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Prevalence of metabolic syndrome in patients admitted to the national cardiac center of Benghazi, Libya

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Abstract

Metabolic syndrome (Mets) represents a constellation of metabolic disorders, including diabetes mellitus, obesity, dyslipidemia, and hypertension. Since it is associated with different risk factors of cardiovascular diseases (CVD), studying its prevalence is important. The main objective of this work was to find out the prevalence of metabolic syndrome and to characterize its presence among cardiovascular patients admitted to the National Cardiac Center of Benghazi (Libya). The IDF and AHA/NHLBI definitions were used to diagnose metabolic syndrome among 136 patients. Blood samples were taken following a 12-hour fast, and clinical data was documented. All biochemical parameters were assessed in the biochemistry laboratory of Benghazi Cardiovascular Center using standard protocols. Out of the 136 subjects, 77.2% of patients were found to have metabolic syndrome, and it was more common in males than females. The mean age, blood pressure (BP), fast blood glucose (FBG), and high density lipoprotein (HDL-C) levels were significantly associated with the presence of Mets. Compared to CVD patients without Mets, central obesity (72.1%; P=0.003) and high FBG (69.1%; P=0.000) were significantly the main prevalent components of Mets. High DBP and high SBP presented a significant association with age group and were found to be more prevalent among the age group between 50 and 60 years and the group of patients aged more than 60 years (> 60 years), respectively. Libyan patients with CVDs express a high incidence of metabolic syndrome. Central obesity and high FBG were the main prevalent components of Mets. High BP was found to be associated with aging in Mets patients. Early diagnosis and management of these CVD risk factors seems to be necessary and crucial to prevent subsequent complications.

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Introduction

Several metabolic risk factors for cardiovascular disease are grouped together to form metabolic syndrome (Mets), a complicated condition that was initially referred to as hypertension, diabetes, and gout, according to the Reaven study (Reaven, 1988). Later in 2005 and 2006, the Adult Treatment Panel (ATPIII) proposed two definitions, and the International Diabetes Federation has presented a new definition for metabolic syndrome in which the waist circumference has been used as a major factor (Bertoni *et al.*, 2006; Saely *et al.*, 2006).

Mets is strongly influenced by environmental factors, such as low physical activity and inappropriate dietary habits. The causes of metabolic syndrome are complex and involve a combination of genetic, environmental, and lifestyle factors (Alberti *et al.*, 2005).

Globally, Mets is becoming more prevalent, with certain cases having higher rates of obesity, specifically abdominal obesity, and type II diabetes. The main pathophysiological mechanisms that account for the increasing prevalence of metabolic syndrome are increased insulin resistance, old age, and central obesity (Jahangiry *et al.*, 2017; Julibert *et al.*, 2019).

The management of metabolic syndrome necessitates changes in lifestyle. The primary components of treatment are weight loss, proper nutrition, and adequate physical activity. Current guidelines require the application of therapeutic strategies for correcting modifiable risk factors, such as high blood pressure or dyslipidemia. To reduce the risk of associated cardiovascular complications, early detection and intervention are crucial (Visseren *et al.*, 2021).

Previous studies have reported a high prevalence of metabolic syndrome in the Middle East and North Africa region, with rates ranging from 20% to 40% (Visseren *et al.*, 2021). In Libya, except for the high prevalence of Mets among patients with type-2 DM attending the Benghazi Diabetes Center revealed by the study conducted in 2007 (Alshkri and Elmehdawi, 2007), there is no valuable data on the prevalence of Mets, particularly among patients admitted to cardiovascular centers.

The objective of this work was to characterize the prevalence of Mets among a cohort of Libyan patients from the National Cardiac Center of Benghazi to raise awareness about its complications. Understanding the prevalence of metabolic syndrome in such a cohort of patients is important for informing healthcare policies and interventions aimed at reducing the burden of cardiovascular disease in Libya (Visseren *et al.*, 2021).

Materials and methods

Study population

The present study was conducted between January and July 2024. A number of 136 CVD patients from the National Cardiac Center of Benghazi were included. Clinical data, including the metabolic risk factors for CVD and medications, were recorded during the study. CVDs consist of heart attack, chest pain (angina), or stroke, and other heart conditions, such as those that affect the heart's muscles, valves, or rhythm, are also considered forms of heart disease (Salari *et al.*, 2020; Wang *et al.*, 2023).

All subjects were examined for biochemical and anthropometric parameters after a 12-hour fasting period prior to the assessment day. A written informed consent was provided by all patients. The study was approved by the Libyan International University ethics committee (Certificate Reference No: AMS-2024-00196 to the project__MHS-1-G-00242).

Diagnostic criteria for metabolic syndrome

Metabolic Syndrome was diagnosed based on the IDF and AHA/NHLBI definition (Zimmet *et al.,* 2005), which requires the presence of at least three of the following criteria: the central (abdominal) obesity (defined as waist circumference (WC) ≥94 cm in men and ≥80 cm in women), the raised TG 1.70≥ mmol/L (drug treatment is an alternate indicator), the

reduced HDL-C <1.04 mmol/L in men and <1.29 mmol/L in women (or specific treatment), the elevated systolic blood pressure (SBP) ≥130 mmHg and/or diastolic blood pressure (DBP) ≥85 mmHg (antihypertensive drug treatment in a patient with a history of hypertension was an alternate indicator), and the elevated FPG ≥5.56 mmol/L or previously diagnosed type 2 diabetes.

Anthropometric measurements

Height and weight were measured according to a standardized protocol in the study population. Body mass index (BMI) was calculated by dividing weight in kilograms by height in square meters (kg/m2). Waist circumference was measured in the horizontal plane midway between the lowest rib and the iliac crest (WHO, 2011). Systolic blood pressure (SBP) and diastolic blood pressure (DBP) were measured to the nearest 5 mmHg using a mercury sphygmomanometer with subjects in the supine position and relaxed for 5 minutes (Huang *et al*., 2024).

Biochemical analysis

Blood samples were collected after a 12-hour fasting period. The serum was immediately obtained by blood centrifugation for 15 min at 4 °C and 3000 rpm. All analyses (blood glucose, total cholesterol, triglycerides, and HDL-C and LDL-C) were assessed in the medical laboratory and blood bank of the National Cardiac Center of Benghazi using standard protocols.

Data analysis

Data were analyzed using the statistical package for social sciences (IBM SPSS, version 26). Categorical variables were expressed as frequencies (%) and compared using the χ2 test. Continuous variables were expressed as means (SD) compared using the t-test. A p-value of less than or equal to 0.05 was considered statistically significant.

Results

Table 1 shows the anthropometric and biochemistry parameters of the studied population. Metabolic syndrome was present in 77.2% (n = 105) and was more prevalent in males (52.9%) than females (24.3%). The presence of metabolic syndrome was significantly associated with the mean age (P = 0.03) and not with the age group (p = 0.35). The high incidence (44.9%) of Mets according to the age group was observed among patients aged older than 60 years. There was also a significant association of SBP, FBG, and HDL-C mean levels between patients with or without MetS. There was no significant association of the remaining variables with metabolic syndrome.

Table 1. Clinical data and anthropometric parameters of patients

Variables	Total (n=136)	Patients with metabolic syndrome (n=105)	Patients without metabolic syndrome (n=31)	p-value
Age	62.76±12.80	62.6±11.80	63.19±15.95	0.03
Age group				0.532
< 50 years	19 (14.0%)	13 (9.6%)	6 (4.4%)	
50- 60 years	41 (30.1%)	31(22.8%)	10 (7.4%)	
> 60 years	76 (55.9%)	61 (44.9%)	15 (11.0%)	
Sex				0.80
Male	94 (69.1%)	72 (52.9%)	22 (16.2%)	
Female	42 (30.9%)	33 (24.3%)	9 (6.6%)	
WC (cm)	111.8±21.11	113.5±20.94	105.84±20.9	0.59
BMI (kg\m2	37.5±9.15	38.27±8.94	35.06±9.55	0.91
SBP (mm Hg)	126.1±4.25	129.98±25.02	113.59±17.62	0.04
DBP (mm Hg)	69..96±18.7	71.40±19.7	65.10±14.11	0.21
FBG (mg\dl)	189.3±75.26	205±75.9	134.4±37.96	0.00
Cholesterol (mg\dl)	159.25±44.35	159.33±45.81	158.9±35.77	0.29
TG (mg\dl)	161.82±113.7	170.04±117.2	132.6±97.29	0.29
HDL (mg\dl)	35.7±15.15	36.11±11.0	52.10±20,05	0.00
LDL (mg\dl)	91.26±40.31	91.78±39.32	89.52±15.9	0.20
Smoking				0.88
Yes	63 (46.3%)	49 (36.0%)	14 (10.3%)	

No	73 (53.7%)	56 (41.2%)	17 (12.5%)	
Alchool				0.58
Yes	1 (0.7%)	1 (0.7%)	0 (0.0%)	
No	135 (99.3%)	104 (76.5%)	31(22.8%)	

Data are expressed as n (%). WC: waist circumference; SBP: systolic blood pressure; DBP: diastolic blood pressure; FBG: fasting blood glucose; TG: triglyceride; HDL: high-density lipoprotein; LDL: Low-density lipoprotrin; n: number.

Table 2. Prevalence of individual components of mets in CVD patients

Variables	Patients without metabolic syndrome	Patients with metabolic syndrome	P-value
Central obesity			0.003
Yes	23 (16.9%)	98 (72.1%)	
No	8 (5.9%)	7 (5.1%)	
High BP			0.000
Yes	5 (3.7%)	55 (40.4%)	
No	26 (19.1%)	50 (36.8%)	
High TG			0.000
Yes	4 (2.9%)	52 (38.2%)	
No	27 (19.9%)	53 (39.0%)	
Low HDL			0.000
Yes	8 (5.9%)	86 (63.2%)	
No	23 (16.9%)	19 (14.0%)	
High FBG			0.000
Yes	10 (7.4%)	94 (69.1%)	
No	21 (15.4%)	11 (8.1%)	

Data are expressed as n (%). WC: waist circumference; BP: blood pressure; FBG: fasting blood glucose; TG: triglyceride; HDL: high-density lipoprotein.

Table 3. Distribution of mets components according patients age groups

Mets components	<50 years	50-60 years	> 60 years	P-value
High SBP	3 (2.2%)	20 (14.7%)	33 (24.3%)	0.045
High DBP	3 (2.2%)	16 (11.8%)	13 (9.6%)	0.020
High TG	6 (4.4%)	19 (14.0%)	31 (22.8%)	0.555
Low HDL-C	13 (9.6%)	28 (20.6%)	53 (39.0%)	0.985
High WC	18 (13.2%)	34 (25.0%)	69 (50.7%)	0.297
High FBG	12 (8.8%)	32 (23.5%)	60 (44.1%)	0.335

Data are expressed as n (%). WC: waist circumference; BP: blood pressure; FBG: fasting blood glucose; TG: triglyceride; HDL: high-density lipoprotein. Mets: metabolic syndrome

Table 2 revealed a significant association of all components of metabolic syndrome in patients with CVDs. Central obesity had the highest incidence (n = 98; 72%; P = 0.003). High FBG (69.1%) and low HDL (63.2%) were more prevalent than high BP and high TG.

Regarding their distribution according to the age group, Table 3 showed a high prevalence of Mets components in above-50-year-old patients. High SBP (24.3%), high TG (22.8%), low HDL-C (39.0%), high WC (50.7%), and high FBG (44.1%) were more prevalent in the age group > 60 years.

Only High blood pressure was significantly associated with age group with p-values of 0.045 and 0.020 for high SBP and high DBP, respectively. High DBP was more prevalent among patients aged between 50 and 60 years.

Discussion

It is commonly acknowledged that the components of the metabolic syndrome are risk factors for cardiovascular diseases and the main causes of their rise throughout the world. Middle- and low-income countries, including Libya, currently face a rapid increase in non-communicable disease risk factors,

including dyslipidemias, hypertension, and obesity (Popkin *et al.*, 2020; Visseren *et al.*, 2021; Bollyky *et al.*, 2017).

This is the first work focusing on the characterization of Mets among Libyan cardiovascular patients. We found that 77.2% of CVD patients participating in this study had Mets. A result that lines with the incidence (80.8%) of Mets among Libyan type 2 diabetic patients showed in a previous study (Alshkri and Elmehdawi, 2007), and it was relatively higher than its overall prevalence of 38.96% among patients with cardiovascular disease in African countries revealed by a recent meta-analysis (Bowo-Ngandji *et al.*, 2023).

According to earlier research, the incidence of Mets varied throughout Sub-Saharan African nations, particularly in Nigeria (23%) (Adejumo *et al.*, 2019), Ghana (41.8%) (Annani-Akollor *et al.*, 2020), and North African nations, where Tunisia and Morocco had respective prevalences of 39.6% and 48.5%. These disparities may be caused by lifestyle, sociodemographic, anthropometric, and sample size differences across different research, as well as by various Mets definition criteria (Abourazzak *et al.*, 2015; Ben Ali *et al.*, 2014).

The current study found that the prevalence of metabolic syndrome increased with age in all age groups, with rates for those under 50, those between 50 and 60, and those over 60 years old being 9.6%, 22.8%, and 44.9%, respectively. This is consistent with the results of a prior study conducted in other countries, which showed that for the study population, aging was regarded as a risk factor for the development of multiple sclerosis (Santos e*t al.*, 2010).

Mets was more common in men (52.9%) than in women (24.3%), despite the fact that there was no significant correlation between sex and Mets. This finding supports that men are more likely than women to have Mets and are hence at higher risk for CVD (Regitz-Zagrosek *et al.*, 2007; Després *et al.*, 2008; GBD 2019 Risk Factors Collaborators, 2020).

Although this study found no significant correlation between smoking and Mets, it is noteworthy that smokers had a comparatively higher prevalence of Mets (36.0%) than nonsmokers (10.3%). Numerous studies have found that smoking is an independent risk factor for Mets and that smoking is linked to reduced HDL, higher LDL, and triglyceride levels in the blood. Additionally, a comparison of light, moderate, and heavy smokers and non-smokers revealed a dose-dependent connection with each of these characteristics (Shahabi *et al.*, 2024).

Regarding the components of Mets, the order of prevalence was abdominal obesity (72.1%), increased fasting glucose (69.1%), low HDL (63.2%), elevated blood pressure (40.4%), and hypertriglyceridemia (38.2%). This is consistent with the increase of CVD risk factors in Libya, a country currently facing a rapid increase in non-communicable disease risk factors, including overweight and obesity (Alshkri and Elmehdawi, 2007; Popkin *et al.*, 2020; Bowo-Ngandji *et al.*, 2023).

High blood pressure, systolic (P = 0.045), and diastolic (P = 0.020) were significantly associated with age group, and they were more common in patients over 50, according to the distribution of Mets components by patient age group. It is commonly known that aging causes circulating leptin and visceral fat to rise, both of which are linked to a substantial rise in blood pressure (Intapad *et al.*, 2013). Several studies have shown that the metabolic syndrome causes arterial stiffening, speeds up vascular aging, and causes hypertension (Safar *et al.*, 2006; Sowers, 2013).

Conclusion

This study is the first to examine metabolic syndrome in a group of cardiovascular patients from Libya. Metabolic syndrome appears to be highly prevalent in Libyan patients with CVDs. High FBG, high blood pressure, and

central adiposity were the main causes. Additionally, blood pressure was found to be linked to aging. The findings suggest that the introduction of an early diagnostic and management program is necessary to prevent additional issues and reduce the socioeconomic impact of these CVD risk factors.

Recommendation(s)

Since the study was limited to a single cardiac center in Libya with a small number of patients, it is advised to increase the sample size of the population under investigation and look into other factors that might be influencing the incidence of Mets, such as the patient's lifestyle, sports, habits, diet, etc. Mets components may increase as a result of bad lifestyle choices and a lack of knowledge. The incidence of CVDS and its risk factors should be reduced by more preventative interventions, such as health care education.

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