Full Length Research Paper

Metabolic syndrome among medical university students in Kashan, Iran

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Metabolic syndrome (MetS) is defined as a clustering of complicated disorders such as: central obesity, hypertension, increased blood glucose and impaired blood lipids. This study was carried out to determine the prevalence of metabolic syndrome among students of Kashan University of Medical Sciences between 19 to 27 years old (n=221). Metabolic syndrome was defined using the updated 2001 National Cholesterol Education Programs Adult Treatment Panel III (ATP III) criteria. Anthropometrics and blood pressure were measured. Fasting blood samples were taken for measuring triglycerid (TG), high-density lipoprotein cholesterol (HDL-C), Chol and FBG of the volunteers. The results revealed that the prevalence of metabolic syndrome was 3.2% (95% CI: 0.9-5.5); prevalence of 1 or 2 MetS criteria were 30.8% (95% CI: 24.7-36.8) and 14.9% (95% CI: 10.2-19.6), respectively. Low HDL-C (26.2%) concentration and elevated blood pressure (16.7%) were the most prevalent criteria. Mean BMI (p=0.015), WC, FBG and TG (p<0.0001) in males were found to be greater than females significantly. However, females had significantly higher mean concentrations of HDL-C than males (p<0.0001). Based on our findings, blood pressure and lipid disorders are the most important risk factors of metabolic syndrome in young adults. Lifestyle modifications such as increased physical activity and dietary changes can be beneficial changes in MetS criteria.

Key words: Metabolic syndrome, blood pressure, lipids, university students.

INTRODUCTION

Metabolic syndrome (MetS), a collection of metabolic and non-metabolic disorders, leads to a high risk of cardiovascular disease, diabetes, dyslipidemia, stroke, osteoarthritis, some cancer, and deaths (Jaber et al., 2004; McNeill et al., 2005; Shiwaku et al., 2005). It has been reported that the prevalence of metabolic syndrome among Iranian adults is about 23 to 34% (Sarraf-Zadegan et al., 1999; Azizi et al., 2003); whereas, MetS prevalence among Iranian adolescent is low (Salem and Vazirinejad, 2009). Studies show that metabolic syndrome prevalence in young adults is 0.6 to 13.0% (Huang et al., 2004, 2007; Mattsson et al., 2007; Yen et al., 2008; Burke et al., 2009; Fernandes and Lofgren, 2011). Considering the high prevalence of metabolic syndrome in obese adolescents, it seems that study on students, as a sample of youth group is important due to the lack of adequate opportunities, more inclination to fast foods with high calories and low volume (Azizi et al., 2003; Irazusta et al., 2007; Ryu et al., 2007).

Young adults entering university are at a critical point in their lives. They are making their own lifestyle choices that can affect their future health (Huang et al., 2004; Irazusta et al., 2007). This transition into adulthood is an ideal time to adopt healthy lifestyle habits since dietary intake and amount of physical activity can affect all the

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Abbreviations: MetS, Metabolic syndrome; **WC,** waist circumference; **BMI,** body mass index; **SBP,** systolic blood pressure; **DBP,** diastolic blood pressure; **TC,** total cholesterol; **LDL-C,** low-density lipoprotein cholesterol; **HDL-C,** high-density lipoprotein cholesterol; **TG,** triglycerid; **FBG,** fasting blood glucose; **CHD,** coronary heart disease.

NCEP ATP III metabolic syndrome criteria. If poor lifestyle habits are developed during this time, they will likely be carried through to adulthood and continue to negatively affect an individual's health status (Irazusta et al., 2007; Fernandes and Lofgren, 2011). Medical university students, who are responsible for providing future general health, are at risk of major cardiovascular diseases especially overweight and obesity. Due to lack of adequate information regarding the prevalence of metabolic syndrome among young adults in Iran, this study have been designed to investigate the prevalence of this syndrome among students at Kashan University of Medical Sciences, Iran.

MATERIALS AND METHODS

Participants

Two hundred and forty subjects were recruited for this research. Nineteen subjects (7.9%) withdrew due to a lack of interest (n = 8) and discomfort with blood draws (n = 11). A final sample of 221 subjects, consisting of 140 males (63.3%) and 81 females (36.7%) completed all required study assessments. Eligible subjects for the study were those that have spent 1 to 3 years at Kashan University of Medical Sciences in Iran in 2009. Subjects aged between 19 and 27 years old were excluded if they were pregnant or lactating, liver disease, bleeding disorder, diabetes, cancer, or CHD. All subjects read and signed an informed consent approved by the Vice Chancellor for Research Ethical Committee.

Anthropometrics

Trained personnel performed all anthropometric measurements. Subjects' weight and height were measured in kilograms and centimeters respectively. Waist circumference was measured using stadiometer in the upper iliac crest region. BMI was calculated using the following formula: weight in kilograms/height in m^2 (kg/m^2). BMI classifications used were underweight (<18.5), normal (18.5 to 24.9), overweight (25.0 to 29.9), and obese (≥ 30.0).

Biochemical measures

Blood sampling was performed early in the morning after a 12-h overnight fast. Samples were transported to the clinic's laboratory within 2 h of collection and serum was separated by centrifugation. Serum levels of blood glucose (BG), total cholesterol, HDL- (HDL-C) and LDL-cholesterol (LDL-C), and triglycerides (TG) were determined.

Blood pressure

Blood pressure (BP) was measured after a 5-min seated resting period. A trained nurse student measured each subject's resting BP. The width of the cuff was placed at the highest possible part of the right arm. Blood pressure was conducted in duplicate, with a 5-min interval between measurements.

Metabolic syndrome criteria

The updated 2001 NCEP ATP III criteria were utilized to determine MetS prevalence. The criteria are increased abdominal fat measured by WC (> 102 cm for males and > 88 cm for females), elevated TG (≥ 150 mg/dL), low HDL-C (<40 mg/dL for males and < 50 mg/dL for females), elevated fasting BG (≥ 100 mg/dL), and hypertension (≥ 130 mmHg systolic blood pressure [SBP] or ≥ 85 mmHg diastolic blood pressure [DBP]). Subjects that met three or more of the criteria were classified with MetS.

Statistical analysis

SPSS software version 14.0 was used for analysis. Demographics were calculated using means and frequencies. Independent samples t tests were used to examine differences between genders for anthropometric, clinical, and biochemical variables. Fisher's exact chi-square tests were used to analyze the point prevalence of MetS criteria in the total sample by gender and the point prevalence of MetS criteria per BMI category. Significance was set at p < 0.05 for all tests.

RESULTS

The descriptive characteristics of the students separated by gender are presented in Table 1. Mean BMI (22.1 ± 3.2 kg/m^2) was in the normal range; however, 14.5% subjects (95% CI: 9.8-19.1) were overweight and 2.6% (95% CI: 0.5-4.7) subjects were obese. As shown, males had a significantly greater mean BMI than females (p= 0.015). Males also had a significantly greater mean WC, FBG and TG than females (p<0.0001). However, females had significantly higher mean concentrations of HDL-C (p<0.0001). Overall prevalence of MetS in the total sample was 3.2% (95% CI: 0.09-5.50). Although there were more females than males classified with MetS (4.3% versus 1.2%), significance was not tested due to only one male meeting the MetS classification. 30.8% (95% CI: 24.7-36.8) of the total sample had at least one criterion for MetS and 14.9% (95% CI: 10.2-19.6) had two criteria (Figure 1).

As seen in Table 2, the most prevalent MetS criteria in the total sample were low HDL-C (26.2%), hypertension (16.7%) and elevated TG (14.1%) concentrations. Elevated FBG (8.1%, p= 0.013) and hypertension (13.1%, p= 0.041) in female were significantly higher than male. According to BMI category, 3.1% (95% CI: 0.8-5.3) of overweight and 33.3% (95% CI: 27.1-39.5) of obese students had non-significant MetS (Figure 2).

DISCUSSION

Results showed that the metabolic syndrome prevalence among students according to ATP III criteria was 3.2% (95% CI: 0.9-5.5). The most prevalent criteria in this sample were low HDL-C concentrations (26.2%) and hypertension (16.7%). 30.8% of students had at least one criterion for metabolic syndrome and 14.9% had two criteria.

The metabolic syndrome prevalence in the present

Table 1. Anthropometric, clinical and biochemical description of subjects.

Characteristic	All (n=221)		Male (n=81)		Female (n=140)		P- value
	Mean	SD	Mean	SD	Mean	SD	
Age (years)	21.5	2	22.1	1.8	21.3	1.2	0.005
Height (cm)	167	9.5	175.1	7.4	160.5	5.6	< 0.0001
Weight (kg)	61	12	69.8	13.1	55.6	7.2	< 0.0001
WC (cm)	76.2	9.3	82.4	9.6	72.6	6.9	< 0.0001
BMI (kg/m^2)	22.1	3.2	22.7	3.7	21.6	2.9	0.015
SBP (mmHg)	112.7	12.2	114.8	10.4	113.1	13.2	0.318
DBP (mmHg)	77.4	8.4	78.2	6.5	77.1	9.4	0.292
FBG (mg/dl)	79.6	11	87.5	9.7	74.3	8.3	< 0.0001
TG (mg/dl)	80.4	41.2	101.5	45.1	66.4	31.6	< 0.0001
Chol (mg/dl)	132.5	27.2	134.4	28.1	131.3	26.7	0.434
LDL- Chol (mg/dl)	63.1	21.7	64.8	22.4	61.9	21.2	0.355
HDL-Chol (mg/dl)	53.2	11.7	49.2	10.9	56.1	11.4	< 0.0001

Data was analyzed using independent samples t- tests to determine gender differences. WC = Waist circumference; BMI = body mass index; SBP = systolic blood pressure; DBP = diastolic blood pressure; TC = total cholesterol; LDL-C = low-density lipoprotein cholesterol; HDL-C = high-density lipoprotein cholesterol; TG = triglycerid; FBG = fasting blood glucose.
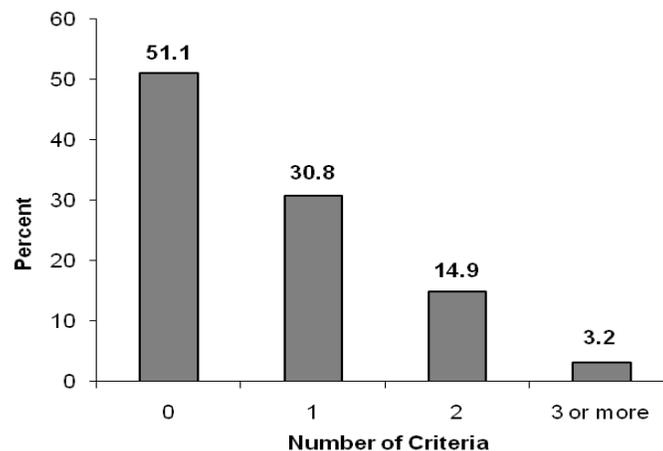
Figure 1. Prevalence of components of metabolic syndrome of total samples.

Table 2. Number of metabolic syndrome criteria present by gender.

Criteria	Male (%)	Female (%)	All (%)	95% CI	P- value
WC(cm)	4 (1.8)	4 (1.8)	8 (3.6)	0.13-2.32	0.469
BP(mmHg)	8 (3.6)	29 (13.1)	37 (16.7)	1.03-5.50	0.041
FBG(mg/dl)	2 (0.9)	18 (8.1)	20 (9)	1.31-25.8	0.013
TG(mg/dl)	9 (4.1)	22 (10)	13 (14.1)	0.65-3.41	0.423
HDL-Chol(mg/dl)	19 (8.6)	39 (17.6)	58 (26.2)	0.66-2.37	0.528

Data was analyzed using chi-square difference testing, examining genders separately.

study is the lower end of the range, 0.6 to 13.0%, found in other studies (Huang et al., 2004, 2007; Gonzalez Deschamps et al., 2007; Yen et al., 2008; Koziarska-Rosciszewska et al., 2010; Fernandes and Lofgren, 2011; Morrell et al., 2012). Our findings are similar to those of Fernandes and Lofgren (2001) and Gonzalez
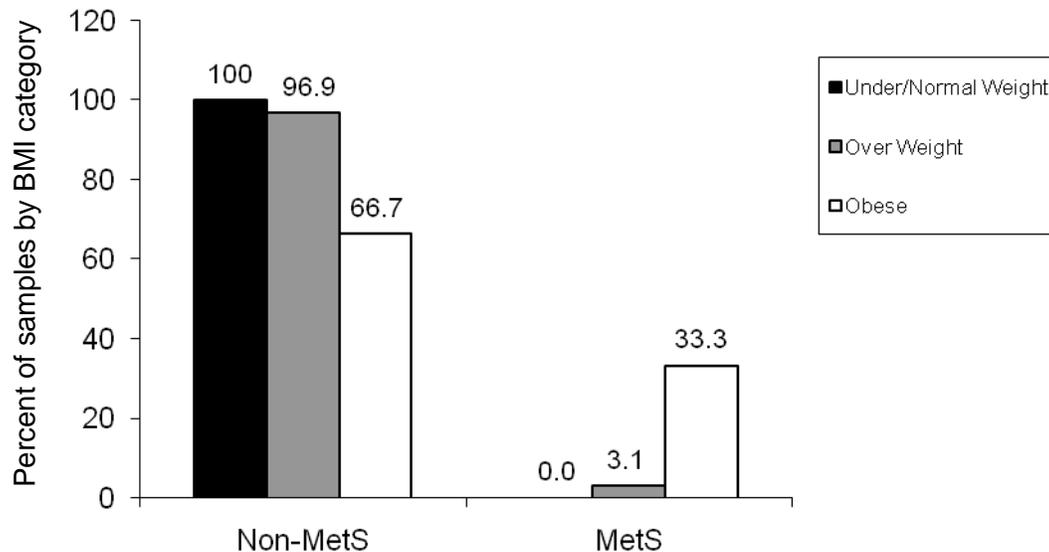
Figure 2. Prevalence of metabolic syndrome per BMI category.

Deschamps et al. (2007) (3.7%), Vissers et al. (2007) (4.1%) and Yen et al. (2008) (4.6%). The prevalence of this study was higher than that of Huang et al. (2004, 2007) (0.6%, 1.3%), Koziarska-Rosciszewska et al. (2010) (0.59%) and lower than those of Ryu et al. (2007) (5.5%), Mattsson et al. (2007) (13.0%).

A greater percentage of females presented with MetS than males (4.3% vs 1.2%). This study's findings are similar to Park et al. (2008) and Fernandes and Lofgren (2001) who reported higher prevalence, but not significant, in females than males. The findings of this study differ from other studies where the male prevalence of MetS was higher than the female (Huang et al., 2007; Yen et al., 2008; Koziarska-Rosciszewska et al., 2010; Morrell et al., 2012). Studies show that racial/ethnic differences affect the prevalence of metabolic syndrome. Park et al. (2008) and Tan et al. (2004) reported that the prevalence of the metabolic syndrome in young adults (ages 20 to 39 years in the US was nearly three times higher than in Korea.

The most prevalent criteria in this sample were low HDL-C concentrations and elevated BP. This finding is similar to those found by Yen et al. (2008) and Burke et al. (2009). Young adults generally present with low HDL-C concentrations, elevated TG concentrations, elevated BP, and increased WC (Fernandes and Lofgren, 2011). People with metabolic syndrome are at risk of cardiovascular disease and type 2 diabetes mellitus (Ford et al., 2002; Zarich, 2006). Metabolic syndrome alone predicts almost 25% of new cases of cardiovascular diseases (Grundy et al., 2004). Mortalities resulting from cardiovascular disease are the most important factors in Iran (Sarraf-Zadegan et al., 1999).

Prevalence of at least one criterion for MetS in subjects in the present study was 30.8%; and was similar to other studies have shown the percentage of young adults with at least one criterion for MetS from 27.0 to 37% (Gonzalez Deschamps et al., 2007; Huang et al., 2007; Burke et al., 2009; Fernandes and Lofgren, 2011). College students presenting with at least one criterion will likely be at a heightened risk of MetS and CHD development as they enter adulthood, compared to those college students with no criteria (Fernandes and Lofgren, 2011).

A majority of students was normal weight (72.9%), whereas 14.5 and 2.6% were overweight and obese respectively. According to BMI category, the prevalence of MetS in overweight and obese students were 3.1 and 33.3% respectively. Overweight and obesity among students in Fernandes and Lofgren (2011) study were 18.5 and 6.9% and the prevalence of MetS in overweight and obese students were 5.8 and 38.5%, respectively (Fernandes and Lofgren, 2011). Although obesity is one of the most important risk factors for MetS, other young adults not classified as overweight or obese should not be overlooked, as they are also at risk of MetS and CHD development, according to the findings of this study. The results of the present study support the need to continue screening for all MetS criteria in young adults especially in university students.

Conclusion

Young adults are at risk of developing MetS. Hypertension and low HDL-C concentration are the most important risk factors for MetS in this study. Therefore planning to increase physical activity and using adequate diet can be an important step in reducing the prevalence of metabolic syndrome among students.

LIMITATIONS

This is the first study on the prevalence of MetS among university students who are at young adult ages in Iran. Our study has a number of limitations. Firstly, because different ethnic groups are studying in University of Iran the role of ethnic differences have been ignored. Additionally, one challenge of determining MetS prevalence in young adults is multiple definitions for "young adult". Other studies define young adults as those in the range of 18 to 24 years (Huang et al., 2004; Burke et al., 2009; Fernandes and Lofgren, 2011) as in this study, or as 20 to 39 years (Mattsson et al., 2007).

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