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CLINICAL ISSUES

Prevalence of the metabolic syndrome and its individual components in brazilian college students

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Aims and objectives. To identify the prevalence of the metabolic syndrome and its individual components in a population of college students at a public higher education institution in Fortaleza, Brazil.

Background. Scientific evidence has demonstrated the ascent of the metabolic syndrome in the young population.

Design. Cross-sectional study of 702 Brazilian college students between January–July 2011.

Methods. Socio-demographic indicators, life habits and the components of the metabolic syndrome were assessed. ANOVA statistical tests were used to associate gender with the metabolic syndrome components, and the chi-square test to associate the number of metabolic syndrome components with gender and body mass index.

Results. High fasting venous glucose, triglyceride, total cholesterol and LDL-C levels were found in 12·3, 23·0, 9·7 and 5·9% of the sample, respectively. The prevalence of the metabolic syndrome amounted to 1·7%. Nevertheless, 30·4% of students manifested at least one and 12·4% at least two individual components. The prevalence of the metabolic syndrome was higher in men (58·3%) and in people who were overweight (33·3%) and obese (41·7%). It is important to implement public health policies to reduce college students' vulnerability to the metabolic syndrome.

Conclusions. Most college students who displayed ≥ 3 metabolic syndrome components were men and already indicated being overweight and/or obesity.

Relevance to clinical practice. It is important that nurses assess the frequency of metabolic syndrome in college students as a predictor of cardiovascular health.

Key words: health risks, research, students

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Introduction

The metabolic syndrome (MS) can be defined as a complex disorder, represented by a set of cardiovascular risk factors, usually related to central fat deposits and insulin resistance. What proves the relevance of MS to clinical practice is the fact that it increases general mortality by about 1·5 times and mortality owing to cardiovascular problems by 2·5 times. Also, it is a precursor of diabetes mellitus (Sociedade Brasileira de Cardiologia 2005).

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In recent decades, the prevalence of MS has been growing in the global population. It is estimated at between 20–25% in people under and 42% among people over 60 years of age (Dunstan *et al.* 2002), which underlines its association with age (Ford *et al.* 2004, Mattsson *et al.* 2007, Terry *et al.* 2007, Ervin 2009).

According to experts, however, MS was found in 20·3% of men and 15·6% of women between 20–39 years of age (Ervin 2009). Regarding the prevalence of individual components for MS in young adults, it was verified that among men 25·2 and 1·6% displayed one and two components against 33 and 5·7% among women (Huang *et al.* 2004, 2007). According to other important data, the prevalence of MS ranges between 0·6–13·0%, although studies are still considered scarce (Huang *et al.* 2004, Mattsson *et al.* 2007, Huang *et al.* 2007, Yen *et al.* 2008, Burke *et al.* 2009).

The gap in this knowledge also extends to health professionals' practice as, according to recommendations, at the age of 20 years, young people should be examined for the presence of two MS criteria, that is, high triglycerides and low HDL-C American Medical Association (2001). This recommendation has been neglected, which contributes to the increased prevalence of MS in the young population. In Brazil, no studies with representative data exist yet about MS prevalence in the general population (Sociedade Brasileira de Cardiologia 2005).

In recent years, however, research has been done in different population segments (Costa *et al.* 2007, Nakazone *et al.* 2007, Cavagioni *et al.* 2008, Schimtt 2009). Despite the importance of college students, a risk population owing to its age and, perhaps, its lifestyle (NCEP 2001, Fernandes & Lofgren 2011), no study was identified in this population. Although scarce, international literature shows studies focusing on this group, in which significant prevalence rates of MS and its individual components were observed (Huang *et al.* 2004, 2007, Terry *et al.* 2007, Yen *et al.* 2008, Burke *et al.* 2009).

It is undeniable that a wide range of populations needs to be investigated, but the youngest should receive priority as, the earlier MS and its components are identified, the more time there will be to encourage healthy life habits and provide health education. When they start college, young people have reached a critical point in their lives and make lifestyle choices, which can strongly affect their future health, making the transition to adult life is a perfect time to adopt healthy life habits. Thus, if these habits are inadequate during the young phase, they will probably be perpetuated and continue to negatively affect these individuals' health (Huang *et al.* 2007, Irazusta *et al.* 2007).

In view of the above, the aims of this study were to identify the prevalence of MS and its individual components in a population of college students from a public higher education institution in Fortaleza Brazil, as well as the most prevalent component in the study population, and to associate the components with gender and BMI variables.

Method

Design and place of study

About 1000 students from a public university in Fortaleza Brazil were recruited for this cross-sectional study, 702 of whom agreed to participate between January–July 2011. The selected university is located in the capital of Ceará State, Brazil and plays an important role in the state's higher education system. All knowledge areas are represented in its four centres (Sciences, Agricultural Sciences, Humanities and Technology) and five colleges (Law; Education; Economics, Administration, Actuarial Science and Accounting; Pharmacy, Dentistry and Nursing; and Medicine), distributed between the state capital and interior.

Participants

Based on the total number of students enrolled in in-class courses at the place of study, the formula for finite populations was applied for sampling purposes, using $p = 50\%$, $Q = 50\%$, a significance level of 0·05 and a relative sampling error of 8% (absolute error = 4%) (Pocock 1989).

$$n = \frac{t^2 5\% \times p \times Q}{e^2}$$

Calculation resulted in 702 students, stratified according to the following knowledge areas: human (20·4%), exact (16·5%), agricultural (14·0%), health (15·1%), sciences (18·1%) and technology (15·9%). The following inclusion criteria were established: age ≥ 18 years, being a student in daytime in-class courses, agreeing to participate in all data collection phases, having a fixed or mobile phone and e-mail for contact, while pregnant and breastfeeding women were excluded. From the total group of daytime in-class courses, two were selected from each knowledge area. Students were recruited through invitations the researchers presented in the classroom, posters the university displayed and mouth-to-mouth information. All students signed the Informed Consent Term and approval for the project was obtained from the Ethics Committee for Research Involving Human Beings at Universidade Federal do Ceará under protocol number 208/10.

Socio-demographic variables

Socio-demographic and life habit data were collected through a self-completed questionnaire, addressing: gender (male and female), age (years), self-referred colour (white, black, yellow or mulatto), family income (reported monthly sum of family revenues), economic class (A1, A2, B1, B2, C, D or E) (Associação Nacional de Empresas de Pesquisas 2009), course, semester taken (newcomers – in the first half of the course, veterans – in the second half of the course), job situation (only studies, studies and works formally or studies and works informally), marital status (married/fixed partner, single, widowed or divorced), and whom the student lives with (parents, relatives, friends, partner, or alone).

Variables related to life habits

Students who did practice any regular physical exercise for at least three times per week and thirty consecutive minutes per exercise were classified as physically active (Souza *et al.* 2003). Smoking was classified in four categories: daily smokers (who smoked at least one cigarette per day for at least one month before completing the questionnaire); occasional smokers (who did not smoke daily); former smokers (who, after having been smokers, quit at least one month earlier); and non-smokers (who had never smoked or had been smoking for less than a month) [World Health Organization (WHO) 2003]. To classify alcohol consumption, the version validated in Brazil (Figlie *et al.* 2000) of the AUDIT (Alcohol Use Disorders Identification Test) was used, a 10-question test WHO developed as a screening instrument, specifically to identify people with harmful alcohol consumption and alcohol addiction. Subjects were classified in one of the following risk zones: zone I (low-risk drinking pattern); zone II (medium-risk pattern); zone III (high-risk pattern or harmful alcohol consumption); and zone IV (probable presence of alcohol dependence).

Anthropometric variables

A properly trained group of nurses who strictly followed standard procedures performed all measurements. Weight was measured on electronic 200-kg anthropometric scales for adults, with the students standing barefoot, wearing light clothing and no accessories. A non-elastic anthropometric tape was fixed to a smooth wall to check height, with the subjects standing straight and immobile, with their hand palms on their thighs and the head adjusted to the Frankfurt plane. The body mass index (BMI), defined as the ratio between weight (kg) and square height (m^2), was calculated and analysed according to World Health Organization (WHO 2004) recommendations: low weight (BMI $< 18{\cdot}5$ kg/m^2); eutrophic (BMI $\geq 18{\cdot}5$ and $< 25{\cdot}0$); overweight ($25{\cdot}0$ and $29{\cdot}9$ kg/m^2); and obese (BMI $\geq$ 30 kg/m^2). Waist circumference (WC), measured at the midpoint between the lowest rib and the upper border of the iliac crest, was verified at the end of the expiration movement, using a non-elastic metric tape, placed on the skin, with the subject standing upright (Grundy *et al.* 2005, Fernandes & Lofgren 2011).

Biochemical variables

In the assessment of biochemical parameters (glucose, triglycerides, total cholesterol, HDL-C), commercial Labtest Diagnóstica S/A® (Industry Labtest, Lagoa Santa, Brazil) kits were used, with standardised techniques based on enzymatic and colorimetric methods, through spectrophotometry, following the manufacturer's recommendations. While concentrations were determined with the help of the automated biochemical analyser Labmax 240® (Industry Labtest), LDL-C determinations were calculated using Friedewald's formula.

A clinical analysis laboratory performed venous blood collections, using the vacuum collection system BD Vacutainer® (Becton, Dickinson and Company, Franklin Lakes, NJ, USA), through venipuncture. The study participants submitted to 12 hours of fasting for the biochemical determination of glucose, triglyceride, total cholesterol and fractions. Ten millilitres of blood were collected, stored in two tubes of 5 ml each, one without anticoagulant (for triglyceride doses and total cholesterol and fractions) and the other with the anticoagulant sodium fluoride (for glucose determination). After the collection, the samples were processed and centrifuged at 2200 rpm for 20 minutes in a digital serology centrifuge, LS3 Plus CELM® (CELM Company Equipadora Modern Laboratory, Barueri, Brazil). Then, 1-ml serum and plasma samples were separated for biochemical dose determinations. All participants were offered a free lunch after the blood samples had been collected.

Clinical variables

Aneroid sphygmomanometers and different sizes of Welch-Allyn cuffs were used for blood pressure measurement, with the width of the band corresponding to 40% of arm circumference and length involving at least 80%. In addition, a bi-auricular Littman stethoscope was used for auscultation. To choose the adequate arm, both upper limbs were measured and, in case of difference, the arm with the highest pressure

level was chosen for subsequent measures. Pressure was measured thrice, with at least one-minute intervals between each, and the mean of the last two measures was considered as that person's blood pressure. The remaining steps were performed according to the VI Brazilian Arterial Hypertension Guidelines (Sociedade Brasileira de Hipertensão 2010).

Criterion for the MS

As a reference framework to classify the college students as MS patients, the criterion of the National Cholesterol Evaluation Program for Adult Treatment Panel III (NCEP 2001) was used. Therefore, at least three of the following components had to be present: Abdominal obesity, characterised by abdominal circumference >102 cm (men) or >88 cm (women); Systolic blood pressure $\geq$ 130 mmHg and/or diastolic $\geq$ 85 mmHg; Fasting glucose $\geq$ 100 mg/dl; Serum triglycerides >150 mg/dl; HDL-serum cholesterol <40 mg/dl (men) and <50 mg/dl (women).

Statistical analysis

For statistical analysis SPSS version 16.0 (SPSS Inc., Chicago, IL, USA) was used. For the anthropometric, clinical and laboratory variables, means and the standard error of the mean (SEM) were calculated. As for statistical tests, ANOVA was used to associate gender with individual components for MS and BMI classification, while chi-square was used to associate the number of MS components with BMI classification and gender. Inferential statistical analyses were considered as significant if $p < 0{\cdot}05$.

Results

Study participants were 702 college students. In this group, 62·7% were women, 49·3% black, 92·3% single and 53·3% between 20–24 years; ages ranged between 18–58 years, with a mean 21·5 years (SD: 1·57). Students mainly came from Human Sciences (20·4%) and were newcomers (69·1%). The mean family income was U$ 1745·67 (SD: 2045·46) dollars, more concentrated in economic classes B and C (79·0%), considered of median purchasing power according to Brazilian standards. In addition, 64·7% exclusively studied and 70·4% lived with their parents (Table 1).

Overweight was detected in 26·4%, with 21·3% of overweight, 5·1% of obese students and high WC in 5·4% of students. As for blood pressure levels, 3·0% of the students were classified as hypertensive. As verified, 70·2% were sedentary, 8·5% smoked and harmful alcohol intake was present in 6·6%. High fasting venous glucose, triglyceride, total cholesterol and LDL-C were found in 12·3, 23·0, 9·7 and 5·9%, respectively. Concerning HDL-C, lower levels were present in 12·0% of students. Table 2 displays gender differences related to anthropometric measures, clinical and laboratory variables.

Concerning the MS, in the study sample, its prevalence amounted to 1·7%. Nevertheless, 30·4% of the students presented at least one and 12·4% at least two individual components (Table 3). Most subjects with $\geq$ 3 MS

Table 1 Sample characteristics according to sociodemographic and economic variables of college students from Fortaleza, Brazil in 2011 (n = 702)

Variables	n (%)	
Gender		
Female	440 (62·7)	
Male	262 (37·3)	
Age range (years)		
18–19 years	237 (33·8)	Mean ± SD: 21·5 ± 1·57
20–24 years	374 (53·3)	
25–58 years	85 (12·1)	
Did not answer	6 (0·8)	
Colour		
White	246 (35·0)	
Black	53 (7·5)	
Yellow	38 (5·4)	
Mulatto	345 (49·3)	
Did not answer	20 (2·8)	
Semester		
Newcomers	485 (69·1)	
Veterans	202 (28·8)	
Did not answer	15 (2·1)	
Economic class		
A	74 (10·5)	Mean income ± SD:
B	277 (39·5)	1745·67 ± 2045·46
C	277 (39·5)	
D/E	70 (10·0)	
Did not answer	4 (0·5)	
Work situation		
Only studies	454 (64·7)	
Studies/Works	242 (34·5)	
Did not answer	6 (0·8)	
Marital status		
Single	648 (92·3)	
Married/Fixed Partner	42 (6·0)	
Did not answer	12 (1·7)	
Who they live with		
Parents	494 (70·4)	
Relatives	118 (16·8)	
Friends	27 (3·8)	
Partners	35 (5·0)	
Alone	20 (2·8)	
Did not answer	8 (1·2)	

SD, standard deviation.

Table 2 Distribution of means for anthropometric, clinical and laboratory data of college students from Fortaleza, Brazil in 2011 (n = 702)

		Gender		
Characteristics	Total Mean ± SEM	Female Mean ± SEM	Male Mean ± SEM	p*
Age	21·50 ± 0·172	21·40 ± 0·193	21·66 ± 0·327	0·470
Height	1·65 ± 0·034	1·60 ± 0·029	1·73 ± 0·040	<0·0001
Weight	64·17 ± 0·518	58·28 ± 0·480	74·04 ± 0·828	<0·0001
BMI	23·27 ± 0·143	22·57 ± 0·170	24·43 ± 0·242	<0·0001
WC	94·50 ± 0·133	90·35 ± 0·121	99·45 ± 0·233	<0·0001
MSBP	109·61 ± 0·447	104·51 ± 0·456	118·16 ± 0·632	<0·0001
MDBP	71·06 ± 0·323	68·44 ± 0·379	75·45 ± 0·474	<0·0001
Glucose	88·61 ± 0·405	88·24 ± 0·490	89·21 ± 0·705	0·245
Triglycerides	127·30 ± 1·232	122·38 ± 1·526	135·40 ± 1·980	<0·0001
Total cholesterol	155·28 ± 2·376	154·02 ± 3·622	157·35 ± 2·003	0·497
HDL-C	53·74 ± 0·296	56·45 ± 0·374	49·27 ± 0·334	<0·0001
LDL-C	74·62 ± 1·278	70·65 ± 1·618	81·19 ± 2·024	<0·0001

BMI, body mass index; WC, waist circumference; MSBP, mean systolic blood pressure; MDBP, mean diastolic blood pressure; HDL-C, high density lipoprotein cholesterol; LDL-C low density lipoprotein cholesterol; SEM, standard error of the mean.
*Student's t-test for equal and unequal variances (p significant if <0·05).

Table 3 Association between metabolic syndrome components and mean body mass index classifications of college students from Fortaleza, Brazil in 2011 (n = 702)

	BMI classification				
MS components	Low weight Mean ± SD	Eutrophic Mean ± SD	Overweight Mean ± SD	Obesity Mean ± SD	p*
WC	66·59 ± 4·77	74·75 ± 5·96	87·03 ± 7·20	101·73 ± 11·01	<0·0001
MSBP	107·52 ± 8·82	107·75 ± 11·43	114·39 ± 12·0	116·59 ± 11·30	<0·0001
MDBP	70·48 ± 7·85	69·69 ± 8·46	74·07 ± 7·67	77·19 ± 8·07	<0·0001
Glucose	88·0 ± 11·17	88·32 ± 10·41	89·32 ± 10·86	90·0 ± 12·32	0·623
Triglycerides	124·79 ± 29·63	125·80 ± 32·25	132·31 ± 30·76	130·81 ± 39·99	0·156
HDL-C	53·80 ± 6·75	54·24 ± 8·04	52·66 ± 7·40	51·88 ± 6·29	0·075

*ANOVA association test (p significant if <0·05).

components were male (58.3%) and was obese (25%) (Figs 2 and 3).

Discussion

As mentioned, the study involved 702 men and women college students with a mean age of 21·5 years, the most frequent age range for higher education in Brazil. The analysis of risk factors for cardiovascular illnesses among college students in Biological and Health Sciences revealed that 45·3% of the sample was between 20–30 years old (Oliveira *et al.* 2008).

Overweight and obesity were present in 21·3 and 5·1%, respectively, higher than among college students in Portugal (Piedade-Brandão 2008), with 12·2 and 3·2%; and lower than in Chile (Palomo 2006), where overweight was present in 70·1% of the sample. In the United States (Smith & Essop 2009), lower levels were found for overweight (18·5%) and higher levels for obesity (6·9%).

As for physical exercise, most students were classified as sedentary (70·2%). References for comparison with this result almost unanimously demonstrate the high level of physical inactivity among higher education students, not only in Brazil, but also in other countries, often with more concerning prevalence rates. In the national context, research found 74·7 and 57·9% of sedentariness (Oliveira 2008, Silva *et al.* 2011), against 91·5 and 72·5%, in the international context (Palomo 2006, Oviedo *et al.* 2008).

Also concerning life habits, smoking was present in 8·5% of students, and drinking in 6·6%. Higher percentages were observed in Venezuela where, in a population of 100 college students, 23·0% smoked according to experts (Hernandéz & García 2007). In an analysis of risk factors for non-transmissible chronic illnesses among 120 medical

students, others found 34·2% of smoking prevalence and 68·3% for drinking (Oviedo *et al.* 2008).

Based on the data, MS was present in 1·7% of the sample analysed. A search in literature shows study results that are either close, like 1·3% (Huang *et al.* 2007); lower, with 0·6% (Huang *et al.* 2004); or higher, with 3·7% (Fernandes & Lofgren 2011), 4·6% (Yen *et al.* 2008), 4·9% (Burke *et al.* 2009), 10·3% (Cardoso *et al.* 2008), 10·7% (Barbieri *et al.* 2006) and 13·0% (Mattsson *et al.* 2007). These findings gain importance when considering that many people believe that the young population does not get ill and is totally healthy. In general, researchers ignore this population segment in chronic disease development risk analyses, and even when assessing MS prevalence. This reveals a clear need for diagnostic assessment of these individuals with a view to the early identification of the syndrome and its individual components (Fernandes & Lofgren 2011).

In line with the data, the most present components for MS among the subjects were high triglyceride (23·0%) and blood glucose (12·3%) and low HDL-C levels (12·0%), in line with other studies (Huang *et al.* 2007, Fernandes & Lofgren 2011). Moreover, some studies emphasised higher prevalence levels of high blood pressure (Yen *et al.* 2008, Burke *et al.* 2009) and others of higher WC levels (Park *et al.* 2008).

Concerning the number of components, as verified, 30·4% of the students had one and 12·4% two components for MS. When considering that MS is a group of components, if no interventions and lifestyle changes are promoted for these individuals who already display one or two components, they will probably turn into MS patients in the near future (Huang *et al.* 2004, 2007, Brown *et al.* 2005, Grundy *et al.* 2005). As demonstrated in research, the percentage of college students with one MS component varies between 27·0–37·1%, fitting the present research findings into this interval. As for the prevalence of two components, authors from the United States found lower percentages, with 7·4% (Fernandes & Lofgren 2011).

Specifically concerning gender, in line with the present research, among MS patients, the male gender prevailed with 58·3%. Similarly, some experts have identified higher MS prevalence levels in men, some with slight differences (Ervin 2009), others with greater proportions of almost the double (Barbieri *et al.* 2006). Nevertheless, some studies identified a distinct relation between MS and gender, with higher proportions among female students (Park *et al.* 2008, Fernandes & Lofgren 2011). As shown in Fig. 1, high blood pressure, triglyceride levels and HDL-C prevailed among men. Women revealed greater alterations in venous fasting glucose and WC and HDL-C. In a study that involved 300 young students from Kansas University in Lawrence, blood pressure and triglycerides were also reported as the most prevalent components for MS among men. Similarly, high venous fasting glucose levels prevailed in men (Huang *et al.* 2007).

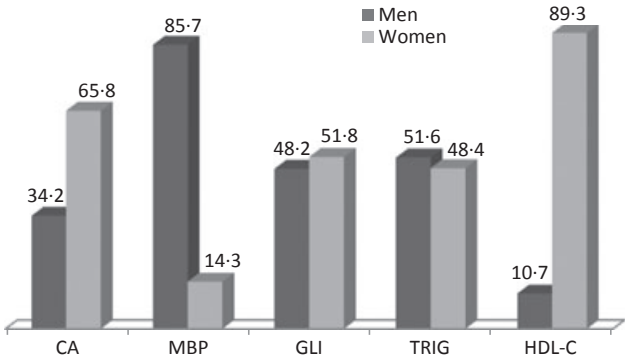

Figure 1 Association between metabolic syndrome components and gender in college students from Fortaleza, Brazil in 2011 (n = 702). Use of Fisher's exact test. CA, abdominal circumference (p = 0·409); MBP, mean blood pressure (p < 0·0001); GLI, venous fasting glucose (p = 0·022); TRI, triglycerides (p = 0·000); HDL-C, high density lipoprotein (p < 0·0001).

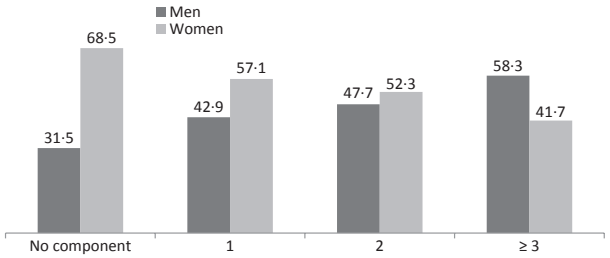

Figure 2 Association between prevalence of number of metabolic syndrome (MS) components and gender of college students from Fortaleza, Brazil in 2011 (n = 702). MS components: HDL-C; triglycerides; glucose; abdominal circumference and blood pressure. Data analysed through χ^2 (p = 0·004).

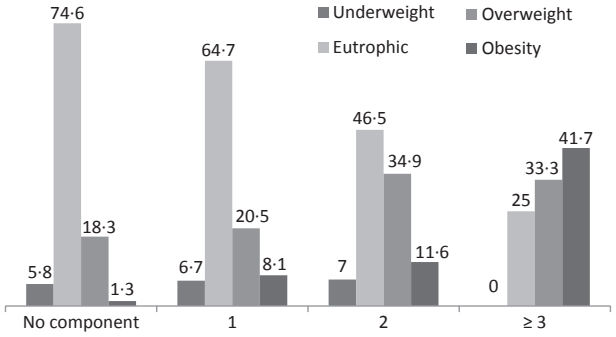

Figure 3 Association between prevalence of the number of metabolic syndrome components and body mass index categories of college students from Fortaleza, Brazil in 2011 (n = 702). MS components: HDL-C; triglycerides; glucose; abdominal circumference and blood pressure. Data analysed through χ^2 (p < 0·0001).

Concerning the BMI, we attempted to associate its classification with the number of MS components. According to Fig. 3, obesity revealed greater proportions among students with some MS component, and was present in most students with three or more components (41·7%). In addition, the prevalence of students classified as eutrophic is inversely proportional to the number of MS components. Among students without any syndrome component, 74·6% were eutrophic, to the detriment of 25·0% for those with three or more components. Literature clearly reveals the direct relation between the BMI and MS. A study in the United States showed that men with overweight and obesity displayed six and 32 times more chance, respectively, of having MS when compared with normal-weight men, against five and 17 times more chance for women (Ervin 2009).

Conclusions

Despite the low prevalence of MS among college students, a majority indicated at least one or two individual components. Most of the college students with three or more components were men, who revealed higher mean blood pressure and triglyceride levels. Women, on the other hand, revealed higher WC and venous fasting glucose and lower HDL-C when compared with men. Moreover, excess weight (overweight and obesity) was directly associated with a greater presence of MS components.

Limitations

The criterion used for MS classification may have underestimated the actual number of cases. Replication of this study in other populations of college students is recommended, and also using other classification criteria for more accurate comparisons and conclusions.

Acknowledgements

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