Metabolic Syndrome among Type-2 Diabetic Patients in Benghazi-Libya: A pilot study

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Abstract

Background: Metabolic syndrome is a cluster of three out of five conditions that are due to hyperinsulinemia: abdominal obesity, atherogenic dyslipidemia (high triglycerides and/or low HDL), elevated blood pressure, and elevated plasma glucose. The syndrome is highly prevalent in patients with type-2 diabetes mellitus and often precedes the onset of hyperglycemia. It has been shown that metabolic syndrome is an independent clinical indicator of macro- and microvascular complications in diabetics. **Aim and objectives:** the aim of this pilot study was to estimate the frequency and characteristics of metabolic syndrome among type-2 diabetic patients in Benghazi. Patients and methods: This cross-sectional study involved 99 randomly selected adult patients with type-2 diabetes mellitus. The patients were interviewed and examined, and their lipid profiles were checked 9-12 hours after overnight fasting. Metabolic syndrome was defined according to the criteria of the National Cholesterol Education Program (NCEP) Adult Treatment Panel III (ATP III) and of the International Diabetes Federation (IDF). **Results:** About 92% of the patients had the metabolic syndrome according to ATP III criteria and 80.8% according to IDF criteria. Females were more affected, males with metabolic syndrome were significantly older, and females were significantly more obese. No significant difference was observed between males and females regarding waist circumference, HDL level and triglyceride level. The commonest and most important component of metabolic syndrome in the study group was low HDL. **Conclusion:** Metabolic syndrome is common among Libyans with type-2 diabetes mellitus, and it is significantly more common in females than males. The most significant predictor of metabolic syndrome in type-2 diabetic patients in Benghazi is low HDL.

Key words: Metabolic, diabetes, hypertension, dyslipidemia, obesity, Benghazi, Libya.

Introduction

Metabolic syndrome (MS) is a cluster of multiple cardiovascular risk factors. It is defined as the presence of two out of four conditions that result from insulin resistance: abdominal obesity, atherogenic dyslipidemia, elevated blood pressure, and elevated plasma glucose. In 2001, the National Cholesterol Education Program (NCEP) Adult Treatment Panel III (ATP III) proposed a set of easily applicable criteria to diagnose metabolic syndrome [1]. The criteria were modified in 2005 by the American Heart Association (AHA) and the National Heart, Lung and Blood Institute (NHBI) [2]. Other similar criteria were proposed in 2005 by the International Diabetes Federation (IDF) [3]. Compared to ATPIII, IDF criteria seem to overestimate the prevalence of MS without improving prognostic value [4,5,6]. Patients with type-2 diabetes mellitus (DM) already fulfill one of the NCEP-ATP III or IDF diagnostic criteria, and two more are required for an MS diagnosis. From an epidemiological point of view, the syndrome is highly prevalent in patients with type-2 DM, and it often precedes the onset of hyperglycemia [7,8,9]. However, much controversy surrounds the importance of MS in diabetics as a separate biological entity over each of its components as a cardiovascular risk factor [10,11,12]. On the other hand, many studies have shown that MS, irrespective of its definition, is an independent clinical indicator of macrovascular and microvascular complications in diabetics [10,11]. The objectives of this pilot study were as follows:

- estimate the frequency and characteristics of MS among male and female type- 2 diabetic patients in Benghazi
- compare the two commonly used sets of criteria, ATPIII and IDF.

Patients and method

This cross-sectional study involved 99 randomly selected adult patients with type-2 DM attending Benghazi Diabetes Center during 2007. Each day, nine patients were indiscriminately selected (unsystematic randomization). The patients were interviewed and examined by the authors, and their lipid profiles were checked 9-12 hours after overnight fasting. Obesity was defined according to WHO criteria as body mass index (BMI) ≥ 30 kg/m2. Hyper- tension was defined as blood pressure ≥ 140/80 mmHg. MS was diagnosed, according to the AHA/NHLBI modified ATP III criteria [2], as the presence of two of the following four criteria:

-waist circumference (WC) ≥ 102 cm in males or ≥ 88 cm in females;
- blood pressure(BP) ≥ 130/85 mmHg or on treatment,
- triglycerides(TG) ≥ 150 mg/dl or on treatment;
- high density lipoproteins (HDL) < 40 mg/dl in males or < 50 mg/dl or on treatment in females.

Metabolic syndrome was also diagnosed according to IDF criteria [3] when waist circumference was ≥ 94 cm in males and ≥ 80 cm in females and at least one of the following three criteria was present: blood pressure ≥ 130/85 mmHg, triglycerides ≥ 150 mg/dl, and high density lipoproteins < 40 mg/dl in males and < 50 mg/dl in females. Values above the cut-off points for each parameter were regarded as abnormal. The results were expressed as mean ± standard deviation (SD). Statistical analyses were performed using the Statistical Package for the Social Sciences (Windows version 11.0; SPSS Inc, Chicago, IL, USA).

Differences between groups were tested statistically using the Chi Square test or the independent-sample t-

test, as indicated. Data were considered statistically significant when the P-value was < 0.05.

Results

Out of 99 patients, 61 were females and 38 were males. The mean age of all patients was 56 years (SD 9.5 years), males were slightly older, and had slightly longer duration of diabetes. Of all patients, 74.4% were obese, and obesity was significantly more frequent among females (P <0.001). Mean BMI was 33.6 kg/m2 (SD 5.6 kg/m2). There was no significant difference between males and females regarding WC, HDL and TG, but systolic and diastolic BP were slightly higher in males. The prevalence of hypertension (HTN) among the study group was 64% (Table 1). The frequency of MS was 92% according to ATPIII criteria and 80.8% according to IDF criteria, and females were significantly more affected in both cases (Fig. 1). Low HDL was the most significantly frequent abnormality according to ATPIII criteria (83.5%) while both low HDL and high TG were the most significantly frequent abnormalities according to IDF criteria (86.3% and 55% respectively) (Table 2). According to ATPIII, the mean HDL was significantly lower in both males (36 mg/dl) and females (37.1mg/dl) with MS than those without MS (54.1 mg/dl and 59 mg/dl respectively, P < 0.05) but according to IDF criteria it was significantly lower only in females. TG level was significantly higher in MS patients according to IDF criteria (191.8 vs. 115.7 mg/dl, P=0.007) (Table 3). According to ATPIII criteria, males with MS were significantly older and had a higher mean systolic and diastolic BP than females (136.1 vs. 126.7mmHg, P=0.05) while females were significantly more obese with higher mean BMI than males (35.8 vs. 30.4 kg/m2, P=0.000) (Table 4).

Discussion

We show that MS is quite prevalent among Libyan type-2 diabetic patients. In fact, this prevalence is among the highest in the world [5,9,13,14] (Table 5). In view of the small sample size, larger studies would be needed to confirm this finding. This high frequency could be due to both genetic predisposition and environmental factors, such as high caloric diet and lack of exercise. Roaied and Kablan reported that only 20% of males and 58% of females with diabetes in Benghazi practice regular exercise [15]. Females were significantly more affected by MS than males, probably because of the higher frequency of obesity among females. The high rate of general and central obesity in our patients, particularly in females, endorses the importance of exercise for diabetic patients. There was no significant difference between males and females in mean waist circumference and mean HDL, neither in the MS patients nor in the non- MS patients. This raises the following question: do we need different cut off values for males and females for abnormal WC and HDL? This question requires serious investigation. Atherogenic dyslipidemia (high TG and/or low HDL) appears to be the most frequent and the most significant component of MS in Libyan diabetic patients, as has been reported in other parts of the world [16]. Thus, TG and HDL require particular attention in the diagnosis of MS in diabetic patients, unlike WC, which showed no significant difference between MS and non- MS Libyan diabetic patients, as has been reported elsewhere. For example, one Japanese study concluded that neither the presence of MS, as defined by the IDF guideline, nor the WC was associated with the presence of either microvascular nor macrovascular complications in Japanese type 2 diabetic patients [4].

Table 1 Characteristics of the entire study group (Biochemical parameters are given in mg/dl. DM= diabetes mellitus, BMI=body mass index, HDL= high density lipoproteins, WC= waist circumference, TG=triglyceride, SBP= systolic blood pressure, DBP= diastolic blood pressure, BP=Blood pressure, HTN= hypertension, MS= metabolic syndrome, ATPII=adult treatment panel III, IDF= international diabetes federation. P-values refer to differences between males and females)

	Males	Females	P-value	All patients
Number	38	61		99
Age: mean±SD (range)	58.2±11.5 (37-76)	54.6±7.8 (39-75)	0.073	56±9.5
DM duration: mean±SD	10.7±9.6	8.7±6.5	0.22	9.4±7.8
Obesity	47.3%	91.8%	<0.001	74.4%
BMI:mean±SD (range)	30±5.3 (16-42)	35.9±4.5 (16-42)	<0.001	33.6±5.6
WC: mean±SD (range)	102.9±11.6 (67-125)	104.2±10.5 (52-121)	0.57	103.6±10.9
Abnormal WC	55.2%	78.6%	0.014	69.6%
HDL: mean±SD (range)	37±14.9 (11-81)	37.8±9.9 (16-65)	0.72	38.2±13.3
Abnormal HDL	65.7%	88.5%	0.006	79.7%
TG: mean±SD (range)	178.2±111 (57-486)	176.6±113 (34-675)	0.94	177.2±112
Abnormal TG	47.3%	47.5%	0.98	47.4%
SBP: mean±SD	134±17.1	126.3±18.2	0.08	129.8±18
DBP: mean±SD	83.1±8.5	79.4±8.4	0.07	81.1±8.5
Abnormal BP	78.9%	73.8%	0.55	75.8%
HTN	65.8%	63.9%	0.85	64.6%
MS (ATPIII): n/n (%)	32/38 (84.2%)	59/61 (96.7%)	0.026	(91.9%)
MS (IDF): : n/ (%)	26/38 (68.4%)	54/61 (88.5%)	0.014	80.8%

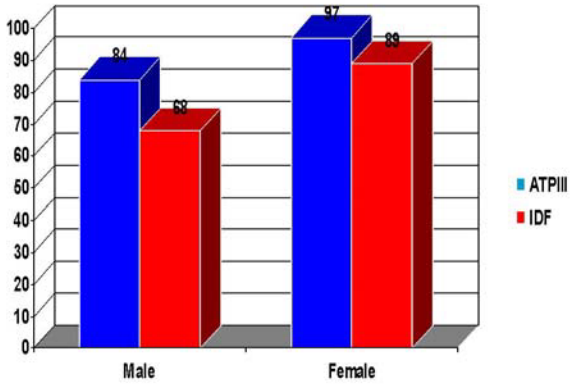

Figure 1 Percent frequency of MS among males and females with type-2 DM according to IDF and modified ATPIII criteria

Table 2 Comparison between MS and non-MS diabetic patients according to IDF and modified ATPIII criteria (HDL= high density lipoproteins, WC= waist circumference, TG=triglyceride, BP=Blood pressure, HTN= hypertension, MS= metabolic syndrome).

	According to ATPIII			According to IDF		
	With MS	With-out MS	P	With MS	With-out MS	P
Raised WC	71.4%	50%	0.2	100 %	52.6%	0.001
Raised BP	78%	50%	0.076	77.5 %	68.4%	0.4
Raised TG	49.4%	25%	0.18	55%	15.8%	0.002
Low HDL	83.5%	37.5%	0.008	86.3 %	52.6%	0.001
Obesity	76.9%	50%	0.09	78.8 %	57.9%	0.06
HTN	68.1%	25%	0.01	65%	63.2%	0.8

Table 3 Comparison between mean values of different MS components among MS and non-MS diabetics according to IDF and modified ATPIII criteria (M=male, F=female, WC= waist circumference, BMI=body mass index, HDL= high density lipoproteins, TG=triglyceride, SBP= systolic blood pressure, DBP= diastolic blood pressure, MS= metabolic syndrome

	According to ATPIII			According to IDF		
Mean±SD	**With MS**	**Without MS**	**P**	**With MS**	**Without MS**	**P**
WC/M	104±11.4	96.8±11.5	0.16	106±7.5	96.2±15.8	0.014
WC/F	104±10.7	105.5±7.7	0.85	104.8±8.1	99.2±22.1	0.19
TG	183±114	108±41	0.06	191.8±118	115.7±38	0.007
HDL/M	36 ±16.2	54.1±18.5	0.01	37.1±19	42.5±13.6	0.3
HDL/F	37.1±9.2	59±8.4	0.002	35.8±8.3	53.5±7.3	0.000
BMI	33.9±5.6	30.3±5	0.08	34.2±5.1	31.3±6.9	0.027
SBP	130.3±19	120±8.9	0.16	129.8±18.4	130±16.8	0.9
DBP	81.3±8.47	76.6±5.1	0.18	81.2±8.8	80.7±7.5	0.8

Study limitations

Our study sample was large enough to fulfill our aims, but a larger sample would be more suitable for detecting small differences between means. Unfortunately, because of the high prevalence of MS in the study population, the number of patients without MS was too few to make a reliable comparison between patients with and without MS. Moreover, we did not measure HbA1c in this study, and this may affect the frequency of MS as well as the frequency of each parameter because the degree of glycemic control might affect the lipid profile as well as the weight of the patient. Despite these limitations, this pilot study was able to reveal important aspects of this clinical syndrome among diabetic patients in Libya, perhaps most notable of which is its very high prevalence.

Conclusions

Metabolic syndrome is not only highly prevalent among the study population; it is more prevalent than reported worldwide. It is more common among females than males. Males with MS were significantly older and had a higher blood pressure and females were significantly more obese. The most significant indicator of MS in type-2 diabetics in Benghazi is atherogenic dyslipidemia, particularly low HDL, but there is no significant difference between MS and non MS patients regarding age, disease duration, blood pressure or waist circumference.

Although the need to diagnose MS in diabetics is controversial, we believe that it is worth considering because diabetic patients with MS need a more aggressive approach in management in order to achieve glucose control, which necessitates the use of insulin sensitizers and more emphasis on exercise.

Table-4: Comparison between males and females with MS according to IDF and modified ATPIII criteria (Biochemical parameters are given in mg/dl. Means are given ± SD. Abn.=abnormal, BMI=body mass index, HDL= high density lipoproteins, WC= waist circumference, TG=triglyceride, HTN=hypertension, BP=blood pressure, SBP= systolic blood pressure, DBP= diastolic blood pressure, , MS= metabolic syndrome).

	ATPIII			IDF		
	Males	**Females**	**P**	**Males**	**Females**	**P**
Number	32	59		26	54	
Age	58.5±10.7	54.5±7.7	0.04	59.4±9.7	53.8±7.4	0.006
Duration	11.5±10	8.6±6.5	0.1	12.2±10.2	8.4±6.3	0.04
Mean WC	104±11.4	104±10.7	0.98	106±7.5	104.8±8.1	0.5
Raised WC	55.3%	78.7%	0.06	100%	100%	
Obesity	50%	91.5%	0.000	53.8%	90.7%	0.000
Mean BMI	30.4±5.5	35.8±4.6	0.000	31.3±4.7	35.6±4.7	0.000
Mean TG	190±115	179±114	0.66	202.8±124	186.5±117	0.5
Raised TG	47.4%	47.5%	0.9	57.6%	53.7%	0.7
Mean HDL	36±16.2	37±9	0.16	37.1±19.2	35.8±8.3	0.6
Low HDL	65.8%	88.5%	0.028	73%	92.5%	0.01
HTN	71.9%	66.1%	0.57	58.6%	64.8%	0.9
Raised BP	84.4%	74.6	0.28	84.6%	74%	0.29
Mean SBP	136.1±17.2	126.7±18.5	0.05	135.4±17.9	125.8±18	0.06
Mean DBP	84±8.7	79.7±8.3	0.055	83.4±9	79.6±8.3	0.1

Table 5 Prevalence of metabolic syndrome among type-2 diabetics in different countries

Country	ATPIII	IDF
Libya	92%	80.8%
USA[9]	70%	/
Italy[5]	68.4%	73.7%
UK[13]	61%	54%
China[14]	55.7%	50%

Recommendations

- Physicians treating type-2 diabetics should place greater emphasis on weight reduction and exercise, which together should have a positive impact on patients' weight, HDL and TG levels as well as on BP and glycemic control.
- Metformin should be prescribed to most type-2 diabetic patients, particularly those with MS, unless there is a specific contraindication. Metformin targets insulin resistance and thus it has positive effects on patients' weight, lipid profile and glycemic control.
- Studies of larger samples should be conducted to define more precisely the frequency of metabolic syndrome and its different components among diabetics and non-diabetic subjects.
- The standard WC used in this study as defined by ATPIII/IDF needs to be validated for our patients, and our own local reference measures should be defined.
- Prospective follow up studies are needed to identify the impact of MS on long-term complications of DM.

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