

Personnel training program

In order to get full trained personnel, special sessions regarding handle the electronic medical record software will be necessary, so that, the recollection of data like demographics, family, and personal history was indeed accurate. Also, a rigorous preparation and evaluation will be applied to all trainees, so that the anthropometric evaluation could be done swiftly and precisely; this included height, weight, and abdominal circumference. For the physical examination, special sessions on semiology maneuvers were done, so the proper and standardized protocol was followed during this particular exam. All of these were supervised by a qualified instructor.

Variables definition and evaluation

Smoking habit: To define smoking habit, the Brinkman index was applied, which is obtained multiplying the number of cigarettes consumed daily per number of years with

this habit. A smoker was considered when the person is an active cigarette consumer with a Brinkman index equal or above 801[18], and a recent former smoker (less than a year) were also categorized as smoker. A non-smoker was defined as the person to have never smoked or not achieving a positive index value.

Socioeconomic status: It was studied applying the Graffar scale modified by Mendez Castellano[19], whose criteria are as follows: a. profession of the head of the family, b. instruction level of the mother, c. source of income, and d. housing conditions. The strata were defined according to the score obtained from the arithmetic sum of each criterion; having then: Stratus I (high class), Stratus II (medium high class), Stratus III (medium class), Stratus IV (working class), and Stratus V (extreme poverty). Such a scale was developed for the Venezuelan population, but it has been validated and used in other LA studies where the unequal economic, cultural, and social levels are evident, and influence social behavior, growth, alimentary habits, and biologic development.

Physical activity: As a tool for evaluating physical activity (PA), the International Physical Activity Questionnaire (IPAQ)[20] was used. It is a tool that has been extensively used in clinical and epidemiologic studies to assess physical activity in countries with different cultures and sociocultural classes. It is based on the physical activity preformed in the last 7 days, and it takes into account 4 elements of evaluation: a. physical activity in leisure time, b. domestic and gardening activities, c. physical activity related to work, and d. physical activity related to transport. IPAQ scoring consider 3 PA levels: low, moderate, and high, using as measuring unit the metabolic equivalent, defined by the energy consumption of an individual in a resting state, which is 1 kcal/kg/hour approximately (4.184 kJ/kg/hour)[21].

Race: Many concepts of ethnicity/race have been developed, and most of them have been controversial. The definitions tend to classify human groups according to socio-anthropologic customs and cultural aspects of each homogeneous human cluster, without taking into account its genetic background. In biomedicine, there is a clear relationship between racial groups and the aggregation of some diseases. In this matter, several studies have been conducted using this ethnic classification[22]: a. Amerindians or American Aborigines, b. mixed race, c. Afro-Americans, d. Orientals, e. Hispanic Whites and f. Arabs.

Alcohol Consumption: The American Heart Association[17] criteria are taken into account to consider if a person is a drinker or not. An alcohol drinker was considered when that individual drank over 30 g of alcohol (2 glasses of wine or its equivalent) per day, or, 210 g of ethanol per week. The CAGE[23] and AUDIT[24] test was applied to detect alcohol related problems, Nutritional status evaluation: They were defined by a validated questionnaire[25]; and for this purpose, the examination was divided into 2 parts: (a) 24 hours recall and (b) listing of alimentary preferences and consumption frequency. From these data, alimentary preferences, daily calories obtained from carbohydrates, lipids, proteins, micro-nutrients and the approximate ingestion of hydrophilic and lipidic vitamins, daily ingestion of cholesterol, saturated fats, mono, and polyunsaturated fats will be calculated[26].

Blood Pressure Measuring: It will be done using the auscultatory method for which a calibrated sphygmomanometer will be used. The patients will be sitting still—with their feet on the ground—for less than 15 minutes before the determination. During the procedure, the arm will be at the same level of the heart, being the systolic pressure the first sound that is heard (phase 1) and diastolic pressure the point where the sound fades (phase 5). The procedure will be done 3 times, 15 minutes apart from each other, and at least, in 2 different days[27,28].

Basic Anthropometry: A. Waist circumference (WC) and Waist-to-hip ratio[29] will be assessed using a plastic measuring tape graded in centimeters and millimeters, in a spot equidistant to the lower ribcage border and the anterior–superior iliac spine. B. Height will be measured using a metal height measurer graded in centimeters. The results will be converted to meters dividing the result into 10. C. Body mass index will be calculated applying the equation: weight over square height (kg/(height)^2 in meters[30]. D. Neck Circumference (NC) will be measured in the midway of the neck, between midcervical spine and midanterior neck, to within 1 mm[31].

Impedanciometric Measures: It will be undertaken using a digital 2 electrode impedanciometer (TBF-310GS, Tanita, Japan). The protocol involved previous preparation aiming to standardize the hydration status to undergo the BIA assessment and consisted of the following: be at least seven days after the last menstrual period and seven days before the next; undergo complete fasting in the previous 12 hours; refrain from physical exercises in the previous 12 hours; no alcohol consumption in the previous 48 hours; no use of diuretics for at least seven days before the assessment; and urination 30 Minutes before the assessment[32-34].

Laboratory Analysis: After 8-12 hours of fasting, serum levels of total cholesterol, triacylglycerides (TAG), HDL-C and basal glycemia will determined using computerized equipment (Human Gesellschoft Biochemica and Diagnostica MBH, Magdeburg, Germany). The time between sample taken and its processing never will exceed 3 months. Low density lipoprotein (LDL) levels will be calculated using the Fridewald equation if triacylglycerides levels are below 400 mg/dL, and if they are above, they will be determined by electrophoresis of lipoproteins in agarose gel and ulterior band densimetry (GS-800 densitometer, Bio-Rad, Hercules, CA). Fasting insulin will be quantified using a commercial

ultrasensitive ELISA-based kit (DRG international. Inc. USA. New Jersey), with a detection limit of <1 mU/L. HOMA2-IR and HOMA2-bcell models will be calculated using the HOMA Calculator[35]. Likewise, Lipoprotein(a) [Lp(a)] concentration will be determined using the turbidimetric latex method (Human Gesellschoft Biochemica and Diagnostica MBH, Magdeburg, Germany) with a threshold of ≥30 mg/dL. High sensivity C-Reactive Protein (hs-CRP) will be assessed employing turbidmetric immune essays (Human Gesellschoft Biochemica and Diagnostica MBH, Magdeburg, Germany). Finally, serum TSH, FT3 and FT4 concentration will be determined using a commercial ELISA kit (DRG International Inc. USA). Subclinical Hypothyroidism diagnosis was made according to NHANES criteria: normal levels of FT4 (0.9-1.9 ng/dL) with an elevated TSH level (≥4.12 mUI/L) and absence of prior personal history of thyroid disease[36]. Anti-TPO and anti-tiroglobulin antibodies will be quantified by ultra-sensitive ELISA method.

Neurocognitive evaluation: this will be assessed using the Alzheimer's Early Detection test proposed by Cuetos-Vegas et al.[37], using a 10 memory task survey.

Metabolic Syndrome definitions

The MetS diagnostic criteria used in this study will be:

1. Harmonized IDF-2009 classification (require 3 of the following 5 variables):

a) Elevated WC (Men ≥90 cm and Women ≥80 cm); b) Hypertriacylglyceridemia ≥150 mg/dL or specific treatment for this abnormality; c) Low HDL-C, Men <40 mg/dL, Women <50 mg/dL or specific treatment for this abnormality; d) Elevated Blood Pressure, Systolic ≥130 mmHg, Diastolic ≥85 mmHg, or previous diagnosis of hypertension; e) Elevated Fasting Glucose, Glycemia ≥100 mg/dL or drug treatment for hyperglycemia[15].

2. The IDF-2005 classification stated the following: mandatory elevated WC (Men ≥90 cm and Women ≥80 cm) plus any two of the following: a) Hypertriacylglyceridemia ≥150 mg/dL or specific treatment for this abnormality; b) Low HDL-C, Men <40 mg/dL and Women <50 mg/dL or specific treatment for this abnormality; c) Elevated Blood Pressure, Systolic ≥130 mmHg, Diastolic ≥85 mmHg, or previous diagnosis of hypertension; d) Elevated Fasting Glucose, with Impaired Fasting Glycemia ≥100 mg/dL or previous diagnosis of T2DM[8].

3. The ATPIII-2005 classification require 3 of the following 5 components: a) Elevated WC (Men ≥102 cm and Women ≥88 cm); b) Hypertriacylglyceridemia ≥150 mg/dL or specific treatment for this abnormality; c) Low HDL-C, Men <40 mg/dL, Women <50 mg/dL or specific treatment for this abnormality; d) Elevated Blood Pressure, Systolic ≥130 mmHg, Diastolic ≥85 mmHg, or previous diagnosis of hypertension; e) Elevated Fasting Glucose: Glycemia ≥100 mg/dL or drug treatment for hyperglycemia[14,38].

Supervising procedures

Supervision of the data quality will be done in all the levels of the processing. The evaluation from each coordinator at each level assured that the data recollection was according to protocol. The monitoring of equipment, including mercury sphygmomanometers, was verified and calibrated periodically throughout the whole project.

Data processing

The arrival and processing of all the data will be done within the CIEM and AEF. The medical history and various data will be physically stored and their information digitalized. The processing personnel were capacitated in the proper use of the programs, and all the data were inserted in duplicates to obtain higher security in the process. An audit data base process will be done in 20% of the SPSS patient´s data grid.

Statistical analysis

Study forms were reviewed to ensure that they were complete before data entry. Data will be entered by duplicate into SPSS 22.0 (SPSS Inc., IBM Chicago, IL) for Windows spreadsheets and compared using Epi-Info 2000 (CDC, Atlanta, GA). Any discrepancy was corrected using the original study record. Qualitative variables will be expressed as absolute and relative frequencies and their potential association will be evaluated by the $\chi 2$ (Chi square) test and the difference between proportions will be assessed with the Z Test. Quantitative variables distribution will be evaluated by the Geary´s test and those with not normal distribution will be submitted to logarithmic transformation. The quantitative variables were expressed as arithmetic means ± standard deviation (SD), except CRP-us which will be expressed as median and p25-p75. t-Student test and one-way ANOVA with Tukey´s post-hoc analysis will be employed in order to assess differences between arithmetic means. For medians comparisons the Mann-Whitney´s U test will be employed.

The association between components of MetS and the Homeostasis Model Assessment index and other quantitative n-tiles will be analyzed through a logistic regression model considering adjustments by clustering effect. The degree of concordance between SM classifications was determined employing both, the Cohen's Kappa coefficient and the Landis-Koch´s assessment scale[39,40]. This scale covey a classification for kappa agreement results: a) <0,00: no agreement; >0,00-0,20: insignificant; 0,21-0,40: discreet; >0,41-0,60: moderate; 0,61-0,80: substantial; 0,81-1,00: near perfect. The data were analyzed employing the Statistical Package for Social Sciences ver. 22 for Windows (SPSS IBM Chicago, IL). The results were considered statistically significant if $p<0,05$.

ETHICAL CONSIDERATIONS

The study protocol was designed in compliance with the Helsinki declaration and approved by the Research Ethics Board from the CIEM and ALEF. Consent was obtained from all participants as mentioned above.

In 1999, the World Health Organization (WHO) consultant group published the first MetS definition[41], whose principal aspect was the biologic and physiologic description of the insulin resistance as the main feature of this entity. It was also recognized that CVD was the primary adverse outcome of the syndrome. Afterward, other MetS definitions came to the spotlight, for example, The European Group for the study of Insulin Resistance[42] in 1999, The National Cholesterol Education Program/Adult Treatment Panel III (ATP III) in 2001[14] (which was popular due to its simplicity), The American Association of Clinical Endocrinologists MetS diagnostic criteria[43], and many others. Yet, it was not until 2005 that the International Diabetes Federation (IDF) founded a consensus group whose purpose was to establish a new definition for MetS that could be used in epidemiologic and clinical trials all around the world. They proposed that central obesity is the mandatory requisite that was necessary to make the diagnosis, and for the first time, cut-off values for WC were offered for different ethnic groups[8].

Knowing previous statements, one of the most important observations to IDF classification resides in cut-off points for each studied variable because LA countries have no population studies that could establish a proper cut-off point to numerically separate a normal from abnormal value, and of course, the attributable risk to each variable measure. In fact, IDF asks that any investigator in need of such values—for abdominal circumference, for example—must assume that Eastern Asians cohort data are good enough for research purposes in LA context. This simple suggestion is quite delicate because there are few studies in our countries evaluating MetS behavior; so applying Asian data could be wrong in the sense of lack of concordance between ethnic groups. That is why one of the goals of this trial is to shed some evidence on the epidemiologic aspects of MetS taking as pattern the IDF and ATP III classifications, and afterward, to be able to set cut-off points in accordance to the peculiarities of our population.

Despite this weakness, some research groups have explored the epidemiologic behavior of MetS in Hispanic whites and mixed LA groups. For instance, in 2005, the Metabolic Syndrome in Active Subjects (MESYAS) study was conducted in 7256 active Spanish workers. They applied the ATP III criteria for MetS diagnosis, revealing a prevalence of 10.2%, and it was associated with age, male gender, obesity diagnosis, hypertension, and/or diabetes mellitus. These results indicate that 1 out of every 10 workers had MetS[44]. The Mexican National Health and Nutrition Survey 2006 reported a MetS prevalence in Mexican adults aged 20 years or older according ATP III-2001, ATP-2005, and the International Diabetes Federation (IDF) definitions of 36.8, 41.6 and 49.8%, respectively. A similar trend is observed in Talca, Chile, based on a study done in 2007, where high cardiovascular risk factors prevalence compared with what was observed during the National Health Survey of 2003. In the 2007 study, 1007 individuals who were 18–74 years old were used as population sample (with 66% women), showing an elevated percentage of smoking individuals (70.1%), and obese/overweight subjects (45%). High blood pressure was present (37%), along with hypercholesterolemia (44.5%), low c-HDL (21.5%), and hyperglycemia (26.3%). The prevalence of metabolic syndrome according to the IDF and ATP III criteria was 36.4% and 29.5%, respectively after adjustment for age and sex[45]. This allows us to see that there is an array of environmental factors and life style issues that LAs people are living with that enhances the risk for such disorders.

More recently, a work from Scuteri et al. from the Metabolic Syndrome and Arteries Research (MARE) Consortium made in 12 cohorts from 10 European countries and one cohort from the USA (34,821 subjects), the prevalence of MetS according 2001 ATP III criteria was 24.3% (8468 subjects: 23.9% in men vs. 24.6% in women, $p < 0.001$) with an age associated increase in its prevalence in all the cohorts[46].

The risk factors for MetS and its components have been poorly investigated in a Latin America context, indeed, only one study assessed MetS behavior in a multi-country context, the Cardiovascular Risk Factor Multiple Evaluation in Latin America study (CARMELA), a cross-sectional trial comprised individuals (n: 11,550) aged 25 to 64 years, living in Barquisimeto, Bogota, Buenos Aires, Lima, Mexico City, Quito, and Santiago that investigated CVD risk factors and MetS prevalence. The investigators found that MetS was most prevalent in Mexico City (27%) and Barquisimeto (26%), followed by Santiago (21%) and Bogota (20%); lower prevalence was found in Lima (18%), Buenos Aires (17%), and Quito (14%). Overall, metabolic syndrome was more prevalent in women than men (22% vs 20%, respectively), with the exception of Buenos Aires and Barquisimeto where more men than women had metabolic syndrome. As expected, the prevalence of MetS increased with age. In all cities, women showed markedly greater increase in metabolic syndrome with increasing age than men; in the oldest age group, female prevalence (range 25% to 49%) was greater than male prevalence (range 13% to 38%) in all cities except Buenos Aires. Of the components of MetS, the abdominal obesity was notably more prevalent in women than men, and the difference was accentuated in successively older age groups[11,47]. In a recent investigation, alarming findings were observed in the Maracaibo

City Metabolic Syndrome Prevalence Study[13], a cross-sectional study conducted in a representative sample of 2.230 adult individuals from Maracaibo, Venezuela. ATPIII-2005, IDF-2005 and harmonized IDF-2009 MetS criteria were employed to analyze MetS prevalence and the agreement levels of these classification systems. The investigators found a MetS prevalence of 42,4%, 41,6% and 35,5% according harmonized IDF-2009, IDF-2005 and ATPIII-2005 respectively. The agreement level between harmonized IDF-2009 and ATPIII-2005; IDF-2005 and ATPIII-2005 and IDF-2005 and harmonized IDF-2009, exhibited a kappa index of k=0.98 (p<0,000001); k=0.86 (p<0,00001) and k=0.84 (p<0,0001) respectively[9,13,48].

Although there have been studies that have assessed the prevalence of MetS in Colombia, these have been conducted in specific subgroups, such as a study in college students by Alfonso et al. in 249 young individuals admitted to the National University of Colombia in Bogotá[49] with a MetS prevalence of 2,4%, or the work of Arteaga et al, 2010 in a sample of 614 civilian aircraft pilots (MetS prevalence of 6%)[50]. An exception of this landscape is the work of Davila et al, 2013 whom assessed the prevalence and risk factors for metabolic syndrome (MetS) among adults from Medellin and surrounding municipalities in a sample of 3.000 adult individuals. Of these, 21.4% had high blood pressure (HBP) and 64% had abdominal obesity. In the subsample with serum data (n=943), 19.8% had high fasting serum glucose, 43.9% had high triglycerides (HTG), 56.6% had low c-HDL and a MetS overall prevalence of 41%. Increasing age was associated with MetS and all components except low c-HDL[51].

There is clear evidence that there is a lack of research and validated values to use as reference in our study. Even though the IDF suggested that when studying LA population, they should rely on Asian data. Taking into account all that has been exposed here, we strongly believe that the results of this study will help establish globally acceptable criteria for the early detection and intervention of MS in urban population of Colombia. Moreover, they will provide policy makers, health care providers, and educators from a developing country like Colombia with an opportunity to guide primary and secondary preventive initiatives at individual and community levels.

Finally, this work will serve as a pilot study for the numerous statistical and epidemiologic investigations that will come afterward, providing first hand accurate evidence on the behavior of the MS and its components in our city population.

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References

1. Gami AS, Witt BJ, Howard DE, Erwin PJ, Gami LA, Somers VK, et al. Metabolic Syndrome and Risk of Incident Cardiovascular Events and Death. J Am Coll Cardiol. 2007 Jan;49(4):403–14.
2. Galassi A, Reynolds K, He J. Metabolic Syndrome and Risk of Cardiovascular Disease: A Meta-Analysis. Am J Med. 2006 Oct;119(10):812–9.
3. Ford ES. Risks for all-cause mortality, cardiovascular disease, and diabetes associated with the metabolic syndrome a summary of the evidence. Diabetes Care. 2005;28(7):1769–1778.
4. Bruno G, Merletti F, Biggeri A, Bargero G, Ferrero S, Runzo C, et al. Metabolic syndrome as a predictor of all-cause and cardiovascular mortality in type 2 diabetes the Casale Monferrato study. Diabetes Care. 2004;27(11):2689–2694.
5. Malik S. Impact of the Metabolic Syndrome on Mortality From Coronary Heart Disease, Cardiovascular Disease, and All Causes in United States Adults. Circulation. 2004 Sep 7;110(10):1245–50.
6. Cameron AJ, Boyko EJ, Sicree RA, Zimmet PZ, Söderberg S, Alberti KGMM, et al. Central Obesity as a Precursor to the Metabolic Syndrome in the AusDiab Study and Mauritius. Obesity. 2008 Dec;16(12):2707–16.
7. Ford ES, Giles WH, Dietz WH. Prevalence of the metabolic syndrome among US adults: findings from the third National Health and Nutrition Examination Survey. Jama. 2002;287(3):356–359.
8. Alberti K, Zimmet P, Shaw J. Metabolic syndrome—a new world-wide definition. A Consensus Statement from the International Diabetes Federation. Diabet Med. 2006;23(5):469–480.
9. Bermúdez V, Rojas J, Salazar J, Calvo MJ, Morillo J, Torres W, et al. The Maracaibo city metabolic syndrome prevalence study: primary results and agreement level of 3 diagnostic criteria. Rev Latinoam Hipertens. 2014;9(4):20–32.
10. Bermúdez VJ, Finol FJ, Leal N, Parra MG, Peñaranda LP, Pérez AC, et al. Prevalencia del síndrome metabólico en la población adulta Añú de la laguna de Sinamaica del Municipio Páez, estado Zulia. Rev Latinoam Hipertens. 2009;4(3):64–70.
11. Schargrodsky H, Hernández-Hernández R, Champagne BM, Silva H, Vinueza R, Silva Ayçaguer LC, et al. CARMELA: Assessment of Cardiovascular Risk in Seven Latin American Cities. Am J Med. 2008 Jan;121(1):58–65.
12. Márquez-Sandoval F, Macedo-Ojeda G, Viramontes-Hörner D, Fernández Ballart J, Salas Salvadó J, Vizmanos B. The prevalence of metabolic syndrome in Latin America: a systematic review. Public Health Nutr. 2011 Oct;14(10):1702–13.
13. Bermudez V, Marcano RP, Cano C, Arráiz N, Amell A, Cabrera M, et al. The Maracaibo city metabolic syndrome prevalence study: design and scope. Am J Ther. 2010;17(3):288–294.
14. Expert Panel on Detection E. Executive Summary of the Third Report of the National Cholesterol Education Program (NCEP) Expert Panel on Detection, Evaluation, and Treatment of High Blood Cholesterol in Adults (Adult Treatment Panel III). JAMA. 2001 May 16;285(19):2486–97.
15. Alberti KGMM, Eckel RH, Grundy SM, Zimmet PZ, Cleeman JI, Donato KA, 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 Oct 20;120(16):1640–5.
16. Inicio [Internet]. [cited 2015]. Available from: http://formularios.dane.gov.co/Anda_4_1/index.php/home
17. NHANES - NHANES III Web Tutorial - Sample Design [Internet]. [cited 2015]. Available from: http://www.cdc.gov/nchs/tutorials/nhanes/SurveyDesign/SampleDesign/intro_iii.htm
18. Brinkmann GL and Coates EO, Jr. The Cumulative number of cigarettes predicts diabetes effect of bronchitis, smoking, and occupation on ventilation. 87: 684-693. Am Rev Respir Dis. 1963;87:684–93.
19. Méndez Castellano, Hernán y Méndez, María Cristina de. Sociedad y estratificación : método graffar-Méndez Castellano. Venezuela: FUNDACREDESA; 1994. 206 p.
20. Craig CL, Marshall AL, Sj??Str??M M, Bauman AE, Booth ML, Ainsworth BE, et al. International Physical Activity Questionnaire: 12-Country Reliability and Validity: Med Sci Sports Exerc. 2003 Aug;35(8):1381–95.
21. International Physical Activity Questionnaire [Internet]. [cited 2015]. Available from: https://sites.google.com/site/theipaq/
22. Fernández WMZ, Borjas-Fajardo L, Salgado EF, Castillo C, Socca L, Portillo MG, et al. Use of short tandem repeats loci to study the genetic structure of several populations from Zulia State, Venezuela. Am J Hum Biol. 2005 Jul;17(4):451–9.
23. Ewing JA. Detecting alcoholism: the CAGE questionnaire. Jama.

1984;252(14):1905–1907.

24. Babor TF, Higgins-Biddle JC, Saunders JB, Monteiro MG. Audit. Alcohol Use Disord Identif Test AUDIT Guidel Use Prim Care [Internet]. 2001 [cited 2015]; Available from: http://pftp.paho.org/Public/NMH/Alcohol/Cartagena/Articulos%20USB/AuditBro-3.pdf?Mobile=1&Source=%2F_layouts%2Fmobile%2Fview.aspx%3FList%3De0923874-ac8b-4798-b0ae-be309b53f0b8%26View%3Db9b59ee1-e24f-4a75-8826-6b6128274b00%26RootFolder%3D%252FPublic%252FNMH%252FAlcohol%252FCartagena%252FArticulos%2520USB%26CurrentPage%3D1
25. Automated Self-Administered 24-Hour (ASA24®) Dietary Assessment Tool [Internet]. [cited 2015]. Available from: http://epi.grants.cancer.gov/asa24//
26. Schatzkin A, Kipnis V, Carroll RJ, Midthune D, Subar AF, Bingham S, et al. A comparison of a food frequency questionnaire with a 24-hour recall for use in an epidemiological cohort study: results from the biomarker-based Observing Protein and Energy Nutrition (OPEN) study. Int J Epidemiol. 2003 Dec 1;32(6):1054–62.
27. Ogedegbe G, Pickering T. Principles and Techniques of Blood Pressure Measurement. Cardiol Clin. 2010 Nov;28(4):571–86.
28. O'Brien E, Pickering T, Asmar R, Myers M, Parati G, Staessen J, et al. Working Group on Blood Pressure Monitoring of the European Society of Hypertension International Protocol for validation of blood pressure measuring devices in adults. Blood Press Monit. 2002;7(1):3–17.
29. World Health Organization. Waist circumference and waist-hip ratio: report of a WHO expert consultation, Geneva, 8-11 December 2008. Geneva: World Health Organization; 2011.
30. Ma W-Y, Yang C-Y, Shih S-R, Hsieh H-J, Hung CS, Chiu F-C, et al. Measurement of Waist Circumference: Midabdominal or iliac crest? Diabetes Care. 2013 Jun 1;36(6):1660–6.
31. Ben-Noun L (Louba), Sohar E, Laor A. Neck Circumference as a Simple Screening Measure for Identifying Overweight and Obese Patients. Obes Res. 2001 Aug 1;9(8):470–7.
32. Kyle U. Bioelectrical impedance analysis?part I: review of principles and methods. Clin Nutr. 2004 Oct;23(5):1226–43.
33. Kyle UG, Bosaeus I, De Lorenzo AD, Deurenberg P, Elia M, Manuel Gómez J, et al. Bioelectrical impedance analysis—part II: utilization in clinical practice. Clin Nutr. 2004 Dec;23(6):1430–53.
34. Buchholz AC, Bartok C, Schoeller DA. The Validity of Bioelectrical Impedance Models in Clinical Populations. Nutr Clin Pract. 2004 Oct 1;19(5):433–46.
35. HOMA Calculator : Download [Internet]. [cited 2015]. Available from: https://www.dtu.ox.ac.uk/homacalculator/download.php
36. Spencer CA, Hollowell JG, Kazarosyan M, Braverman LE. National Health and Nutrition Examination Survey III Thyroid-Stimulating Hormone (TSH)-Thyroperoxidase Antibody Relationships Demonstrate That TSH Upper Reference Limits May Be Skewed by Occult Thyroid Dysfunction. J Clin Endocrinol Metab. 2007 Nov;92(11):4236–40.
37. Cuetos-Vega F, Menéndez-González M, Calatayud-Noguera T. Descripción de un nuevo test para la detección precoz de la enfermedad de Alzheimer. Rev Neurol. 2007;44(8):469–474.
38. Grundy SM. Diagnosis and Management of the Metabolic Syndrome: An American Heart Association/National Heart, Lung, and Blood Institute Scientific Statement. Circulation. 2005 Oct 25;112(17):2735–52.
39. Landis JR, Koch GG. The Measurement of Observer Agreement for Categorical Data. Biometrics. 1977 Mar;33(1):159.
40. Sim J, Wright CC. The kappa statistic in reliability studies: use, interpretation, and sample size requirements. Phys Ther. 2005;85(3):257–268.
41. Alberti KGMM, Zimmet P ft. Definition, diagnosis and classification of diabetes mellitus and its complications. Part 1: diagnosis and classification of diabetes mellitus. Provisional report of a WHO consultation. Diabet Med. 1998;15(7):539–553.
42. Balkau B, Charles M. Comment on the provisional report from the WHO consultation. European Group for the Study of Insulin Resistance (EGIR). Diabet Med. 1999;16:442–3.
43. Einhorn D. American College of Endocrinology position statement on the insulin resistance syndrome*. Endocr Pract. 2003;9(Supplement 2):5–21.
44. Alegría E, Cordero A, Laclaustra M, Grima A, León M, Casasnovas JA, et al. Prevalencia del síndrome metabólico en población laboral española: registro MESYAS. Rev Esp Cardiol. 2005;58(7):797–806.
45. Mujica V, Leiva E, Icaza G, Diaz N, Arredondo M, Moore-Carrasco R, et al. Evaluation of metabolic syndrome in adults of Talca city, Chile. Nutr J. 2008 May 15;7:14.
46. Scuteri A, Laurent S, Cucca F, Cockcroft J, Cunha PG, Manas LR, et al. Metabolic syndrome across Europe: Different clusters of risk factors. Eur J Prev Cardiol. 2015 Apr 1;22(4):486–91.
47. Escobedo J, Schargrodsky H, Champagne B, Silva H, Boissonnet CP, Vinueza R, et al. Prevalence of the Metabolic Syndrome in Latin America and its association with sub-clinical carotid atherosclerosis: the CARMELA cross sectional study. Cardiovasc Diabetol. 2009;8(1):52.
48. Valmore Bermúdez MD, Añez R, Salazar J, Bello L, Toledo A, Chacín M, et al. Metabolic Syndrome components combinations: evidence of asymmetric clustering determined by central obesity and homeostasis model assessment/Combinaciones de los componentes de Síndrome Metabólico: evidencia de agrupación asimétrica determinado por obesidad central y HOMA. Sindrome Cardiometabólico. 2014;4(4):100.
49. Feliciano-Alfonso JE, Mendivil CO, Ariza IDS, Pérez CE. Cardiovascular risk factors and metabolic syndrome in a population of young students from the National University of Colombia. Rev Assoc Médica Bras. 2010;56(3):293–298.
50. Arteaga-Arredondo LF, Fajardo-Rodríguez HA. Prevalencia de factores de riesgo cardiovascular en pilotos de aviación civil en Colombia en el aÃ$\pm$o 2005. Rev Salud Pública. 2010;12(2):250–256.
51. Davila EP, Quintero MA, Orrego ML, Ford ES, Walke H, Arenas MM, et al. Prevalence and risk factors for metabolic syndrome in Medellin and surrounding municipalities, Colombia, 2008–2010. Prev Med. 2013 Jan;56(1):30–4.

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