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Evaluation of factors associated with the development of metabolic syndrome in the university population of huasteca potosina

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Abstract

Metabolic syndrome (MS) has been classified as one of the most common causes of risk for a heart attack, taking factors such as diabetes (Diab), prediabetes (Pre-D), dyslipidemia and hypertension. The objective of this study was to evaluate the presence of factors associated with the development of MS in a population of young adults. For this, various parameters related to the development of MS in young adults of university to Huasteca Potosina were evaluated, using clinical measures: blood pressure (BP), anthropometric weight, height and waist circumference (CCIN) and biochemical determinations: glucose (Glu), cholesterol (Chol) and triglycerides (TGL). The results show that the prevalence of hyperglycemia (Glu> 105 mg / dL) for the study population was 20.8%, the prevalence of hypercholesterolemia (> 200 mg / dL) and hypertriglyceridemia (> 150 mg / dL) is 5.0% and 13.8% respectively. These results reveal that the study population is in a vulnerable state, which can lead to suffer chronic degenerative diseases like diabetes mellitus type 2 or cardio-vascular diseases and therefore SM.

Diabetes, hyperglycemia, obesity, dyslipidemia, overweight

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Introduction

Metabolic syndrome is classified by the International Diabetes Federation (DFI) as one of the most frequent causes of risk of heart attack, including diabetes (Diab), prediabetes (Pre-D), dyslipidemia and hypertension (IFD, 2005). Globally, it is estimated that 20-25% of the adult population suffers from this syndrome, which makes it twice as likely to die and three times as likely to suffer from cardiovascular accidents, compared with people who do not suffer from it (Zimmet et. Al., 2005).

In Mexico, by 2012 it was estimated that 45% of the population had this syndrome (Salas, et al, 2014); At present, these figures coupled with reports on the prevalence of obesity and overweight have increased up to 50% in the last ten years; About 31% of women of reproductive age are overweight and 22% are obese (Monrreal et al, 2010).

Obesity as a risk factor is associated with increased blood lipid levels and their fractions, such as HDL and LDL cholesterol or triglycerides; High concentrations of these in the blood are associated with a high risk of atherosclerosis, coronary morbidity and some other cardiovascular diseases, especially in the middle-aged population, dyslipidemias, on the other hand, has a different prognostic effect, according to age: The younger the person, the greater the negative impact on life expectancy (Monrreal et al, 2010).

Cardiovascular diseases currently account for 30% of all deaths in the world and reduce 10% of healthy life years, affects about 13 million American citizens and is the most important cause of death in Latin America (Munguia et al.

In Mexico, studies have been carried out in which some of the components of MS in adults are analyzed.

However, there are few who value the overall. The scarce data available do not allow us to relate the magnitude of the problem, since the cut-off criteria of the different studies do not agree with each other.

Therefore, it was considered important to study the prevalence of factors that have previously been associated with the development of MS in a young adult population. All the information collected and processed can be useful to demonstrate the effects of overweight and obesity that currently affect the young Mexican adult population.

Methodology

Study population

In order to carry out this study, 400 new students from the Autonomous University of San Luis Potosí - Multidisciplinary Academic Unit Huasteca Area in Ciudad Valles San Luis Potosí, belonging to the school year 2015-2016, from rural areas (20.25 %) And urban (79.75%), of which 175 (43.75%) are men and 225 (56.25%) are women.

Clinical measures

Blood pressure

Blood pressure is defined as the force exerted by the blood on the arterial walls, which can be expressed as systolic pressure, diastolic pressure or mean pressure (Conyer et al., 2002). To obtain the BP measurement, the protocol suggested by NOM-030-SSA2-2009 was used, for which the patient was asked to sit for five minutes in a seat that supported the back. Discover the left arm and place it flexed at the level of the heart.

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The bracelet was placed 2 cm above the fold of the elbow, with the help of the stethoscope the humeral artery was located and it was left there, the handle of the baumanómetro was filled until the pulse disappeared and the air was slowly released by means of the Valve until hearing the loud and clear beat, there took the first reading of PA, then continued to release the air until the beat was stopped listening and at the point where this happened took the second reading. PA values were classified according to Table 1.

Blood Pressure	Reference Value
Great	< 120/80 mm Hg
Normal	120-129/80-84 mm Hg
High normal	130-139/85-89 mm Hg

Table 1 Type of blood pressure according to the reference value. (Source: Undersecretariat for Prevention and Protection of Health, 2002.

Anthropometric measurements

Weight

Weight is an anthropometric measure determined by body mass, which is expressed in kilograms. This determination was carried out by using a scale in which the protocol was suggested by the SSA, where the participant was asked to remove the shoes and stand on the scale with the feet in parallel And without moving, the reading was taken once the weight indicating hand was kept fixed (Undersecretariat for Prevention and Protection of Health, 2002).

Size. Size is a measure used to determine the height of an individual, this result is expressed in meters. In order to take this measure, the patient was asked to remove his shoes, caps and in the case of the girls, the hair was loose, the position was erected, once the patient had placed the correct position, the height was measured Undersecretariat of Prevention and Protection of Health, 2002).

Determination of obesity

The determination of obesity was performed by two methods, the first by calculation of Body Mass Index (BMI) and the second by waist circumference (CCin).

Body Mass Index. BMI is defined by the World Health Organization as an indicator of the relationship between weight and height of an individual. It is used in the identification of overweight or obesity and is used more frequently in adults than in infants. This was calculated by equation 1:

$$IMC = \frac{weight\ (kg)}{\text{height}^2\ (m)} \quad (1)$$

For the interpretation of the result obtained from the calculation, the classification proposed by the WHO was used (Table 2).

Classification	***Value***
Malnutrition	**<18.50**
Severe thinness	<16.00
Moderate thinness	16.00 – 16.99
Light thinness	17.00- 18.49
Normal	**18.5 – 24.99**
Overweight	**≥25.00**
Pre-obese	25.00 – 29.99
Obesity	**≥30.00**
Mild obesity	30.00 -34.99
Average Obesity	35.00 – 39.99
Morbid obesity	≥40.00

Table 2 Classification of obesity according to WHO criteria (Source: WHO, 2015)

For the population of low stature (men <1.60 m and women <1.50 m), the cut-off point is between> 23.00 and> 25.00 for overweight and obesity respectively (NOM-008-SSA3-2010).

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Waist Circumference (CCin)

CCin is an anthropometric measure in which the abdominal diameter is determined with the help of a tape measure, based on the protocol marked in NOM-043-SSA2-2012, which indicates that to carry out this measurement The lower point of the last rib and the upper point of the iliac crest must be located correctly, the measuring tape is placed so that it does not tighten or tighten the abdomen of the person and the data obtained at the end of the expiration is taken Of the patient. If the patient is overweight already diagnosed, this measurement should be performed on the widest part of the abdomen. This measure is useful in the diagnosis of central or visceral obesity, which is significantly related to the presence of elevated serum cholesterol and triglycerides (McCarthy et al, 2003).

Gender	Reference value
Male	≤ 90 cm
Female	≤ 80 cm

Table 3 Reference for CCin measurement. (Source: NOM-043-SSA2-2012).

Biochemical determinations

For the accomplishment of the biochemical determinations, a sample of peripheral blood was collected by means of venipuncture, in a tube without anticoagulant with particles of silicone (BD Vacutainer®). The blood sample was collected in the morning, with a fasting not greater than 12 hours, as stipulated in NOM-037-SSA2-2012. Serum was then obtained by centrifugation of the sample at 3500 revolutions per minute (rpm) for 15 minutes in a centrifuge (Thermotec®).

Once the serum was separated from the globular package, the sample was processed in an automated equipment (MINDRAY® BS-120) for the quantification of Glucose (Glu), Cholesterol (Col) and Triglycerides (Tgl) using the spectrophotometry method, with reagents SpinReact® brand, taking as normal values of Glu up to 100 mg / dL, as pre-diabetes values> 100 and <125 mg / dL and as diabetes> 126 mg / dL (NOM-015-SSA2-1994). Col values were <200 mg / dL and for Tgl <150 mg / dL (NOM-037-SSA2-2002).

Statistic analysis

Data analysis included descriptive statistics with means quantification and standard deviation for continuous variables. For the analysis of statistical significance, the statistical program GraphPad Prism V 7 was used; For data from a normal distribution, ANOVA and Pearson correlation analysis were used, whereas for data not coming from a normal distribution, a Kruskal-Wallis test and a Pearson correlation analysis were performed, taking One $p \leq 0.05$ as statistically significant.

Results

Table 4 shows the characterization of the population according to each of the determinations that were performed to the patients, it can be observed that the average values presented in each one of the determinations, are within the range of reference used By NOM 015, 037 and 030.

As far as lipid concentrations are concerned, the findings of this study are in agreement with Barquera et. In 2007 (144.6 + 35.4 mg / dL) as regards cholesterol concentration, they also indicate that the prevalence of hypercholesterolemia was more frequent in men than in women (186.6 vs 181.1 mg / dL) respectively, which coincides in the same way with the result obtained.

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For the case of triglycerides, the values presented greater difference between those reported by the same author vs those obtained in the present study; however, they show the same trend of higher values for men than women.

Determination	Total n=400 (100%)	Male n=175 (43.75%)	Female n=225 (56.25%)
Biochemistry			
Glu (mg/dL)	94.35 ±7.22	95.98 ±6.57	93.09 ±7.47
Col (mg/dL)	152.12 ±27.55	153.92 ± 26.69	150.72 ±28.18
Tgl (mg/dL)	101.26 ±63.93	108.97 ±75.07	95.26 ±53.11
Clinical Measure			
P.A. (mm Hg)	109.89/71.22 ±12.08	116.70/74.42 ±12.0	104.75/68.74 ±10.60
Obesity Index			
CCin	78.86 ±12.20	85.08 ±12.20	74.03 ±9.66
IMC	24.10 ±4.95	25.46 ±5.18	23.04 ±4.51

Average values + SD

Table 4 Characterization of the population.

Table 5 shows the characterization of the population according to indicators of obesity, which were BMI and PC, also having as a variable the locality of origin (urban or rural), it can be observed that patients from urban areas present (31.0%) and OP (15.4%), which means that approximately 2 out of 10 young adults suffer from this type of disorder, in terms of values considered normal, it is observed that the population From rural areas (58.0%) have a higher percentage of normal BMI than those from urban areas (53.6%), this could be attributed to a healthier lifestyle.

In the report given by ENSANUT in 2006, it is mentioned that 39.3% of the population analyzed by locality shows rural areas, while 39.6% have urban areas; An increase of approximately 0.3%, which is in line with what was reported in this research, 22.2% and 22.6%, respectively.

As for IMC nor, ENSANUT in the same year reports that in the rural localities the percentage is 34.1% while in the urban localities, the percentage found is 27.7%, whereas in the present study we found values of BMI Nor Of 53.6% and 58% in urban and rural populations, respectively. For the case of PO, ENSANUT reports that for rural areas, 24.8% of the study population presents this condition, whereas in urban communities, 31.3% suffer from it. When comparing the results obtained in the present research with the figures obtained with those reported in ENSANUT, it is observed that the percentage of OP in both localities (R = 13.6% vs U = 15.4%) which may differ by the n used in each One of the studies.

Obesity index		U n=319 (79.8%)	R n=81 (20.3%)	T n=400 (100%)
IMC	Dn	n=27 (8.4%)	n=5 (6.2%)	n=32 (8.0%)
	Nor	n=171 (53.6%)	n=47 (58.0%)	n=218 (54.5%)
	Sp	n=72 (22.6)	n=18 (22.2%)	n=90 (22.5%)
	OP	n=49 (15.4%)	n=11 (13.6%)	n=60 (15.0%)
PC	OC	n=99 (31.0%)	n=20 (24.7%)	n=119 (29.8%)
	Nor	n=220 (69.0%)	n=61 (75.3%)	n=281 (70.3%)

U: urban. A: rural. T: total

Table 5 Characterization of the population by indicators of obesity.

Table 6 shows the prevalence of hyperglycemia and dyslipidemia, according to different criteria: Health Secretariat NOM-015-SSA2-1994, American Diabetes Association (ADA) and World Health Organization (WHO). Section A) of Table 6 shows the comparison between the reference values used by the different organizations. According to the limits marked by NOM-015-SSA2-1994, the 20.8% population of the study presented has Pre-D status, compared to that reported by Monreal et. In 2009, the prevalence of Pre-D was 4.2% for the population of aspirants to the same house of studies, which is indicative of a change in the lifestyle of the families with the passage of the years, provoking an increase in the percentage of young people with elevated glucose levels.

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When comparing each of the criteria used for the determination of hyperglycemia in patients, it is observed that the use of the Pre-D marking by the NOM covers the largest number of people with the possibility of developing diabetes, The diagnosis of Diab is performed until the patient shows values higher than 126 mg / dL, so that the entire population, at least of this study would be without preventive treatment for the development of this disease, with the subsequent effects that this entails . As for the values given by the AAD, the percentage of patients with hyperglycemia is 5.5%, using this criterion the early detection of the disease is achieved in only 22 patients of the 83 who are identified by the Pre-D criterion using the NO M. In the classification criteria given by the WHO, only 1.5% of the population studied presented hyperglycemia, a figure well below that observed when using the NOM. Unfortunately the percentage of subjects diagnosed with diabetes using the NOM criterion drops to 0% for this population. Therefore a recommendation would be to sensitize the population (doctors and patients) for the use of AAD values as a cutoff point for diagnosis or to give sufficient relevance for the proper management of the Pre-D patient.

In section B), the comparison between the cutoff points marked by the NOM and by the WHO is shown, in this case the values of both coincide, which shows that 5% of the population presents a hypercholesterolemia problem, being More frequent in women than in men, contrary to what Barquera et al. Al, 2007, this being possible because of the size of the population that was studied in both cases.

Section C) refers to the prevalence of hypertriglyceridemia based on the criteria given by NOM-037-SSA2-2012 and WHO in 2015, when evaluating both criteria, it is observed that the NOM with the cut-off points that are used to make this diagnosis, 13.8% of the study population presented with this condition.

While using the reference value indicated by the WHO is only diagnosed at 6.5%, corresponding to the half of the population identified by NOM.

A)	NOM Pre-D./Diab (≥100 mg/dL)	AAD (>105 mg/dL)	OMS (>110 mg/dL)
T n=400 (100.0%)	n=83 (20.8%)	n=22 (5.5%)	n=6 (1.5%)
H n=175 (43.75%)	n=44 (25.1%)	n=13 (7.4%)	n=2 (1.1%)
M n=225 (79.75%)	n=39 (17.3%)	n=9 (4.0%)	n=4 (1.8%)
B)	**NOM** (≥ 200 mg/dL)		**OMS** (≥ 200 mg/dL)
T n=400 (100.0%)	n=20 (5.0%)		n=20 (5.0%)
H n=175 (43.75%)	n=9 (5.1%)		n=9 (5.1%)
M n=225 (79.75%)	n=11 (4.9%)		n=11 (4.9%)
C)	**NOM** (≥ 150 mg/dL)		**OMS** (≥ 200 mg/dL)
T n=400 (100.0%)	n=65 (13.8%)		n=26 (6.5%)
H n=175 (43.75%)	n=35 (20.0%)		n=14 (8.0%)
M n=225 (79.75%)	n=30 (13.3%)		n=12 (5.3%)

TO). Glucose. B) Cholesterol. C) Triglycerides.
T: Total. H: Man. M: Woman.
Table 6 Prevalence of hyperglycemia and dyslipidemias by different classification criteria.

Table 7 shows the prevalence of hyperglycemia (reference value given by AAD) and dyslipidemias each classified by the obesity indicator. In the case of IMC Nor, the prevalence of hyperglycemia was 27.3%, hypercholesterolemia 35.0% and hypertriglyceridemia 39.7%, SP 31.8%, 30.0% and 28.6%, respectively; For Ob 36.4%, 35.0% and 31.7%, respectively. The data obtained for PC showed that for OC the prevalence of hyperglycemia was 63.6%, hypercholesterolemia 60% and hypertriglyceridemia was 71.4%, all these percentages based on the population that presented some biochemical alteration.

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Comparing the prevalence of biochemical disorders between BMI Ob and PC Oc, it is observed that the population classified as Oc using PC seems to be a better indicator of alterations at the biochemical level. Therefore it is recommended its use as an early indicator for the diagnosis timely treatment of metabolic disorders.

Obesity index		Glu >105 mg/dL n= 22 (5.5%)	Col ≥200 mg/dL n= 20 (5.0%)	Tgl ≥150 mg/dL n=63 (15.8%)
IMC	Dn	n=1 (4.5%)	n=0 (0.0%)	n=2 (3.2%)
	Nor	n=6 (27.3%)	n=7 (35.0%)	n=25 (39.7%)
	Sp	n=7 (31.8%)	n=6 (30.0%)	n=18 (28.6%)
	Ob	n=8 (36.4%)	n=7 (35.0%)	n=20 (31.7%)
PC	Oc	n=14 (63.6%)	n=12 (60.0%)	n=45 (71.4%)
	Nor	n=8 (36.4%)	n=8 (40.0%)	n=18 (28.6%)

Table 7 Prevalence of hyperglycemia and dyslipidemias classified by BMI and PC.

A Pearson correlation analysis was performed for the BMI and PC data, regarding the serum Glu, Col and Tgl values for each study subject. The results showed a directly proportional correlation between Glu and PC ($r = 0.1620$, $p = 0.0012$), and between Glu and BMI ($r = 0.1024$, $p = 0.0406$). For Col, a positive correlation was found with CP ($r = 0.2214$, $p = 0.0001$), and with BMI ($r = 0.2435$, $p < 0.0001$). As for Tgl, a directly proportional correlation between Tgl and PC concentrations ($r = 0.3561$, $p < 0.0001$) and for Tgl and BMI were also found ($r = 0.3569$, $p < 0.0001$). These results show that for this study population, the anthropometric measurements of CP and BMI could serve as external indicators of the levels of Glu, Col and Tgl, which can be found in serum. These results and those shown in Table 7, confirm the use of PC with a better indicator of metabolic disorders on the use of BMI.

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Conclusions

It is possible to observe the presence of risk factors for the development of metabolic syndrome in the study population. Since the metabolic syndrome is a multifactorial disease, the change in lifestyle toward the sedentary lifestyle, poor eating habits and stress typical of today's university life would favor the increase of risk, becoming increasingly evident problems of dyslipidemia, hypertension, intolerance to Glucose, obesity, etc. Among the young adult population. Therefore, the intentional search for chronic degenerative diseases in this population is evident for the diagnosis and timely treatment. This research aims to raise awareness in the authorities in charge to create programs that contribute to improve the health and quality of life of students. Therefore it is hoped to implement and consolidate health, culture and sport programs as part of the integral formation of the student and shape the lifestyle towards good health habits.

References

Barquera, S., Flores, M., Olaiz-Fernández, G., Monterrubio, E., Villalpando, S., González, C., Rivera, J. Á., & Sepúlveda, J. (2007). Dyslipidemias and obesity in Mexico. *Salud Pública de México*, *49*(Supl. 3), s338-s347.

Gutiérrez JP, Rivera-Dommarco J, Shamah-Levy T, Oropeza C, Hernández-Ávila M (2012) Encuesta Nacional de Salud y Nutrición 2012. Resultados Nacionales. Cuernavaca, México: Instituto Nacional de Salud Pública (MX)

International Diabetes Federation, 2005. IFD worldwide definition of the metabolic symdrome. Disponible en: http://www.idf.org/metabolic-syndrome?language=es

Monreal Escalante, E., Medina Cerda, E., Vargas Morales, J. M., Martínez Zuñiga, R., Díaz Gois, A., Ortiz Villalobos, G., & Gabriela, A. (2009). Prevalencia de prediabetes en jóvenes aspirantes a la Universidad Autónoma de San Luis Potosi. *Bioquimia*, *34*(1), 126.

Monrreal, M. M., Cabriales, E. C. G., Cervantes, A. L. C., Leura, D. S., & Blanco, M. A. O. (2010). Sobrepeso, obesidad y dislipidemias en población universitaria del noreste de México. *Invest Educ Enferm*, *28*(1), 101-7.

Munguía-Miranda, C., Sánchez-Barrera, R. G., Hernández-Saavedra, D., & Cruz-López, M. (2008). Prevalencia de dislipidemias en una población de sujetos en apariencia sanos y su relación con la resistencia a la insulina. S*alud pública de méxico*, *50*(5), 375-382.

NORMA Oficial Mexicana NOM-008-SSA3-2010. Para el tratamiento del sobrepeso y la obesidad.

NORMA Oficial Mexicana NOM-015-SSA2-2010, Para la prevención, tratamiento y control de la diabetes mellitus.

NORMA Oficial Mexicana NOM-030-SSA2-1999, Para la prevención, tratamiento y control de la hipertensión arterial.

NORMA Oficial Mexicana NOM-037-SSA2-2012, Para la prevención, tratamiento y control de las dislipidemias.

NORMA Oficial Mexicana NOM-043-SSA2-2012, Servicios básicos de salud. Promoción y educación para la salud en materia alimentaria. Criterios para brindar orientación.

Salas, R., del Mar Bibiloni, M., Ramos, E., Villarreal, J. Z., Pons, A., Tur, J. A., & Sureda, A. (2014). Metabolic syndrome prevalence among Northern Mexican adult population. *PloS one*, *9*(8), e105581.

Subsecretaría de Prevención y Protección de la Salud, (2002). Manual de procedimientos. Toma de medidas clínicas y antropométricas en el adulto y el adulto mayor. Secretaria de Salud.

Zimmet, P., Magliano, D., Matsuzawa, Y., Alberti, G., & Shaw, J. (2005). The metabolic syndrome: a global public health problem and a new definition.*Journal of atherosclerosis and thrombosis*, *12*(6), 295-300.

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