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ISSN 2470-0983

Pediatrics and Neonatal Nursing: Open Access

Research Article | Volume: 2.2 | Open Access

Prevalence of Metabolic Syndrome among Young Sudanese University Students Using Three Different Criteria of WHO, IDF and NCEP-ATP III

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Received date: 28 Jan 2016; **Accepted date:** 24 Mar 2016; **Published date:** 28 Mar 2016.

Citation: Sabir FM, Hassan DA, Elamin MI (2016) Prevalence of Metabolic Syndrome among Young Sudanese University Students Using Three Different Criteria of WHO, IDF and NCEP-ATP III. Pediatr Neonatal Nurs Open Access 2(2): doi http://dx.doi.org/10.16966/2470-0983.112

Abstract

Background: During the last few decades, developing countries including Sudan experienced rapid socio-cultural transition associated with major changes in life style and eating habits. Such transition has been claimed for the rising rates of so-called metabolic syndrome (MetS) among young adults and children, which is the leading cause to develop type II diabetes and cardiovascular diseases.

Objective: To estimate the prevalence and distribution of metabolic syndrome (MetS) risk factor among university students from Khartoum State, Sudan.

Design and Method: A cross sectional study. Subjects were 1012 university students (680 females and 332 males) aged 16-25 years with no prior diagnosis of illness. Three international definitions of metabolic syndrome were used in this study (National Cholesterol Education Program Adult Treatment Panel III NCEP-ATP-III, International Diabetes Federation IDF, and World Health Organization WHO). Direct measurements were obtained for metabolic syndrome components; anthropometric screenings included measurement of height, weight, waist circumference (WC) and body mass index (BMI). The clinical screenings included measurement of blood pressure (BP) and determination of fasting lipid profile and glucose concentrations.

Results: Prevalence for MetS varied depending on the definition used. The prevalence was highest by using IDF criteria (8.4%) followed by NCEP ATP-III (7.5%) and WHO (6.1%). Among MetS components prevalence was highest for low levels of high-density lipoprotein (HDL) cholesterol (40.7%; NCEP) and lowest for impaired fasting glucose (8.1%; NCEP). Overweight and obesity was found in 15.3% and 3.1% of study population based on WHO criteria. The prevalence of abdominal obesity (large waist circumference WC) was 8.9% by NCEP. The prevalence of high blood pressure (hypertension) and pre-hypertension was 9.7% and 13.5% (WHO) respectively. Triglycerides prevalence was 8.4% based on NCEP definition, respectively. With the exception of low HDL-cholesterol, all MetS risk factors were more prevalent in males rather than females.

Conclusions: Our findings provide evidence for the high prevalence of MetS in Sudanese university students. These findings agree with previous studies that have shown an alarming high prevalence of overweight/obesity (20.5%) among school children. Adoption of national programs of promoting healthy food habits and physical activity among children is recommended to avoid adult weight gain and development of metabolic syndrome.

Keywords: Metabolic syndrome; Type II diabetes; Cardiovascular diseases

Introduction

The metabolic syndrome has become one of the major public-health challenges worldwide. It is a complex disorder with high socioeconomic cost that is considered a worldwide epidemic [1]. Metabolic Syndrome is an aggregation of conditions that together increases the risk of cardiovascular disease in individuals that would not otherwise be recognized to be at risk. Additionally, Metabolic Syndrome increases the risk of developing diabetes mellitus and chronic kidney disease and is associated with a number of other disorders [2]. Metabolic syndrome first described by Reaven (1988) as a cluster of risk factors for diabetes and cardiovascular disease that include obesity, dyslipidemia, hypertension, and impaired fasting plasma glucose (FPG) [3]. In 1998 the WHO defined metabolic syndrome by the presence of insulin resistance (IR) or its surrogates, impaired glucose tolerance (IGT) or diabetes mellitus type 2 (DMT2), as essential components of the syndrome, along with at least two of the following parameters: raised blood pressure (BP), hypertriglyceridemia and/or low high density lipoprotein-cholesterol (HDL-cholesterol), obesity (as measured by waist/hip ratio or body mass index (BMI), and microalbuminuria [4]. In 2001, the NCEP-ATPIII published a new set of criteria that included waist circumference, blood lipids, BP, and fasting glucose [5]. The NCEP-ATPIII definition differed from the WHO definition in that IR was not considered as a necessary diagnostic component. In 2005, The IDF definition introduced abdominal obesity as a prerequisite of the diagnosis of metabolic syndrome, with particular emphasis on waist measurement as a simple screening tool [6].The prevalence of metabolic syndrome is increasing worldwide. The overall prevalence of the WHO-defined metabolic syndrome in non-diabetic adult Europeans is 15% [7]. In USA, the prevalence among those aged 20–29 years was almost 7% [8]. In Thailand and China the prevalence was ranging from 10-15 [9,10]. There are limited published data on the prevalence of the metabolic syndrome among adolescents and young adults. In Sudan the prevalence of combined overweight/obesity among higher, middle and lower socioeconomic class children was 56.8, 27.3 and 3.1%, respectively. These figures, being higher than those reported among Nigerian and South African children, living in

similar conditions, may refer to an emerging problem of overweight and obesity especially among children of the higher and middle class families. Adoption of national programs of promoting healthy food habits and physical activity among children is recommended [11]. The findings from studies in adults, coupled with the obesity epidemic in childhood, have resulted in a renewed interest in the study of the metabolic syndrome in youth and on its potential impact on the health and well-being of children and adolescents. Prevalence estimates among youth range from 1% in Japan [12], 6.4% in the United States [13], 6.5%in Mexico and 10% [14].

Materials and Methods

This study was conducted in Khartoum State in two public universities; Al Neelain University and University of Khartoum, and two private universities; The National Rabat University and University of Medical Sciences and Technology. Students from different faculties were involved in the selection with a total number of 1022. Sample size for each university was calculated using computer based "R-for statistical analysis" program R-version 2.81, (2008), taking into account 5% prevalence in the population with a 95% confidence interval and 0.05 P-value. Prior to the study, an application form of research ethical permission was completed and attached with study proposal and then approved by ethical commission from the faculty of postgraduate studies in the National Rabat University. An illustration about the research and its objectives had been presented and then written approval had been issued. Body weight was measured to an accuracy of 0.1 kg using a standard balance scale manufactured by Microlife®, Switzerland. Subjects were barefoot and wearing light indoor clothing. Body height was recorded to the nearest 0.5 cm using a ruler attached to the wall without shoes. BMI was obtained through body weight (kg) divided by the square of their height (m). The definition of BMI used in this study is the same as the definition of world health organization (WHO) which is: Underweight<18.50, Normal 18.50-24.99, overweight ≥ 25 obese ≥ 30. Waist circumference was taken from all participants using a non-stretchable tape measure at level of the uppermost edge of the hip bone on a light clothed abdomen with the tape parallel to the ground and recorded to the nearest 0.5 centimeters. Hip circumference was measured at the point of trochanter major by the same procedure, and Waist/Hip ratio (WHR) was defined as waist to hip circumference. The measurement above 102 cm and 88 cm in men and women respectively was considered as central obesity, and WHR excess than 0.8 considered as a risk value according to the IDF & NCEP ATP III criteria. Blood pressure was measured using sphygmomanometers with subjects seated in a chair with arm at the level of the heart. Standard mercury sphygmomanometer was used with regular adult cuff size. Systolic and diastolic blood pressure was considered as Korotkoff's phases 1 and 5 respectively. The BP was measured again after a 5-min rest and the average BP was used in the analysis. For this study, hypertension was defined as systolic blood pressure (SBP) ≥ 140 mmHg, or diastolic blood pressure (DBP) ≥ 90 mmHg. Pre hypertension defined as BP levels of 120–139 mmHg for systolic and 80–89 mmHg for diastolic BP, respectively [15]. Subjects found to have hypertension or use any medications that affect blood pressure were excluded from this study. Biochemical assessment done using post-fasting blood samples collected intravenously using 5 ml sterile syringes in anticoagulant-containing sterile containers. Blood samples were centrifuged in 3500 rpm for 5minutes and biochemical parameters were measured using enzymatic colorimetric assay. All samples were analyzed using the same colorimetric device (Jenway bench colorimeter 6051-UK) and the same chemical reagent kit (Biosystems-Germany). In this study, three criteria were involved to diagnose metabolic syndrome; National Cholesterol Education Program Adult Treatment Panel III (NCEP:ATPIII), modified World Health Organization (WHO) and the International Diabetes Federation (IDF) [5,16,6].

Results

The total number of students was 1012; 332 males (32.8%) and 680 females (67.2%). The overall mean age of students was 20.0 ± 1.94 year (16-32 years). Demographic characteristics and mean values of the study population shown in table 1.

The mean BMI for all students was 24.2 ± 5.83 (males 25.9 ± 6.42 and females 23.2 ± 5.31). The mean waist circumference was 80.4 ± 15.74 cm. The mean values for systolic blood pressure (SBP) and diastolic blood pressure (DBP) were 116.1 mmHg and 76.5 mmHg respectively, table 2. The mean value for fasting blood glucose for the study subjects was 79.5 ± 23. The means value for triglycerides among the study population was 80.8 ± 42.7 mg/dl. Mean HDL-C level was 50.6 ± 14.89 mg/dl (Table 2).

The prevalence of metabolic syndrome using NCEB ATP-III criteria was found to be in 67 students (7.5%). The prevalence of metabolic syndrome using IDF criteria was the highest among the other two criteria, (8.4%). In this study the result showed that metabolic syndrome using WHO criteria prevalent among 62 subjects (6.1%), (Figure 1).

The highest prevalence was for low HDL-cholesterol by all three criteria, and the lowest prevalence was for elevated fasting blood glucose (FBG) by NCEP and WHO criteria, (Figure 2). In this study, overweight and obesity together were prevalent in 18.4% of study population (15.3% overweight and 3.1% obese, WHO). In our study, prevalence of abdominal obesity by using waist circumference was 8.9% (NCEP) and 23.6% (IDF), and by using waist-to-hip-ratio (WHR) 10.4% (WHO). The prevalence of high blood pressure among our study population was 9.7% (15.7% in males and 6.8% in females) based on WHO definition and 15.6% (22.3% in males and 11.9% in females) based on NCEP/IDF definitions. The prevalence of

	Sex			
	Males	Females	Total	p-Value
N (%)	332 (32.8%)	680 (67.8%)	1012 (100%)	
Mean age (years)	20.7 ± 1.93	19.7 ± 1.85	20.0 ± 1.94	0.228
Mean weight(kg)	78.3 ± 19.57	62.1 ± 15.27	67.5 ± 18.47	0.000
Mean height(cm)	174.0 ± 7.37	163.1 ± 6.56	166.7 ± 8.53	0.000
Mean BMI	25.9 ± 6.42	23.2 ± 5.31	24.2 ± 5.83	0.000
Mean waist/ circumference (cm)	84.9 ± 17.91	78.1 ± 14.04	80.4 ± 15.74	0.000

Table 1: Demographic Characteristics and Mean Values of the study population

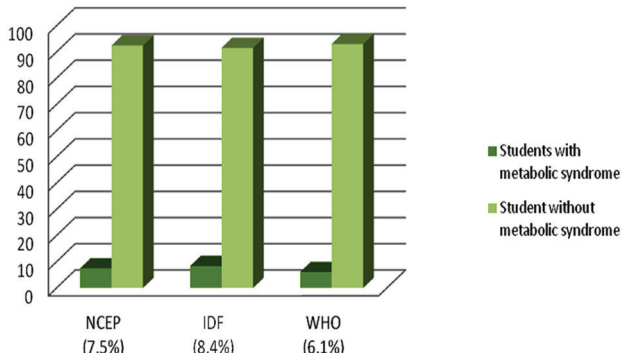

Figure 1: Prevalence of metabolic Syndrome using the three major criteria

Mean values of clinical anthropometric measurements				
	Sex			
	Males	Females	Total	p-Value
Mean BMI	25.9 ± 6.42	23.2 ± 5.31	24.2 ± 5.83	0
Mean waist/circumference (cm)	84.9 ± 17.91	78.1 ± 14.04	80.4 ± 15.74	0
Mean Systolic blood pressure (mmHg)	114.3 ± 9.98	119.6 ±10.15	116.4 ± 10.54	0
Mean Diastolic blood pressure (mmHg)	78.7 ± 8.02	75.3 ± 7.69	76.5 ± 7.97	0
Mean values of biochemical laboratory investigations				
Mean Fasting Blood Glucose	81.9 ± 24.08 mg/dl	78.3 ± 22.56 mg/dl	79.5 ± 23.11 mg/dl	.027*
Mean TG	80.8 ± 42.7 mg/dl	87.9 ± 39.91 mg/dl	77.4 ± 43.65 mg/dl	0
Mean HDL-C	50.7 ± 14.8 mg/dl	47.6 ± 14.64 mg/dl	52.1 ± 14.80 mg/dl	.000*

Table 2: Mean values (± SD) of clinical anthropometric measurements and biochemical parameters

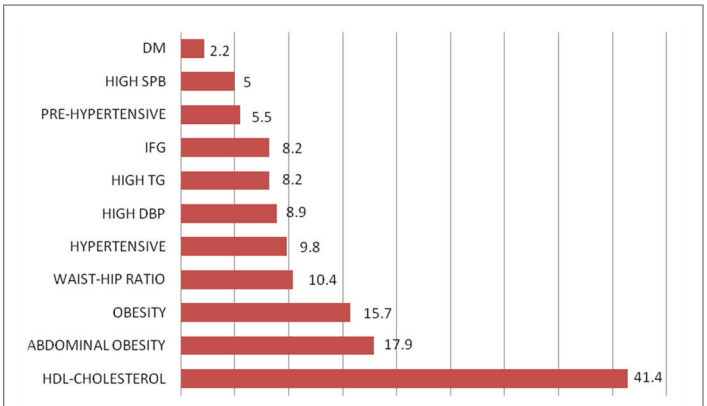

Figure 2: Prevalence of individual risk factors for Metabolic Syndrome

Impaired Fasting Glucose (IFG) was 8.1% (10.6% males *vs*. 6.9% females) by NCEP/WHO and 11.3% (13.9% males *vs*. 10.0% females) by IDF definitions. The prevalence of high triglyceride was 8.4% (males 11.1%, females 7.0%).

Discussion

One thousands and twelve students participated in this study; the majority of the participants were females constituting 67.8% of the study population which is indicative of the female gender in Sudanese universities. The overall prevalence of metabolic syndrome in this study was found to have different values when using the three common criteria (NCEP-ATPIII, IDF and WHO). The prevalence was highest by using IDF criteria (8.4%) followed by ATP-III (7.5%) and WHO (6.1%). This difference could be explained by the fact that; the prevalence of metabolic syndrome clearly varied widely depending on the definition applied when some main factors like age and ethnicity held constant [17,18]. Compared to studies on the prevalence of metabolic syndrome among young population, our finding was lower than in the United States (12%, NCEP) [19], Finland (13%, NCEP) [20] and Canada (17%, NCEP) [21], and higher than the findings from Turkey (3.6%, NCEP) [22], India (3.3%, IDF) [23] and Tanzania (1.1% IDF) [24]. Most of the studies done in nearby countries investigated adult (20 years and above), and the prevalence according to NCEP ATP-III criteria in Ethiopia was 15.2%, Oman 21%, Tunisia 24.3%, Qatar 26.5%, Botswana 34%, Iran 34.7% and Saudi Arabia 39.3% [25-31]. These results were higher when compared to ours and to others obtained from studies on young population, where age, as documented, is a key player in the increased incidence of metabolic syndrome risk factors [32]. One of the main contributors in this increasing is the alarming increase in the prevalence of overweight, abdominal obesity and other risk factors in children and their persistence to adulthood [33]. In addition, young adults entering college are in a critical transition state, and it is well documented that college students experience weight gain faster than an average adult [34,35]. Various studies have indicated that the poor health and lifestyle choices of college students, such as unhealthy diets, lack of physical activity and regular exercise, use of tobacco, and alcohol consumption have been reported to contribute toward increasing the risks for metabolic syndrome [36,37]. Overweight and abdominal obesity are the main risk factors that are associated with the development of metabolic syndrome [38]. In this study, overweight and obesity together were prevalent in 18.4% of study population, 15.3% overweight and 3.1% obese according to BMI-based WHO definition. Our finding was higher than the prevalence in Uganda (10.4% and 2.3% respectively) [39] and Tanzania (1.4% Obesity) [24] and very close to the prevalence in Nigeria (15.0% and 3.3% respectively) [40]. Higher than our results was found in Lebanon (24.0%, 7.2% respectively) [41], Saudi Arabia (21.8% and 15.7% respectively) [42], Kuwait (32.0% and 8.9% respectively) [43], and Malaysia (15.9% and 5.2) [44].The reasons behind the increase in obesity rate among children and young adults whether in developed or developing countries are numerous and complicated. The great and pervasive changes that have occurred in the pattern of life, including unhealthy eating habits, physical inactivity, smoking, increased television viewing, internet surfing have contributed to a more sedentary lifestyle towards more overweight and obese individuals , in addition to family background and hereditary aspects [45].

Conclusion

Our findings provide evidence for the high prevalence of MetS in Sudanese university students. These findings agree with previous studies that have shown an alarming high prevalence of overweight/obesity (20.5%) among school children. Adoption of national programs of promoting healthy food habits and physical activity among children is recommended to avoid adult weight gain and development of metabolic syndrome.

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