



Prevalence of Metabolic Syndrome and Its Relation with Pro-Inflammatory Markers Among Group of Libyans

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Abstract: Metabolic syndrome (Met S) is known as the clustering of several metabolic abnormalities; it can be diagnosed according to several different criteria such as the International Diabetes Federation (IDF) criteria, which is intended for global application in clinical practice. Hematological tests (total Leukocyte count, differential count, platelet count and ESR) has been considered to be a marker of inflammation, several studies have examined the relationship between hematological tests, and components of metabolic syndrome; the data reveals correlations between it and metabolic syndrome in some cross-sectional studies. The study used participants recruited from Albayda and Almarj cities outpatient clinic. History of hypertension, diabetes, Blood pressure, were taken, height, weight, and waist circumference were measured body mass index (BMI, kg/m²) was calculated. Blood samples were collected for hematological tests and others. The study subject was included and categorized according to IDF criteria. A total of 192 residents aged 16 to 85 years were investigated, 80 (41.7%) participants were Males and 112 (58.3 %) were Females. The mean BMI was 29 (St. Dev±07). Rates of underweight, normal weight, overweight and obesity were 4.7%, 24.5%, 27% and 43.75%, respectively. Prevalence of Metabolic Syndrome in our study according to IDF Criteria is 25.5 % (males 12.5% and females 13%), central obesity, high plasma glucose, high blood pressure, elevated TG accounted for development of Met S. Inflammatory markers showed no significant difference between Met S and None-MetS groups, which could be explained by high prevalence of overweigh and obesity in none-MetSsyndrome persons in our study group.

Keywords: Metabolic syndrome, International Diabetes Federation (IDF), body mass index (BMI), pro-inflammatory marker.

INTRODUCTION

Metabolic syndrome (Met S) represents a cluster of health factors (like dyslipidemia, hypertension and hyperglycemia), it raises risk for heart disease and other health problems, such as diabetes and stroke (Grundy, 2008; Wilson et al., 2005). There are several definitions of Metabolic Syndrome; in 2005, the International Diabetes Federation (IDF) proposed a definition of Metabolic Syndrome intended for global application in clinical practice and represents modifications to the WHO definition and ATP III criteria

(Organization, 1999). The International Diabetes Federation consensus worldwide definition of the metabolic syndrome is: Central obesity (defined as waist circumference with ethnicity-specific values) AND any two of the following:

Raised triglycerides: > 150 mg/dL (1.7 mmol/L), or specific treatment for this lipid abnormality

Reduced HDL cholesterol: < 40 mg/dL (1.03 mmol/L) in males, < 50 mg/dL (1.29 mmol/L) in females, or specific treatment for

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this lipid abnormality. Raised blood pressure (BP): systolic BP > 130 or diastolic BP >85 mm Hg, or treatment of previously diagnosed hypertension Raised fasting plasma glucose (FPG): >100 mg/dL (5.6 mmol/L), or previously diagnosed type 2 diabetes If FPG is > 100 mg/dl (5.6 mmol/L), an oral glucose tolerance test is strongly recommended, but is

not necessary to define presence of the syndrome.

If BMI is >30 kg/m², central obesity can be assumed and waist circumference does not need to be measured (IDF 2006). Table (1).

Table (1). Definitions and Sources of Definitions of the Metabolic Syndrome

ATP III 4	WHO 5	IDF 6
Metabolic syndrome is defined as follows: The presence of *three or more of the components listed below:	Metabolic syndrome is defined as follows: The presence of three or more of the components listed below: *Diabetes, *impaired fasting glucose, *impaired glucose tolerance, or clinically determined *insulin resistance plus at least *two of the following criteria:	Metabolic syndrome is defined as follows: *Central obesity (defined as 94 cm European men and 80 cm for European women) plus any *two of the following four factors:
+		
Waist circumference	Men >102 cm	Women >88 cm
Triglycerides	150 mg/dL	
HDL cholesterol	Men <40 mg/dL	Women <50 mg/dL
Blood pressure	>130/85 mmHg	
Fasting glucose	>110 mg/dL	

ATP III: Third Report of the National Cholesterol Education Program Expert Panel on Detection, Evaluation, and Treatment of High Blood Cholesterol in Adults (Adult Treatment Panel III); WHO, World Health Organization; IDF, International Diabetes Federation; HDL, high-density lipoprotein; LDL, low-density lipoprotein) Insulin resistance and/or associated hyperinsulinemia are believed to be the direct cause of the Metabolic Syndrome risk factors; Insulin resistance is enhanced by excess adipose tissue, in particular abdominal adiposity. Hyperinsulinemia may increase the production of very low-density lipoprotein triglycerides and thus raise triglycerides. Insulin resistance can raise blood pressure. Adipose tissue, once only considered to be a storage depot for triglycerides, is now recognized as a complex and active endocrine tissue that secretes many factors that regulate metabolic and vascular biology. These factors, collectively called adipokines, include adiponectin, leptin, tumor necrosis factor-alpha, resistin, angiotensinogen,

interleukin-6 plasminogen activator inhibitor-1 and C-reactive protein; deregulation of these adipokines may participate in the pathogenesis of Metabolic Syndrome Chronic, sub-clinical inflammation and its association with Metabolic Syndrome is a well-documented. Inflammatory mediators have been recognized as factors that increase the risk of cardiovascular disease, but also are one cause of insulin resistance (Ross, 1999). The peripheral circulating white blood cell (WBC) count is an objective marker of acute infection, tissue damage, and other inflammatory conditions, the leukocyte count has been proposed as an emerging biomarker for predicting future cardiovascular events and mortality (Danesh et al., 1998; Imano et al., 2007). It has also been shown that macrophages residing in the adipose tissue may also be a source of pro-inflammatory markers (Boisvert et al., 1998).

The aim of the present study with a representative sample of Libyans was to investigate the prevalence of metabolic

syndrome using the International Diabetes Federation (IDF) and assessment of the association between the pro-inflammatory markers using hematological tests (total Leukocyte count, differential count, platelet count and ESR) as possible predictors of the development of metabolic syndrome and/or its features in our population at high risk of cardiovascular disease.

MATERIALS AND METHODS

The study used participants recruited from Albayda and Almarj cities outpatient clinic, where the interview and physician examination were conducted, for each study subject, date of birth and sex, marital status, smoking, history of hypertension, diabetes and use of antihypertensive medications, antidiabetic medications. Blood pressure, height, weight, and waist circumference were measured during the physician examination. Weight and height were measured with participants standing without shoes or heavy outer garments, from which body mass index (BMI, kg/m²) was calculated. Waist circumference was measured in the erect position at the midpoint between the lowest rib and the superior border of the iliac crest. Using the World Health Organization (WHO) criteria, (Organization, 1995, 2000). BMI was categorized into four groups as underweight (BMI, <18.5), normal weight (18.5< BMI, <25.0), overweight (25.>BMI, <30.0) and

obesity (BMI >30.0). Blood samples were collected for blood Hb (hemoglobin), PLT (platelet count), TLC (Total leukocyte count), DLC (differential leukocyte count), ESR (erythrocytes sedimentation rate), cholesterol, LDL (low density lipoprotein), HDL (high density lipoprotein), TG (triglyceride), urea, FPG (fasting plasma glucose), T.Bil (total bilirubin), AST (aspartate aminotransferase), ALT (alanine aminotransferase).

ALP (alkaline phosphatase). The study subject was included and categorized according to IDF (International Diabetes Federation); the exclusion criteria from the study were, active infectious disease, hepatitis, positive serology of HIV (human immunodeficiency virus), HCV (Hepatitis C Virus), and HBV (Hepatitis B Virus).

Statistical analysis: All analyses, descriptive Statistics, analysis of variance (ANOVA) and Correlations (Pearson) were done using Windows-based Minitab Statistical Package (version 11.12), and P values 0.05 were considered significant.

RESULTS

A total of 200 residents aged 16 to 85 years were investigated, 8subjects were excluded, 192 participants who had complete interview and blood sample data were included. Table (2).

Table (2). General characteristics of the study population

	Number	Mean		St Dev	MIN		Max	
Age years	192	45.56		±15.36	16 yrs		85 yrs	
		M	F		M	F	M	F
		45.65	45.49		17	16	78	85
Abd Girth cm	192	96.53		±18.89	46 cm		194 cm	
		M	F		M	F	M	F
		95.54	97.23		46	52	194	173
BMI %	192	29.06		±06.998	14.4%		53.4%	
		M	F		M	F	M	F
		27.25	30.35		14	15.10	40,40	53.40
Male	80							
Female	112							

80 (41.7%) participants were Males and 112 (58.3%) were Females. The mean age of the participants was 45.6 (StDev. ± 15.36) years, 57.5% participants were married, 28.5% were Single, 12% were widowed and 2% were divorced, all female were non-smoker, 18 % of male participants were current smokers. 50% metabolic syndrome males are smoker. The mean BMI was 29 (St. Dev±07). Rates of underweight, normal weight, overweight and obesity were 4.7%, 24.5%, 27% and 43.75%, respectively.

The mean waist circumference was 95.54 (St

Dev.± 19.33) cm for male and 97.23 (St Dev. ± 18.62) cm for female (no significant difference P: 0.541). The mean systolic blood pressure and diastolic blood pressure was 134.64 (St Dev.± 27.75) mm Hg and 82.23 (StDev 18.84±) mm Hg, respectively.

The mean TG 131.01 (St Dev.± 70.4) mg%, the HDL cholesterol 50.19 (St Dev.± 15.12) mg % and fasting plasma glucose was 109.95 (St Dev.± 44.25) mg%. Table (4) shows the descriptive Statistics of Diagnostic criteria of metabolic syndrome used in the current study.

Table (3) Body mass index category and prevalence of Metabolic Syndrome

	None Met S Male	Met S Male	None Met S Femal	Met S Female	Total
Underweight 18.5	4 (2.1%)	0 (0%)	5 (2.6)	0 (0%)	9 (4.7%)
Normal >18.5 <25	25 (13%)	2 (1%)	20 (10.4%)	0 (0%)	47 (24.5%)
Over weight >25<30	16 (8.3%)	5 (2.6%)	25 (13%)	6 (3.1%)	52(27.0%)
Obesity > 30	11 (5.7%)	17 (8.9%)	37 (19.3%)	19 (9.9%)	84(43.75)
Total	56 (29.2%)	24 (12.5%)	87(45%)	25 (13%)	192

Table (4). Descriptive Statistics of Diagnostic criteria of metabolic syndrome used in the current study

IDF Criteria	None Met S Male	Met S Male	None Met S Female	Met S Female	Total	ANOVA For None Met S & Met S
Mean Waist circumference cm	90.70	106.8	93.21	105.6	96.53	P: 0.000
Mean Triglycerides mg%	107.3	197.8	103.2	194.5	131	P: 0.000
Mean HDL cholesterol mg %	49.84	41.56	51.82	52.64	50.19	P: 0.064
Mean Fasting plasma glucose mg%	104.8	145.4	111.6	122.9	118.2	P: 0.000
Mean Systolic BP mm HG	118.6	153.6	125.04	157	134.6	P: 0.000
Mean Diastolic BP mm HG	76.29	86.50	78.30	94.50	82.23	P: 0.000

(IDF: International Diabetes Federation Criteria, Met S: metabolic syndrome, ANOVA: Analysis of Variance, BP: blood pressure) For the whole study population, the mean HB g% is 12.8, platelet count is 251000/ Cmm, Total white blood cells is 7529/ Cmm, Neutrophil % is 62 %, Lymphocyte % is 29%, bilirubin 0.50%, AST 20 U/L, ALT 20 U/L, ALP 152 U/L, while the result of different category of persons of metabolic syndrome and non-metabolic syndrome in table (5).

Table (5). inflammatory markers and other blood tests

Variable	None-Met S		Met S		ANOVA For None Met S & Met S P Value
	Min	Max	Min	Max	
Hb gm%	7.8	17.1	5.3	17.4	0.324
WBC x1000/Cmm	3.1	19.6	3.5	13.1	0.250
Neutrophil %	5.8	84	41	75	0.842
Lymphocyte %	7	88	10	50	0.405
Plateletx1000/Cmm	17	774	125	355	0.221
ESR mm./1 st Hr	2	83	5	125	0.115
Bilirubin mg%	0.1	2.2	0.3	7.4	0.082
AST U/L	7	59	3	45	0.623
ALT U/L	7	124	5	44	0.813
ALP U/l	49	319	69	303	0.094
Urea mg%	9	62	13	71	0.002*

(Met S: metabolic syndrome, ANOVA: Analysis of Variance)

DISCUSSION

prevalence of Metabolic Syndrome in our study according to international Diabetes Federation (IDF) Criteria is 25.5 % (males 12.5% and females 13%), which is low comparable to other regional and international studies; in Saudi adults is more than 28%(Aljohani, 2014), the prevalence of Metabolic Syndrome among adults in Egypt Suez Canal area is 42.1%(Maklady et al., 2014); thirty - four cross- sectional studies were analyzed with a sample of 83227, Iranian population from Jan 2005 to May 2016. With overall weighted prevalence of Met S of 31% (Dalvand *et al.* 2017); Nearly 35 percent of all U.S. adults and 50 percent of those 60 years of age or older were estimated to have the metabolic syndrome in 2011-2012,(Aguilar et al., 2015).

High plasma glucose, high blood pressure, elevated TG and increase waist circumference (reflecting central obesity) accounted for significant determinate for diagnosis of metabolic syndrome in our study population as the difference is strongly significant between metabolic syndrome and non- metabolic syndrome (table 4, P<0.001) (Carnethon et al., 2004). There is no significant difference in level of HDL cholesterol among Met S and non-MetS subjects (P 0.240) respectively. The Mean fasting plasma glucose among female study population were significantly higher than those among male (P 0.049), although the prevalence of known male diabetic in our sample study is 25% of males, 12,5 % of females; this could be explained by poor control of plasma glucose among diabetic female as the prevalence metabolic syndrome among male and female almost identical. Central obesity as an obligatory component in the IDF definition, central obesity and BMI have strong positive correlation (0.64 P 0.01). The prevalence of two components of MetS, namely central obesity and TG among male were lower than those among female,

see table (3). 32.2% of female who did not satisfy the IDF criteria of metabolic syndrome, have Overweight, and Obesity Table (6); On appreciative difference of eating habits in our society according to marital status, there is no statically significant effect of marital status on prevalence of metabolic syndrome in this study; however housekeepers was identified as significant risk factors for acquiring metabolic syndrome by a cross - sectional, community-based study that covered the entire population of KSA in 2005 (Aljohani, 2014).

Table (6). prevalence of overweight and obesity in female

	None Met Female	Met S Female
Over weight >25<30	25 (13%)	6 (3.1%)
Obesity > 30	37 (19.3%)	19 (9.9%)
Total	62 (32.3%)	25(13%)

We fail to demonstrate significant increase in proinflammatory markers using hematological tests (total Leukocyte count, differential count, platelet count and ESR) in metabolic syndrome group, for example the numbers of total leukocytes, neutrophils, and lymphocytes were equal in both metabolic and non-metabolic syndrome, other inflammatory markers showed no significant difference between both groups, which could be explained by high prevalence of overweigh and obesity in non-metabolic syndrome persons in our study groups (table 5), however leukocytes increase is more evidently in acute vascular complications, and they seem to be less valuable for chronic inflammatory character, this finding was seen in few other study (Genel et al., 2014).

There significant difference of elevate blood urea level among metabolic syndrome participant (P value = 0.002); which could be linked to risk of vascular cause; of renal

impairment due to high prevalence of atherosclerotic changes in Met S (table 5).

CONCLUSION

prevalence of Metabolic Syndrome in our study according to international Diabetes Federation (IDF) Criteria is 25.5 % (males 12.5% and females 13%), which is low comparable to other regional and international studies, There is no significant correlation between BMI and Waist circumference for diagnosis of metabolic syndrome in our population; which could be attributed to high prevalence of overweight and obesity in non-metabolic syndrome persons in our study group 18 % of male participants were current smokers. 50% metabolic syndrome males are smoker.

Overweight, obesity, metabolic syndrome, smoking habit necessitate the work of national health system and other health financing and policy making institutions in Libya, in order to successfully diagnose and treat metabolic syndrome and create campaign to reduce obesity and smoking, trying to prevent cardiovascular complications(Grundy et al., 2005). We fail to demonstrate significant increase in proinflammatory markers using hematological tests (total Leukocyte count, differential count, platelet count and ESR) in metabolic syndrome group as possible predictors of the development of metabolic syndrome and/or its features

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مدي انتشار المتلازمة الأيضية وعلاقتها بدلالات سابقات الالتهابات لدي مجموعة من الليبيين

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المستخلص: المتلازمة الأيضية هي تجمع لعدد من التشوهات الأيضية ويمكن تشخيصها وفقا لعدة معايير مختلفة مثل معايير الاتحاد الدولي للسكري ويهدف تعريف الاتحاد الدولي للسكري إلى تطبيقه وانتشاره عالميا في مجال الممارسة السريرية. وقد اعتبرت الاختبارات الخاصة والتحليل لصوره الدم (العدد الكلي لكرات الدم البيضاء والعدد التفاضلي وعدد الصفائح الدموية، ومعامل سرعه الترسيب) مؤشرات دالة على الالتهاب وكشفت البيانات عن الارتباطات بين هذه الاختبارات والمتلازمة الأيضية في عدة دراسات عرضية هذه الدراسة استخدم فيها مشاركين من مدينتي البيضاء والمرج والذين ترددوا علي العيادات الخارجية، تتبعنا الإجراءات الطبية المتبعة من أخذ التاريخ المرضي لأمراض ارتفاع ضغط الدم والسكري والكشف السريري (قياس معدل ضغط الدم والوزن والطول ومحيط الخصر) ومن ثم حساب دليل كتلة الجسم (كجم / م²) وجمع عينات الدم من أجل الاختبارات المختلفة. أجريت هذه الدراسة طبقا للمعايير الخاصة للاتحاد العالمي للسكري. المتلازمة الأيضية تمثل عدة عوامل مرضية مثل: ارتفاع مستوي الدهون وارتفاع ضغط الدم وارتفاع مستوي السكر في الدم والتي جميعها تزيد من معدل الخطورة لعدة أمراض منها مرض السكري ومرض ارتفاع ضغط الدم، والسكتات الدماغية والقلبية. عدد الحالات التي خضعت للدراسة 192 حالة، تتراوح أعمارهم بين 16 و85 عاما. وكان 80 (41.7%) من المشاركين من الذكور و112 (58.3%) من الإناث. وكان متوسط مؤشر كتلة الجسم 29% (انحراف معياري ± 07). وبلغت معدلات النحافة والوزن الطبيعي وزيادة الوزن والبدانة 4.7%، 24.5%، 27%، 43.75% على التوالي. معدل انتشار المتلازمة الأيضية في هذه الدراسة حسب معيار الاتحاد العالمي للسكري كان 25.5% (الذكور 12.5% والإناث 13%). السمنة المركزية، وارتفاع جلوكوز البلازما، وارتفاع ضغط الدم، مسؤولة عن نشوء الإصابة بالمتلازمة الأيضية. لا يوجد فارق بين علامات ودلالات الالتهابات في مجموعة المتلازمة الأيضية ومجموعة السمنة العادية وذلك لزيادة المعدل في الوزن الزائد والسمنة في أشخاص الدراسة الذين لا يعانون من المتلازمة الأيضية.

الكلمات المفتاحية: المتلازمة الأيضية، الاتحاد العالمي للسكري، دليل كتلة الجسم، سابقات علامات الالتهابات.