

Prevalence of the metabolic syndrome among female Kuwaiti adolescents using two different criteria

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Overweight and obesity are highly prevalent in Kuwait and they are associated with the metabolic syndrome (MS). The present study aims to assess the prevalence of the MS among Kuwaiti female adolescents aged 10–19 years. A cross-sectional random sample of 431, apparently healthy, Kuwaiti female adolescents drawn from several randomly selected schools was studied for the prevalence of the MS using the International Diabetes Federation (IDF) and the National Cholesterol Education Program Third Adult Treatment Panel (ATP III) modified for age diagnostic criteria. Clinical assessment included measurements of waist circumference, blood pressure, fasting blood glucose, HDL and TAG. Whichever criteria are used, the prevalence of the MS among female Kuwaiti adolescents was found to be high, which indicates an urgent need for intervention programmes to prevent increased CVD and type 2 diabetes mellitus. The IDF criteria tend to give higher values for the prevalence of the MS in comparison with the modified ATP III criteria (14.8 v. 9.1%). There have been no diagnostic criteria specific for the MS for the Gulf Arab population as yet.

Metabolic syndrome: Prevalence: Kuwaiti females: Adolescents: International Diabetes Federation: Third Adult Treatment Panel modified for age

The prevalence of overweight (BMI \geq 25 kg/m²) and obesity (BMI \geq 30 kg/m²) has been on the increase in the Gulf Arab population, primarily among children, adolescents and young adults⁽¹⁾. In Kuwait, the overall prevalence of overweight and obesity has been found to be 30.9 and 13.9%, respectively, among adolescents aged 10–14 years, which probably increased through the years due to the effects of modernisation, increased food consumption and sedentary lifestyles^(2,3). The prevalence of overweight and obesity was 28.6 and 7.9%, respectively, among Qatari adolescents⁽⁴⁾, 21.5 and 13.7% in United Arab Emirates⁽⁵⁾ and in Saudi Arabia the prevalence of obesity ranged from 33.9% in Ha'il to 11.7% in Jizan.

Overweight and obesity are associated with the metabolic syndrome (MS)⁽⁶⁾, even in children⁽⁷⁾. The MS has been shown to be associated with a variety of morbid conditions, chief among which are CVD or type 2 diabetes mellitus (T2DM)⁽⁸⁾; it doubles the risk for CVD and further raises the risk for T2DM by about 5-fold⁽⁹⁾. According to the WHO, non-communicable diseases, including CVD and T2DM, were responsible for 52% of the Eastern Mediterranean region's disease burden in 2006, and expected to rise to 60% by 2020⁽¹⁰⁾. In adults, mortality resulting from CVD is significantly higher with the MS than those not suffering from the MS⁽¹¹⁾. Paediatric MS predicts significantly the MS and T2DM 25 to 30 years later⁽¹²⁾, and predicts CVD 25 years later⁽¹³⁾.

Furthermore, the MS was found highly associated with increased CVD and all-cause mortality even in the absence of previous history of CVD and diabetes⁽¹⁴⁾, especially with the combination of elevated waist circumference, elevated glucose, either elevated blood pressure or elevated TAG, and the combination of all four of these MS individual parameters⁽¹⁵⁾. Waist circumference is a simple measure by which abdominal obesity can be easily assessed, and a strong predictor of CVD risk factors in children⁽¹⁶⁾, and its use together with BMI has significant clinical importance for the prediction of risk factors among children and adolescents⁽¹⁷⁾.

There are several criteria for the assessment of the MS, including the criteria produced by the WHO, the European Group for the Study of Insulin Resistance (EGIR), the National Cholesterol Education Program Third Adult Treatment Panel (ATP III) and the International Diabetes Federation (IDF)⁽¹⁸⁾. Diagnosis of the MS requires certain risk factors, which are insulin resistance, obesity, hypertension, high TAG, reduced HDL-cholesterol level, microalbuminuria and elevated plasma glucose. The WHO considered insulin resistance as the major risk factor required for MS diagnosis. According to the EGIR, the presence of elevated plasma insulin plus other two factors (abdominal obesity, hypertension, elevated TAG, reduced HDL-cholesterol or elevated plasma glucose) constitutes a diagnosis of the MS. National Cholesterol Education Program ATP III criteria establishes the diagnosis by the presence of three of five factors of the MS

Abbreviations: ATP III, Third Adult Treatment Panel; IDF, International Diabetes Federation; MS, metabolic syndrome; T2DM, type 2 diabetes mellitus.

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and there is no single factor required for this diagnosis⁽¹⁹⁾. The IDF considers the presence of abdominal obesity as the main factor, with two additional risk factors to be sufficient for MS diagnosis⁽²⁰⁾.

Until now, there is no information on the prevalence of the MS in the Arabian Gulf countries among adolescents. The present study attempted to assess the prevalence of the MS among female Kuwaiti adolescents, and to compare the effectiveness of the IDF and the modified ATP III diagnostic criteria for identifying the MS, since there are no specific Arab diagnostic criteria for the MS.

Methods

Sample

A cross-sectional sample of apparently healthy female Kuwaiti school students aged 10–19 years was used for the study, adapting a multistage cluster sample. Out of six governorates in Kuwait, two governorates were randomly selected for the present study (Capital and Hawally). We obtained the list of all intermediate and secondary public schools in these two governorates from the Ministry of Education. From the list we randomly chose four schools, one intermediate and one secondary from each of the governorate. Every student in each of these four selected schools was invited to participate. Students suffering from diabetes mellitus, hypertension, cardiac diseases, renal diseases, epilepsy, students receiving medications, and those with broken legs (with cast), for the sake of weight measurement, were excluded. We obtained written informed consent from the parent or guardian of all the participants. The final sample included 431 female students, almost all of them Kuwaiti nationals, in the age group of 10–19 years.

Questionnaire and measurements

Sociodemographic and health-related information was obtained through a questionnaire. Ethical approval was taken by the local Ethics Committee in the Faculty of Medicine of Kuwait University. The subjects were examined in the morning after at least a 10h overnight fast. Blood pressure was measured with a standard gauge mercurial sphygmomanometer after the subject had been seated, and waist circumference was measured by using measuring tape, midway between

the inferior margin of the ribs and the superior border of the iliac crest. All measurements were taken by the same investigator to avoid inter-observer variations. Fasting blood samples were collected via venepuncture and kept cooled in an ice box until separation in a refrigerated centrifuge, then the resulted plasma and serum samples were stored frozen at –80°C until analyses were performed. HDL, TAG and glucose were analysed by a Beckman Chemistry Analyser (Beckman Corp., Fullerton, CA, USA). All statistical analyses were done using SPSS statistical software (version 16; SPSS, Inc., Chicago, IL, USA).

Definition of the metabolic syndrome criteria used

Five parameters are used by both the IDF and the ATP III modified for age. According to the IDF criteria, the MS is diagnosed by the presence of high waist circumference plus two other parameters with cut-off values related to age; the cut-off points used are shown in Table 1⁽¹⁸⁾. According to the modified ATP III criteria, the MS is diagnosed when individuals meet at least three of the listed criteria in Table 1, using data from the American Third National Health and Nutrition Examination Survey (NHANES III) with no data for Arabs.

Statistical methods

Data entry and analysis were carried out using SPSS version 16 (SPSS, Inc.). In addition to descriptive statistics such as mean, standard deviation and proportions, we used sensitivity and specificity measures to assess the diagnostic accuracy of the two different MS criteria.

Results

The mean age was 14.8 (SD 2.2) years (Table 2). Anthropometric measures in the female participants are also shown in Table 2. Table 3 shows the results for waist circumference, TAG, HDL, fasting blood glucose, systolic blood pressure and diastolic blood pressure. According to the IDF criteria, waist circumference, TAG, fasting blood glucose and blood pressure were increased among the subjects, while HDL was decreased, same as using the modified ATP III criteria. Table 4 shows the relationship between the IDF and the

Table 1. Cut-off points of International Diabetes Federation (IDF) and Third Adult Treatment Panel (ATP III) criteria

Factors	ATP cut-off points*		IDF cut-off points†	
	Adolescents	Adults	10 to 16 years	16 + years
Waist circumference (cm)				
Male	≥ 90th percentile	> 102	≥ 90th percentile or adult cut-off, if lower	≥ 94
Female	≥ 90th percentile	> 88	≥ 90th percentile or adult cut-off, if lower	≥ 94
TAG (mmol/l)	≥ 1.24	≥ 1.7	≥ 1.7	≥ 1.7
HDL (mmol/l)				
Male	≤ 1.03	< 1.03	< 1.03	< 1.03
Female		< 1.29		< 1.29
Blood pressure (mmHg)	≥ 90th percentile	≥ 130/85	≥ 130/85	≥ 130/85
Glucose (mmol/l)	≥ 6.1	≥ 6.1	≥ 5.6	≥ 5.6

* ATP criteria for the metabolic syndrome identified as the presence of three or more of the listed factors.

† IDF criteria for the metabolic syndrome identified as the presence of high waist circumference plus two or more of the listed factors.

Table 2. Age and anthropometric measures in the female participants (n 439)

(Mean values and standard deviations)

	Mean	SD
Age at time of measurement (years)	14.77	2.22
Weight (kg)	63.17	18.34
Height (cm)	156.02	7.24
BMI (kg/m ²)	26.00	6.00
Waist:hip ratio	0.76	0.07
Biceps skinfold (mm)	8.12	1.67
Triceps skinfold (mm)	8.65	1.80
Subscapular skinfold (mm)	8.61	1.77
Supra-iliac skinfold (mm)	8.63	1.83

modified ATP III criteria; the sensitivity of the IDF for the ATP criteria was 73%, while the specificity was 90.4%. The positive predictive value of the IDF was 0.415, while the negative predictive value was 0.027. If a student has the MS by the IDF, there is a 41.5% chance of having the MS by the ATP criteria, while 2.7% of those not having the MS by the IDF actually have the MS by the modified ATP criteria.

Discussion

Both developed and developing countries are currently expected to be suffering from the MS pandemic, especially among children and adolescents, because the prevalence of the MS increases progressively with weight status, which increases with increasing BMI values^(21,22). Obese patients have a three-fold increased risk of developing the MS with respect to overweight patients⁽²¹⁾. The present study found that the prevalence of the MS among female Kuwaiti adolescents was 14.8 and 9.1%, according to the IDF and ATP III, respectively, which is high. Worldwide, the prevalence of the MS among female adolescents in the USA for the period 1999–2004 was approximately 2.1% using the IDF criteria⁽²³⁾, 2.5% among female Chinese adolescents aged 14–16 years, using the ATP III criteria⁽²⁴⁾, ranging between 5.1% in 1998 and 4.9% in 2001 among female Korean adolescents using the ATP III criteria⁽²⁵⁾, and 9.9% among Iranian females, using the ATP III criteria⁽²⁶⁾. Among 248 Caucasian females in Italy, the prevalence of the MS is increased with the advance of pubertal stage from 19.2% early mid-pubertal stage to 28.9% late pubertal stage⁽⁸⁾.

According to the ATP III criteria, out of 1393 Korean students, aged 12–13 years, the prevalence of the MS was 1.6% for normal-weight and 22.3% for overweight students⁽²²⁾. The overall prevalence of the MS among adolescents in Canada was 9.6% using the IDF adolescent criteria and 7.6% using the modified ATP III criteria⁽²⁷⁾, and 2.2% among Turkish adolescents using the modified ATP III criteria⁽²⁸⁾. The prevalence differs with respect to sex. In a study done on 506 students under the age of 19 years, it was found that the MS was higher among obese (39.1%) than among overweight (2.8%) and normal-weight (0.3%) students⁽²⁹⁾. Furthermore, it was found that MS prevalence among sixty overweight Indian adolescents was 36.6%⁽³⁰⁾. In a large study done on 20 000 Chinese children (aged 6–18 years), the prevalence of the MS was 0.9, 7.6 and 29.8% in the normal-weight, overweight and obese children, respectively⁽³¹⁾.

These criteria, IDF and ATP III, have not been made for the Arab population. Even some studies among adult Arabs showed different cut-off points, as one study among Kuwaiti subjects aged between 18 and < 50 years used waist circumference scores > 90 cm for females as high scores⁽³²⁾. Another community-based study for rural adults in Iraq found that optimal cut-off points for waist circumference for the diagnosis of the MS among the rural Iraqi adult population was 99 cm in women⁽³³⁾. Studies are needed to set cut-off values for waist circumference for the diagnosis of the MS for use among adolescents of the Arab population instead of European values as in the IDF criteria, or of American values as in the ATP III criteria.

Since childhood MS and obesity persist into adulthood, early identification helps target interventions to improve future cardiovascular health⁽²²⁾. It can be concluded that there has been a high prevalence of the MS (> 10%) among Kuwaiti adolescents, whichever criteria are used, which indicates an urgent need for intervention programmes to prevent increased prevalence of CVD and T2DM. Furthermore, the modified ATP III criteria tend to give lower values for the prevalence of the MS in comparison with the IDF criteria (9.1 v. 14.8%), and neither has specific criteria for Arabs, which indicates the need for MS diagnostic criteria specific for the Arab population.

Our findings, however, should be understood in the light of a number of limitations. Although the present study is one of the first studies of this nature in a society where obesity in

Table 3. Metabolic syndrome (MS) prevalence difference between International Diabetes Federation (IDF) and Third Adult Treatment Panel (ATP III) criteria in female students

Anthropometric and biochemical variables	Mean	SD	Prevalence (%) by MS diagnostic criteria	
			Modified ATP III	IDF
Waist circumference (cm)	73.6	13.9	13.2	31.0
TAG (mmol/l)	0.62		6.2	1.1
Range	0.04–4.24			
HDL (mmol/l)	1.2	0.3	26.7	39.6
Glucose (mmol/l)	5.03	0.4	2.1	9.1
Systolic blood pressure (mmHg)	121.2	10.9		
Diastolic blood pressure (mmHg)	81.6	8.2	64.7	49.4
MS prevalence rate			9.1	14.8

Table 4. Sensitivity and specificity of International Diabetes Federation (IDF) and modified Third Adult Treatment Panel (ATP III) metabolic syndrome (MS) diagnostic criteria

	ATP (+MS)	ATP (-MS)	Total
IDF (+MS)	27	38	65
IDF (-MS)	10	356	366
Total	37	394	431

the adolescent has been shown to be rapidly increasing, our findings have several limitations. First, the generalisation of the results may be reasonable but two governorates we have chosen may be slightly more urban than some other governorates in Kuwait. As such, it is possible that our estimates may be slightly biased. There were other limitations such as lower rates of parental and/or students' consent to take part in the study. Higher refusal rate is a concern, particularly in terms of selection bias, if the refusal rates vary with different strata of the population. For instance, if the richer parents refused more frequently than poorer parents or less educated parents were more overprotective than more educated ones there is a possibility of selection bias although it is difficult to ascertain which way such a bias would have affected our estimates. Fasting of the students could also be not controlled and as such blood measurements may not be easily generalised.

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A. A.-I., L. T. and A. O. A. designed the study and wrote the manuscript, supervised the data collection and analysis in addition to writing the manuscript together.

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