

Original Research Article

Metabolic Syndrome among Undergraduate Students Attending Medical Clinics for Obligatory Medical Screening

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Received: 3 July 2014

Revised accepted: 9 January 2015

Abstract

Purpose: To determine the prevalence and risk factors for metabolic syndrome (MS) among first-year undergraduate students in three Sudanese universities.

Methods: A total of 384 first-year students attending university medical clinics for obligatory medical checkup in Khartoum, Sudan participated in this cross-sectional study. Anthropometric parameters, including weight, height, body mass index (BMI) and waist circumference (WC) were measured with reference to National Cholesterol Education Program's Adult Treatment Panel III (NCEP/ATP III) guidelines. Fasting blood samples were collected from all participants and assayed for fasting blood glucose (FBG), total cholesterol (TC), triglyceride (TG), high density lipoprotein (HDL), and low density lipoprotein (LDL).

Results: The overall prevalence of MS in the test group was 7.8 %. The prevalence of MS, though higher in females, was statistically not significant ($p = 0.32$). According to residential area (rural – urban), the prevalence was higher in urban than rural, 10.4 and 4.4 %, respectively ($p = 0.25$ and $p = 0.25$, respectively). In addition, frequency of MS was directly proportional to age. The weight of patients with MS was significantly different from that of non-MS subjects ($p < 0.001$). Same was also observed when obese patients were compared with non-MS subjects. ($p < 0.001$).

Conclusion: The prevalence of MS among Sudanese first-year university students in Khartoum is moderately high. Incidence of MS among the students is directly proportional to BMI.

Keywords: Metabolic syndrome, Obesity, Hypertension, Diabetes, Dyslipidemia, Anthropometric

Tropical Journal of Pharmaceutical Research is indexed by Science Citation Index (SciSearch), Scopus, International Pharmaceutical Abstract, Chemical Abstracts, Embase, Index Copernicus, EBSCO, African Index Medicus, JournalSeek, Journal Citation Reports/Science Edition, Directory of Open Access Journals (DOAJ), African Journal Online, Bioline International, Open-J-Gate and Pharmacy Abstracts

INTRODUCTION

Metabolic syndrome (MS) as a constellation of risk factors that increase a person's risk of developing cardiovascular diseases (CVD), including central obesity, insulin resistance, dyslipidemia and hypertension [1,2]. MS is rapidly increasing in prevalence with rising childhood obesity and sedentary lifestyles worldwide [3]. It is a risk factor for non-

communicable diseases, such as diabetes mellitus and cardiovascular disease, which are world's biggest killer diseases, estimated to cause 3.5 million deaths each year. Overweight and obesity are risk factors for coronary artery disease, hypertension and DM; however, not everyone with these conditions is obese and not all obese people have these conditions.

National Cholesterol Education Program's Adult Treatment Panel III (NCEP/ATP III) defined MS as the presence of three or more of any of the following criteria in an individual: high waist circumference (WC), elevated fasting glucose (GLU), low high-density lipoprotein cholesterol (HDL-C), elevated triglycerides (TG) and elevated blood pressure (BP) [4].

However, very few studies on MS have been done in Sudan. This study was conducted in undergraduate university students to estimate prevalence and risk factors of the MS using NCEP/ATP III protocols. The study group was selected from first-year students because they are required to undergo an obligatory medical examination in the university clinics before commencing their studies in the university. MS is considered a risk factor for the incidence of atherosclerosis and artery diseases as shown by several studies [5-7]. Therefore, the objective of the study was to determine the prevalence of MS in undergraduate students in study area.

METHODS

Subjects

Three hundred eighty four healthy first-year undergraduate students (273 males, 111 females, aged between 18 and 23 years) in Khartoum, Sudan were enrolled in the study. The students attended the medical clinics of their respective institutions for obligatory medical screening from August - October 2013. Three universities were randomly selected from the 15 campuses in the city. The participating students were selected by systematic random method.

Anthropometric parameters

BMI (kg/cm^2) and WC (weight circumference) were measured following the guidelines of NCEP/ATP III [5]. BMI was calculated using the ratio of weight in kilograms to height in meters (kg/m^2). BMI classifications used were underweight ($< 18.5 \text{ kg}/\text{m}^2$), normal ($18.5 - 24.9 \text{ kg}/\text{m}^2$), overweight ($25 - 29.9 \text{ kg}/\text{m}^2$), and obese ($\geq 30.0 \text{ kg}/\text{m}^2$). WC was measured at the top of the iliac crest upon exhalation to the nearest 0.1 cm using Gulick fiberglass, non-stretchable tape measure with a tensometer (average of two measurements) (Patterson Medical, Mount Joy, PA).

Clinical and biochemical parameters

Systolic and diastolic blood pressure were recorded (in mm Hg) using manual monitor;

measurements were performed in sitting position, recorded in duplicate, every 5 min. Fasting venous blood samples were collected from students for measurement of fasting blood glucose (FBG), total cholesterol (TC), triglycerides (TG), high density lipoprotein (HDL) and low density lipoprotein (LDL). All measurements were carried out using enzymatic methods using Hitachi autoanalyzer 704 (Roche Diagnostics Switzerland). Students with diabetes, hypertension, and those taking continuous medications were excluded from the study. All these measurements were done by well trained staff of clinical units under supervision

Criteria for MS

NCEP/ATP III suggests that the clinical diagnosis of the MS is based upon the following: Increased abdominal fat WC was $> 102 \text{ cm}$ for males and $> 88 \text{ cm}$ for females. Elevated TG was $\geq 150 \text{ mg}/\text{dL}$ while low HDL-C was $< 40 \text{ mg}/\text{dL}$ for males and $< 50 \text{ mg}/\text{dL}$ for females. Elevated fasting GLU was $\geq 100 \text{ mg}/\text{dL}$ and arterial BP was $\geq 130/85 \text{ mmHg}$.

Statistical analysis

Data was analysed using SPSS version 19. Chi-Square test was used to examine differences between BMI categories. ANOVA test was used to determine the differences between groups. Fisher exact test for small expected cells was used [↓5]. $P \leq 0.05$ was considered significant for all tests.

Ethical considerations

The objectives of the study were explained to all students participating in this study, and an informed consent was obtained from all participants with the questionnaire. Ethical clearance was obtained from the Ethical Committee Board of the universities included in study.

RESULTS

The results for anthropometric characteristics, blood pressure and biochemical profile are summarized in Table 1. Table 2 states the prevalence of MS categorized by age, gender, residential area and BMI. The weight of patients with MS was significantly different from that of non-MS subjects ($p < 0.001$). Same was also observed when obese patients were compared with non-MS subjects ($p < 0.001$). Figure 1 shows MS profiles categorized by gender.

Table 1: Age, anthropometric, clinical and biochemical parameters of study group

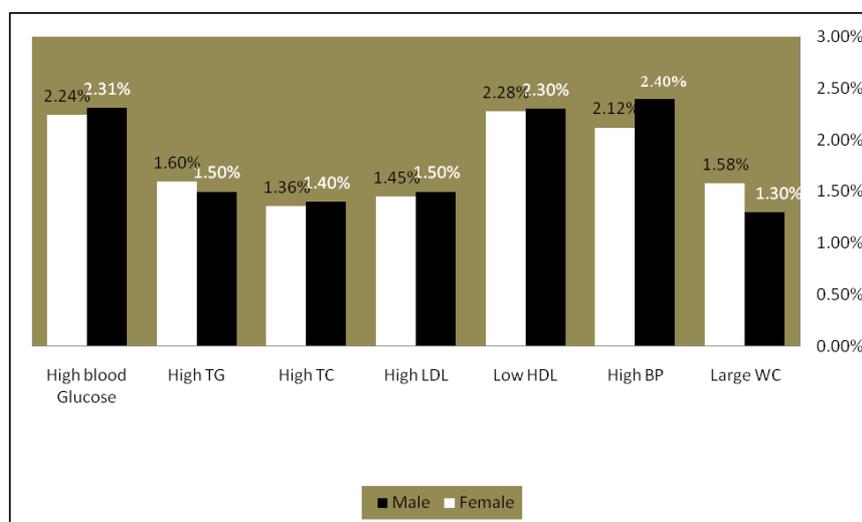
Variable	Male	Female	Total	P-value
	N=273	N=111	N=384	
Age	20.1±1.2	19.9±0.6	20.0±0.8	0.24
Anthropometric parameters				
BMI (kg/cm ²)	22.6±2.3	22.5±1.6	22.5±2.1	0.76
Waist circumference (cm)	76.6±6.9	77.1±7.4	76.8±6.2	0.52
Blood pressure (mm/Hg)				
Systolic (mm Hg)	121.0±8.1	120.4±7.8	121.0±9.7	0.19
Diastolic (mm Hg)	78.2±8.4	78.0±6.9	78.1±8.3	0.49
Metabolic profiles				
Glucose (mg/dL)	97.3±6.5	96.5±5.4	97.0±5.1	0.22
Total cholesterol (mg/dL)	164.2±18.3	162.1±21.1	163.6±19.5	0.10
Triglyceride (mg/dL)	83.6±9.6	84.6±8.1	83.8±8.2	0.24
LDL (mg/dL)	92.1±18.4	90.5±19.1	91.7±17.1	0.12
HDL (mg/dL)	58.6±7.3	57.1±7.3	58.5±5.3	0.21

Note: Data shown are mean ± standard deviation; N = number; BMI = body mass index; WC = waist circumference; TC = total cholesterol; LDL = low-density lipoprotein cholesterol; HDL = high-density lipoprotein cholesterol; TG = triglycerides; GLU = glucose

Table 2: Prevalence of MS categorized by age groups, gender, residential area (rural or urban) and BMI

Variable	MS prevalence	Normal subjects	Total	P-value
	N (%)	N=354	N=384	
Age (year)				
18 – 19	7 (5.7%)	116 (94.3%)	123 (100%)	0.21
20 – 21	11 (7.8%)	131 (92.2%)	142 (100%)	0.11
22 – 23	12 (10.1%)	107 (89.9%)	119 (100%)	0.62
Gender				
Male	21 (7.7%)	252 (92.3%)	273 (100%)	0.32
Female	9 (8.1%)	102 (91.9%)	111 (100%)	0.11
Residential area				
Urban	19 (12.0%)	139 (82%)	158 (100%)	0.25
Rural	11 (4.8%)	215 (95.2%)	226 (100%)	0.10
BMI				
Under weight <18.5 kg/m ²	0 (0%)	8 (100%)	8 (100%)	0.81
Normal weight 18.5-24.9 kg/m ²	2 (0.7%) ^{**}	283 (99.3%)	285 (100%)	< 0.001
Overweight 25.0-29.9 kg/m ²	11 (21.2%) ^{**}	41 (78.8%)	52 (100%)	< 0.001
Obese ≥30 kg/m ²	17 (43.6%) ^{**}	22 (56.4%)	39 (100%)	< 0.001
Total no. of subjects	30 (7.8%)	354 (82.2%)	384 (100%)	0.1

Note: N = number; ^{**} significant at $p \leq 0.01$; (Chi-Square test was used). Fisher exact test for small expected cells ($\downarrow 5$) was used

**Figure 1:** Anthropometric parameters of MS patients based on gender

DISCUSSION

This is the first study with the largest sample size in Sudanese population evaluating the prevalence of MS among college students in Khartoum state and reporting the prevalence of metabolic risks integrating anthropometric, clinical and biochemical parameters.

The overall prevalence of MS in the sample was 7.8 %; this rate is low in comparison with other studies. In Saudi Arabia the prevalence of the syndrome was (31.4 %), also in a Saudi population using the NCEP-ATPIII criteria, Al-Nozha *et al* [8] and Ford *et al* [9] found an age-adjusted prevalence of 23.9 %. Using the data from a nationally representative sample of American citizens derived from a cross-sectional health survey. Alexander *et al* [10] found a prevalence of 43.5 % among subjects older than 50 years from the data derived from the same survey as Ford *et al*. Japer *et al* [11] found a prevalence of 23 % among Arab Americans in their study in 2004. Meigs *et al* [12] studied a large multi-ethnic cohort demographically representative of the US population and found an overall prevalence of the syndrome in 24 % of the general population, with an inter-ethnic variation of 21–31 %. Villegas *et al* [13] found a prevalence of 20.7 % among Irish middle-aged men and women. Using the WHO definition of metabolic syndrome, Abdul-Rahim *et al* [14] found a prevalence of 17 % among the Palestinians in the West Bank. Al-Lawati *et al* [15] in their study of the prevalence of the syndrome among Omani adults found a prevalence of 21 %.

In our study represents the MS to be increased in females than males, (8.1 % vs. 7.7 respectively), this agrees with Al-Nozha study which showed prevalence of metabolic syndrome was increased in females than males, and higher in urban than in rural areas.

The leading factors contributing to the metabolic syndrome in Al-Nozha study was low high density lipoprotein, while in our study the blood sugar was the major contributor and was directly proportional with age.

The prevalence of metabolic syndrome in the present study is likely to be less than the estimated prevalence in other studies since the population of this study was younger in age.

The finding in the present study showed that BMI constitutes one of factors that significantly leads to MS. Hedley *et al* [16] stated that the prevalence of overweight and obesity exceeds

65 % in the U.S. and that overweight and obese individuals are at a substantially higher risk of having MS, these results have important public health implications. Strategies to combat the increasing prevalence of overweight and obesity that also target those with elevated risk factor profiles, including sedentary habits and cardio respiratory failure, are likely to be the most effective in improving the health of the population.

Physicians at primary health care should be motivated to identify the problem and implement necessary remedial and preventive measures focusing on weight control, increased physical exercise, controlling dyslipidemia, hypertension and diabetes. General population should be educated to raise their consciousness toward their health and the value of screening. They should be oriented toward the risks of obesity and physical inactivity. Control of this syndrome among the population is of vital importance and requires the attention of all health professionals.

Limitations of the study

Although the present study has yielded many interested findings, one weakness is the limited population which consisted of only first-year undergraduate students in a few Sudanese universities. Therefore, the results do not portray the general trend of MS in the whole of Sudan.

CONCLUSION

The prevalence of MS among some Sudanese first year college students population is moderately high MS and directly proportional to BMI.

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