GENDER AND AGE-RELATED DIFFERENCES IN PATIENTS WITH THE METABOLIC SYNDROME IN A HIGHLY ENDOGAMOUS POPULATION

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Abstract

The objective of the study was to examine the differences in gender and age prevalences of metabolic syndrome (MetS) among adult Qatari population according to the revised criteria of NCEP ATP III and IDF, assess which component contributed to the higher prevalence of the MetS and identify the characteristics of the subjects with MetS. The study was designed as a cross-sectional study. The survey was carried out in urban and semi-urban primary health care centers. The survey was conducted in the period from January 2007 to July 2008 among Qatari nationals above 20 years of age. Of the 1536 subjects who were approached to participate in the study, 1222 (79.6%) gave their consent. Face to face interviews were conducted using a structured questionnaire followed by laboratory tests. MetS was defined using the National Cholesterol Education Program – Third Adult Treatment Panel (ATP III) as well as the International Diabetes Federation (IDF). The overall prevalence of MetS in studied subjects was 26.7% and 33.9% according to ATPIII and IDF ($p<0.001$) criteria respectively. The prevalence of MetS by both definitions peaked in the 30-39 years age group among males, and the 40-49 years age group among females. The greatest number of males with MetS were university educated; while the greatest number of females with MetS were either illiterate or had a primary school education. The prevalence of MetS was higher among females. Among the components of MetS, the prevalence of central obesity was significantly higher in studied subjects. The overall prevalence of MetS and its components according to IDF criteria was higher in studied subjects than the estimates given by the ATPIII criteria. Overall, the prevalence of the metabolic syndrome in the State of Qatar is about 10-15% higher than in most developed countries, with generally higher prevalence rates for women. Preventive strategies will require identifying socio-demographic factors and addressing modifiable risk behaviours, including lack of physical activity, and dietary intake.

KEY WORDS: prevalence, gender, age, Metabolic Syndrome, Diabetes Mellitus, ATP III, IDF, Qatar

Introduction

Metabolic syndrome has become a major global public health issue (1). The increase in prevalence of the MetS is driven largely by the epidemic of obesity throughout the world (1). The global increase in obesity and MetS has been shown to result in a dramatic increase of type 2 diabetes (T2DM) and is expected to lead to an increase in cardiovascular disease as well (2). There is an urgent need for strategies to prevent the emerging global epidemic. Combating MetS requires knowledge of the incidence, prevalence, and rates of transition between stages of the condition as well as relationships between obesity and cardio-metabolic risk factors. The MetS is associated with increasing risk of cardiovascular morbidity and mortality, with risk estimates ranging from 1.4 to 4.5 (2). The cluster of metabolic and hemodynamic disturbances known as MetS is increasingly attracting the attention of International research institutions and scientific societies, as major modifiable determinants of CVD and impaired fasting glucose. In recent years, MetS has internationally evolved into a recognised clinical entity, assuming an epidemic proportion (3-6). The prevalence of MetS has varied markedly between different populations, most likely because of the lack of accepted criteria for the definition of the syndrome (7).

The most widely accepted criteria have been proposed by the WHO (8), the European Group for the study Insulin Resistance (EGIR) (9) and the National Cholesterol Education Program – Third Adult Treatment Panel (NCEP ATPIII) (10). The International Diabetes Federation (IDF) (11) and American Heart Association (AHA)/ National Heart, Lung and Blood Institute (NHLBI) (11) recently proposed a new worldwide definition of MetS intended to facilitate its clinical diagnosis and simplify the comparison among data from different countries. In our study sample, we have used ATP III and IDF definitions to examine how prevalence estimates might differ according to the definition used and compare the degree to which participants were being similarly or differently classified by the two definitions. The 2005 International Diabetes Federation (IDF) definition of the MetS was designed to be useful worldwide, but to date few prevalence studies have used this definition. As central obesity is regarded as a likely early step in the development of full MetS, this definition puts a very large number of individuals belonging to one of the longest living and healthiest populations in the world, namely the Chinese, at increased risk for CVD and T2DM (12-14). The prevalence of the MetS increases with age through the sixth decade of life among men and seventh decade among women (4-6, 15). Most, but not all studies reported a higher prevalence of the MetS among women compared with men (5). Furthermore, few previous studies have reported the high prevalence of hypertension and T2DM in the Qatari population (5, 15). The aims of the study were to examine the differences in gender prevalence of MetS among the adult Qatari population according to the revised criteria of NCEP ATP III and IDF, assess which component contributed to the higher prevalence of the MetS and identify the characteristics of the subjects with MetS.

Material and Methods

This is a cross-sectional study which was conducted among the adult Qatari population who were over 20 years of age over the period from January 2007 to July 2008. IRB ethical approval was provided by the Hamad Medical Corporation prior to commencement of data collection. Each participant was provided with brief information about the study and was assured of strict confidentiality. Only participants who agreed to participate and signed the consent form were included in the study.

Sampling Procedure

A multistage stratified cluster sampling design was developed using the administrative divisions of the primary health centers. The sample size was determined on a priori presumption that the prevalence rate of impaired fasting glucose in Qatar (15) would be more or less similar to rates found for several other countries in the Eastern Mediterranean, where the reported prevalence of impaired fasting glucose was to be 17%, with the 99% confidence interval for an error of 2.5% at the level of significance; it was determined that a sample size of 1536 subjects would be required for this study. Of the total of 22 primary health care centers available, 10 were selected at random. Of these 8 were located in urban and 2 in semi-urban areas of Qatar. Finally, subjects were selected systematically 1-in-2 using a sampling procedure. During the study period, 1536 subjects were approached, of whom 1222 responded to the questionnaire which gives a response rate of 79.6%.

Questionnaire

A well designed and pilot tested questionnaire was used to collect data. The designed questionnaire was tested among 50 subjects as a pilot study for the validity of the questionnaire (15). The first part included information about socio-demographic and anthropometric characteristics including age, sex, marital status, education level, occupation, height, weight and parental consanguinity. The second part collected information about complications such as central obesity, hypertension, triglyceride, high-density lipoprotein; and family history of diabetes and hypertension. Information regarding lifestyle habits such as physical activity, sleeping hours and smoking habits were collected.

Diagnostic Criteria

National Cholesterol Education Program – Third Adult Treatment Panel (ATP III) (10)

According to ATP III criteria, a participant has the metabolic syndrome if she/he has three or more of the following criteria: (1) Fasting Plasma Glucose (FPG) ≥100mg/dl (5.6 mmol/L) (2) Blood Pressure ≥130/85 mm Hg (3) Triglyceride ≥150mg/dl (1.7 mmol/L) (4) HDL Cholesterol: Men <40mg/dl (1.03 mmol/L); Women < 50mg/dl (1.29 mmol/L (5) Men with waist circumference >102 cm and women with waist circumference >88cm.

International Diabetes Federation (IDF) (11)

According to IDF criteria, a participant has the metabolic syndrome if she/he has a high waist circumference (≥94cm in men and ≥80 cm in women) plus any two of the following conditions: 1) FPG≥100 mg/dl (5.6 mmol/L) or previously diagnosed impaired fasting glucose (2) Blood Pressure ≥130/85 mmHg or treatment for hypertension (3) Triglyceride ≥150mg/dl (1.7 mmol/L) (4) HDL Cholesterol: Men <40mg/dl (1.03 mmol/L); Women < 50mg/dl (1.29 mmol/L) or treatment for low HDL.

Anthropometric examination and measurements

Anthropometric examination and measurements were performed by a trained nurse. Height was measured in centimeters to the nearest 5 millimeters, using a height scale (SECA, Germany) while the subject was standing bare feet and with a normal straight posture. Weight was measured in kilograms to the nearest 100 grams using a weight scale (SECA, Germany). The subjects were asked to remove any objects from their pockets and to stand on the weight scale bare feet with light clothing. BMI was calculated as the ratio of weight (kilogram) to the square of height (meters). Obesity and overweight were classified according to WHO criteria (16). A person was considered obese if the BMI value was ≥30 kg/m2, overweight if BMI ≥25 kg/m^2 and <30 kg/m^2. Two readings of the systolic (SBP) and diastolic (DBP) blood pressure were taken from the subject's left arm while seated and his/her arm at heart level, using a standard zero mercury sphygmomanometer after at least 10-15 minutes of rest. Then the average of the two readings was obtained. Hypertension was classified according to the definition of ATPIII and IDF which is SBP≥130 mmHg or DBP≥85 mmHg or the use of anti-hypertensive medication (5). Waist circumference was measured in centimetres with subjects wearing light clothes at midway level between lower rib margin and iliac crest using non-stretchable measuring tape. Waist circumference was measured according to the definition of ATP III and IDF and considered as risk factor for metabolic syndrome. Subjects were classified as physically active if they reported performance of 30 minutes or more of exercise per day.

Laboratory measurements

Fasting blood venous samples, after 12 hours of overnight fasting, were collected from all participants for determination of impaired fasting glucose, low HDL and Triglyceride. ATP III and IDF criteria for impaired fasting glucose, low HDL and triglyceride were used to classify persons as having MetS.

Statistical analysis

Student-t test was used to ascertain the significance of differences between two means of a continuous variable and confirmed by non-parametric Mann-Whitney test. Chi-square and Fisher's exact tests were performed to test for differences in proportions of categorical variables between two or more groups. Spearman's correlation coefficients between waist circumference and obesity-related metabolic risk factors were calculated. A p-value of less than 0.05 was considered statistically significant.

	Variables	Males (n=612)		Females (n=610)		p-value
		Count	(%)	Count	(%)	
Age	(Mean ± SD)	41.9±9.62		39.6±10.7		0.004
Age group in years						
	<30	72	(11.8)	131	(21.5)	<0.001
	30-39	185	(30.2)	179	(29.3)	
	40-49	220	(35.9)	193	(31.6)	
	50-59	110	(18.0)	77	(12.6)	
	>=60	25	(4.1)	30	(4.9)	
Marital Status						
	Married	368	(60.1)	500	(82.0)	<0.001
	Not married	211	(34.5)	99	(16.2)	
	Divorced/Widow	33	(5.4)	11	(1.8)	
Educational Status						
	Illiterate	8	(1.3)	186	(30.5)	<0.001
	Primary	124	(20.3)	233	(38.2)	
	Intermediate	135	(22.1)	78	(12.8)	
	Secondary	116	(19.0)	28	(4.6)	
	University	229	(37.4)	85	(13.9)	
Occupation						
	Retired/Not working	87	(14.2)	54	(8.9)	<0.001
	Clerical Job	166	(27.1)	135	(22.1)	
	Professional	153	(25.0)	77	(12.6)	
	Manual worker	119	(19.4)	12	(2.0)	
	Student	17	(2.8)	24	(3.9)	
	House maker	0	(0)	308	(50.5)	
	Army / Police	70	(11.4)	0	(0)	
Consanguinity						
	Yes	239	(39.1)	201	(33.0)	0.026
	No	373	(60.9)	409	(67.0)	

TABLE 1. Socio-demographic characteristics of the participants according to gender (N=1222)

Results

Table 1 shows the socio-demographic characteristics of the participants according to gender. The mean ± SD age of studied males and females was (41.9±9.62 and 39.6 ± 10.7 respectively, p=0.004). There was a significant difference between males and females in terms of age group (p<0.001), marital status (p<0.001), educational status (p<0.001), occupation (p<0.001) and consanguinity (p=0.026). The prevalence of MetS according to ATP III and IDF definitions and demographic characteristics of the

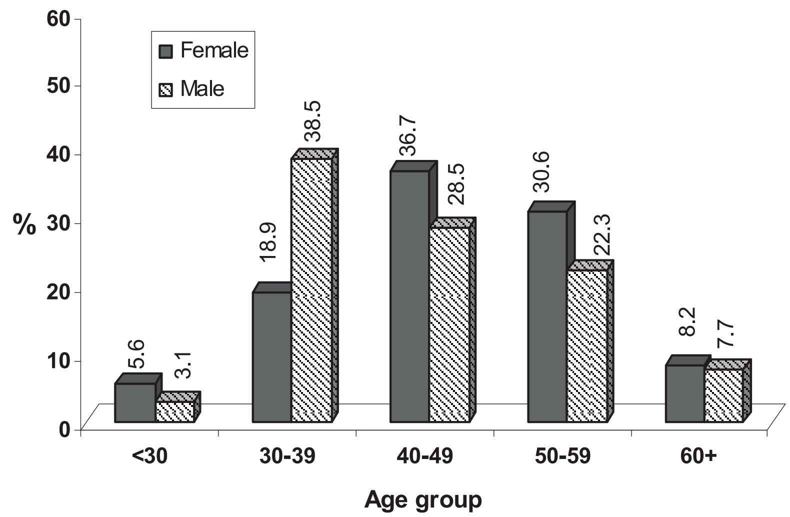

FIGURE 1. Prevalence of Metabolic Syndrome According to ATP III Criteria and Gender in the studied population.

Variables		Total (n=1222)	Male (n=612) Metabolic syndrome				Female (n=610) Metabolic syndrome			
			ATP III[a] (n=130)	P-Value	IDF[a] (n=185)	P-Value	ATP III[a] (n=196)	P-Value	IDF[a] (n=230)	P-Value
Age group	<30	203 (16.6)	4 (3.1)		5 (2.7)		11 (5.6)		11 (4.8)	
	30-39	364 (29.8)	50 (38.5)		71 (38.4)		37 (18.9)		55 (23.9)	
	40-49	413 (33.8)	37 (28.5)	<0..01	52 (28.1)	<0.001	72 (36.7)	<0.001	82 (35.7)	<0.001
	50-59	187 (15.3)	29 (22.3)		41 (22.2)		60 (30.6)		63 (27.4)	
	>=60	55 (4.5)	10 (7.7)		16 (8.6)		16 (8.2)		19 (8.3)	
Marital Status	Married	868 (71.0)	71 (54.6)		114 (61.6)		163 (83.2)		193 (83.9)	
	Not married	310 (25.4)	50 (38.5)	0.315	60 (32.4)	0.752	27 (13.8)	0.161	31 (13.5)	0.200
	Divorced/Widow	44 (3.6)	9 (6.9)		11 (5.9)		6 (3.1)		6 (2.6)	
Educational Status	Illiterate	194 (15.9)	2 (1.5)		6 (3.2)		80 (40.8)		99 (43.0)	
	Primary	357 (29.2)	24 (18.5)		42 (22.7)		87 (44.4)		99 (43.0)	
	Intermediate	213 (17.4)	27 (20.8)	0.854	39 (21.1)	0.024	20 (10.2)	<0.001	20 (8.7)	<0.001
	Secondary	144 (11.8)	23 (17.7)		27 (15.6)		2 (1.0)		4 (1.7)	
	University	314 (25.7)	54 (41.5)		71 (38.4)		7 (3.6)		8 (3.5)	
Occupation	Retired/Not working	182 (14.9)	14 (10.8)		29 (15.6)		15 (7.7)		18 (7.8)	
	Clerical Job	301 (24.8)	33 (25.4)		52 (28.1)		34 (17.3)		42 (18.3)	
	Professional	230 (18.8)	36 (27.7)	0.185	47 (25.4)	0.231	7 (3.6)	<0.001	8 (3.5)	<0.001
	Manual worker	131 (10.7)	27 (20.8)		40 (21.6)		6 (3.1)		6 (2.6)	
	House wife	308 (25.2)	-		-		134 (68.4)		156 (67.8)	
	Army / Police	70 (5.7)	20 (15.4)		17 (9.2)		-		-	

[a] Percent of subjects with metabolic syndrome in that age group out of all subjects with metabolic syndrome.
Note: ATP III, Adult Treatment Panel III; IDF, International Diabetes Federation.

TABLE 2. Prevalence of MetS According to ATP III and IDF Definitions and Demographic Characteristics of the Studied Subjects by Gender (N =1222).

studied subjects by gender is presented in Table 2. The prevalence of MetS was 26.7% according to ATP III and 33.9% according to IDF ($p<0.001$). MetS was more prevalent among females than males according to ATP (60.1%) and IDF (55.4%) definitions. The prevalence of MetS by both definitions peaked in the 30-39 years age group among males, and the 40-49 years age group among females. The greatest number of male subjects with MetS by both definitions were university educated; this finding was statistically significant for the IDF definition ($p=0.024$). The majority of female subjects with MetS by both definitions were in the primary edu-

Variables		Total (n=1222)	Male (n=612) Metabolic syndrome				Female (n=610) Metabolic syndrome			
			ATP III[a] (n=130)	P-Value	IDF[a] (n=185)	P-Value	ATP III[a] (n=196)	P-Value	IDF[a] (n=230)	P-Value
BMI Group	<25	269 (22.0)	22 (16.9)		32 (17.3)		7 (3.6)		10 (4.3)	
	25-30	386 (31.6)	49 (37.7)	0.003	71 (38.4)	<0.001	33 (16.8)	<0.001	37 (16.1)	<0.001
	>30	567 (46.4)	59 (45.4)		82 (44.3)		156 (79.6)		183 (79.6)	
Consanguinity	Yes	440 (36.0)	60 (46.2)	0.061	72 (38.9)	0.964	59 (30.1)	0.303	70 (30.4)	0.304
	No	782 (64.0)	70 (53.8)		113 (61.1)		137 (69.9)		160 (69.6)	
Family history of diabetes	Yes	286 (23.4)	47 (36.2)	0.001	50 (27.0)	0.484	49 (25.0)	0.165	57 (24.8)	0.142
	No	936 (76.6)	83 (63.8)		135 (73.0)		147 (75.0)		173 (75.2)	
Family history of hypertension	Yes	425 (34.8)	62 (47.7)	0.081	102 (55.1)	<0.001	58 (29.6)	0.688	65 (28.3)	0.911
	No	797 (65.2)	68 (52.3)		83 (44.9)		138 (70.4)		165 (71.7)	
Do you practice exercise	Yes	339 (27.7)	27 (20.8)	<0.001	43 (23.2)	<0.001	42 (21.4)	0.961	51 (22.2)	0.686
	No	883 (72.3)	103 (79.2)		142 (76.8)		154 (78.6)		179 (77.8)	
Smoker	Yes	78 (6.4)	23 (17.7)	0.019	33 (17.8)	0.002	4 (2.1)	0.068	4 (1.7)	0.141
	No	1144 (93.6)	107 (82.3)		152 (82.2)		191 (97.5)		225 (98.3)	
Sleeping	≤ 7 hours	594 (48.6)	76 (58.5)	0.066	80 (43.2)	0.009	103 (52.6)	0.023	109 (47.4)	0.566
	> 7 hours	628 (51.4)	54 (41.5)		105 (56.8)		93 (47.4)		121 (52.6)	

[a] Percent of subjects with metabolic syndrome in that age group out of all subjects with metabolic syndrome.
Note: ATP III, Adult Treatment Panel III; IDF, International Diabetes Federation.

TABLE 3. Lifestyle characteristics of studied subjects with MetS according to ATP III and IDF definitions by gender (N=1222)

Age Group	Gender	Total (n=1222)	Waist Circumference‡ (cm)	Fasting Glucose† (mmol/L)	Body Mass Index (kg/m^2)	Systolic Blood Pressure† (mmHg)	Diastolic Blood Pressure† (mmHg)	Triglyceride† (mg/dl)	HDL† (mg/dl)
<30	Male	72	96.1±11.1	4.8±0.4	27.9±5.7	120.3±12.6	75.7±8.7	1.5±0.9	1.3±0.3
	Female	131	88.5±13.2	5.2±2.2	28.3±7.7	116.2±9.7	72.8±7.9	0.9±0.5	1.5±0.3
30-39	Male	185	99.8±11.4	6.1±2.2	28.8±5.8	126.4±15.2	78.8±8.7	1.6±0.9	1.3±0.3
	Female	179	95.8±13.0	5.6±1.9	30.4±6.5	119.7±12.2	74.8±8.6	1.2±0.8	1.5±0.3
40-49	Male	220	97.7±11.9	5.5±1.6	28.5±5.3	131.9±16.9	82.7±9.6	1.3±0.8	1.5±0.3
	Female	193	99.7±9.9	6.3±2.7	33.2±6.0	126.8±15.9	78.6±10.6	1.4±0.7	1.5±0.3
50-59	Male	110	97.4±12.3	5.6±1.6	28.2±4.3	132.5±17.0	81.9±11.1	1.3±0.8	1.4±0.3
	Female	77	104.0±10.3	8.6±3.7	33.4±5.6	135.3±16.8	82.9±8.7	1.6±0.7	1.3±0.3
>=60	Male	25	102.6±10.6	7.2±3.4	28.7±4.3	142.2±15.9	85.5±10.5	1.5±0.8	1.4±0.3
	Female	30	104.6±9.2	7.8±4.1	33.2±6.3	139.6±15.4	83.2±10.8	1.4±0.5	1.4±0.2
Total	Male	612	98.3±11.8	5.7±1.9	28.5±5.3	129.4±16.6	80.7±9.9	1.4±0.9	1.4±0.3
	Female	610	96.9±12.8	6.2±2.9	31.4±6.8	124.2±15.4	77.0±9.9	1.3±0.7	1.5±0.3

† P≤ 0.001; ‡ P=0.038

TABLE 4. Age –Specific Baseline Components of the Metabolic Syndrome According to Gender (N=612)

cational level (44.4% and 43.0%) (p<0.001). Moreover, most of the females diagnosed with MetS by both definitions were housewives (68.4% and 67.8%) (p<0.001). The lifestyle characteristics of studied subjects with MetS according to ATP III and IDF definitions by gender are shown in Table 3. The prevalence of MetS by both definitions increased with BMI, and it was higher in less physical activity subjects. Table 4 presents the age-specific baseline components of MetS according to gender. The mean baseline components of waist circumference, fasting glucose, BMI, systolic blood pressure and diastolic blood pressure all differed with increasing age.

Figure 1. Shows the age-specific prevalence of MetS in studied men and women according to ATPIII criteria in all age groups. Figure 2. Shows the age-specific prevalence of MetS in studied men and women according to IDF definition of MetS.

Discussion

The MetS is highly prevalent globally (3-4, 6, 17). The prevalence of the metabolic syndrome in the State of Qatar is about 15-20% higher than in most developed countries (3, 4, 17). The prevalence of MetS was lower with NCEP-ATP III (26.7%) and higher when using the IDF definition (33.9%). Many studies confirm this difference in prevalence depending on criteria definition. As the two definitions are based on much of the same components, the difference in prevalence is mainly related to different waist circumference and to the focus on central obesity as an obligatory component in the IDF definition in contrast to being one out of five equally weighted components in the 2005 ATP III definition. Similar to our results, in a Portuguese community (18), the prevalence of MetS varied according to definition used. The prevalence of the MetS was lower with the NCEP-ATP III criteria (24.0%) and considerably

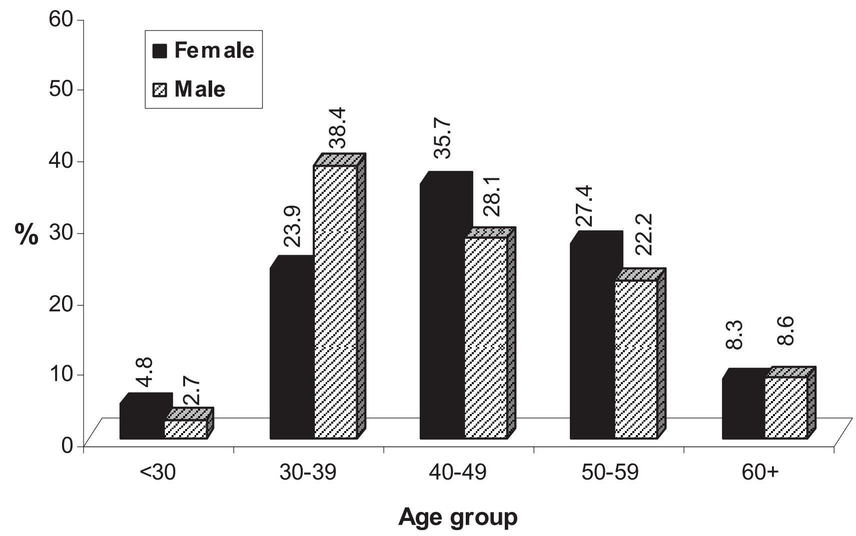

FIGURE 2. Prevalence of Metabolic Syndrome According to IDF Criteria and Gender in the studied population.

higher when using the IDF (41.9%). The Qatari rate of MetS prevalence according to ATP III (26.7%) and IDF (33.9%) is comparable to the rate in the U.K (19) which was (22.0%) using the ATP III criteria and (31.8%) using the IDF definition. But in the Portuguese community, a big gap in prevalence was noted between ATPIII and IDF criteria, but not in the UK and Qatar. The IDF definition results in higher prevalence probably reflecting the IDF criteria for defining the central obesity. A study conducted by Laaka et al. (20) reported that there is generally a strong age and gender dependence in prevalence of the MetS, but a wide geographical variation in its frequency. Several population studies have reported an increase in the prevalence of the MetS with age regardless of definition, although some have reported a peak in the seventh decade (21) which is inconsistent with our study findings of finding a peak in the 4th decade for men and 5th decade for women. These differences in the age-range of MetS may be due to the age-structure of the sample, where significantly more data were collected for males and females in these age groups (Table 1).

Among the Qatari population, the prevalence of MetS was significantly higher in women by ATP III (60.1% vs 39.9%, $p<0.001$) than by IDF criteria (55.4% vs. 44.6%, $p<0.001$). Also, in the U.K, MetS was significantly more frequent in females (24.9% vs. 17.4%, $p<0.001$) (19). In Slovakia, the MetS prevalence was significantly higher in females (23.9%) when compared to males (15.9%, $p<0.0001$) (23). In the Dutch population (24) it was found that the prevalence of MetS was higher in men 36.8% than women (31.0%) ($p=0.01$) according to IDF; by ATP III criteria, the prevalence was 26.7% in males significantly higher than in females 22.8% ($p=0.02$). Furthermore, the different components of MetS in the study sample, central obesity was significantly high in subjects according to ATP III (65.5%) and IDF (83.6%). The prevalence of IDF defined central obesity was quite high compared to ATP III because the IDF emphasize central obesity as an essential component for the MetS, rather than an optional component as in ATP III. Yoon et al (25) reported that in Asian populations, central obesity seems to have greater impact on the overall prevalence of the syndrome, challenging the appropriateness of IDF criteria.

Also, hypertension was more prevalent in subjects by both definitions (37.1%) compared to other components. This is comparable to the prevalence in other populations like Slovak population tends to have increased prevalence of high blood pressure (44%) compared to the US (33%) and Greek populations (38.1%) (22). In the study sample, the frequency of high fasting glucose was relatively low, especially when compared to the prevalence of central obesity or high BP. It was described in a group of subjects who developed MetS with little or no inherent insulin resistance, but with abdominal obesity (26). Finally, this supports the idea that excess body fat plays a major role for MetS (5). The present study results are consistent with other results obtained in other Arab populations such as in Arab Americans (27), in Jordanian's (28) and in the United Arab Emirates (29).

Our study has some limitations. Firstly, in the current study, the systematic sampling procedure could create a bias in that it may underestimate the actual prevalence of MetS in the population. Secondly, the age distribution of the sample may not directly represent the age distribution of the actual population. Nonetheless, strengths of the study include the cross-sectional design of the study, a large sample size, and a broad range of investigations that allowed us to directly compare the different MetS definitions.

Conclusion

Overall, the prevalence of the metabolic syndrome in the State of Qatar is about 15-20% higher than in most developed countries, with generally higher prevalence rates for women. Preventive strategies will require identifying socio-demographic factors and addressing modifiable risk behaviours, including lack of physical activity, and dietary intake.

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