Original paper

Assessment of Metabolic Syndrome and Its Risk Factors among Patients with Type 2 diabetes mellitus at Merjan Teaching Hospital, Al-Hilla City

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Abstract

Background: Metabolic Syndrome (MS) has become prevalent medical problem globally and the main consequence of Diabetes Mellitus (DM) and Coronary Heart Diseases (CHD).
Aim of Study: To determine the proportion of metabolic syndrome among patients with type 2 diabetes mellitus and its association with metabolic syndrome risk factors.
Materials and Methods: A hospital-based cross sectional study design was carried out on (300) diabetic type 2 diabetes mellitus patients at diabetic outpatient clinic in Merjan Teaching Hospital. The study duration was from December 2011to December 2012. Categorical variables were presented as frequencies and percentages. Continuous variables were presented as means with their 95% confidence interval (CI) and standard deviation. The Pearson's chi-square test (x^2) was used to determine the associations between categorical variables. Binary Logistic regression was done for multivariate analysis. A *p*-value of < 0.05 was considered as statistically significant.
Results: The results showed that, out of 300 diabetic patients, the proportion of metabolic syndrome was 226 (75.3%). The overall mean age of patients was 57.26± 7.07 years. (60.0%) patients were male and (45.7%) of the patients were from urban area. (60.0%) of patients had abdominal obesity and (61.0%) of patients adapt sedentary life style. (76.7%) of patients had high triglyceride, meanwhile, only (39.7%) had normal HDL. Hypertension was presented in (73.7%) of patients. Metabolic syndrome was statistically significant with male, urban area, abdominal obesity, sedentary lifestyle, high triglyceride and hypertension. Patients with high triglyceride were 71 times more likely to develop metabolic syndrome than patients with normal triglyceride.
Conclusion: High proportion of metabolic syndrome among diabetic type 2 patients in this study. High triglyceride, urban area and sedentary lifestyle were the strongest predictors of metabolic syndrome.
Key words: *Metabolic Syndrome (MS), Type 2 DM, High Triglyceride, Abdominal Obesity*

Introduction

MS (syndrome X, insulin-resistant syndrome, dysmorphic metabolic syndrome and revean syndrome) is very common clinical condition and one of the major health public challenges due to its association with cardiovascular morbidity and mortality as well as complication of Diabetic Mellitus (DM) [(1)]. MS definition by the recent National Cholesterol Education Program (NCEP) and Adult Treatment Panel (ATP) III required three of the following abnormalities: waist circumference > 88 cm for women and > 102 for men; fasting serum triglyceride > 1.7 mmol/ L (150 mg/dL) and HDL Cholesterol < 1 mmol/ L (40 mg/ dL) for men and < 1.3 mmol/ L (50 mg/ dL) for women; blood pressure > 130/ 85 mmHg

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(or history of hypertension), or fasting blood sugar (FBS) > 5.7 mmol/ L (100 mg/ dL) b[(2)]. There is another definition of MS according to the World Health Organization (WHO) includes either impaired FBS > 6.1 mmol/ L (110 mg/ dL) or hyperinsulinemia plus two of the following: abdominal obesity (waist to hip ratio > 0.9, Body Mass Index (BMI) ≥ 30 kg/ m^2, waist girth > 94 cm); dyslipidemia (triglyceride > 150 mg/ dL or HDL < 40 mg/ dL in men and < 50 mg/ dL in women); hypertension (blood pressure 130/ 85 mmHg); microalbuminurea (30-300 mg/ dL) [(3)]. However, many authorities especially in last few years depend on NCEP- ATP III for definition of MS rather that of WHO criteria, because of accuracy, applicability and specificity of the former definition. The major determinant of MS is insulin resistance with resultant hyperinsulinemia which is the cause of type 2 DM [(4)]. Greater researches worldwide have been associated with increased rate of obesity, which is anticipated to dramatically increase prevalence of MS. The highest recorded prevalence was in Native America with nearly (60%) for women aged 45-49 years and (45%) for men aged 45-49 years according to NCEP and ATP III, meanwhile, it is (22%) for women aged 45-49 years and (19.5%) for men aged 45-49 years which is the lowest by the former record [(5)].

The pathogenesis of MS is still unclear despite of some risk factors which interact to cause this syndrome. Many components of MS have been associated with sedentary lifestyle including increase central adipose tissues, reduce HDL and a trend towards increase triglyceride, high blood pressure as well as glucose. So far, central obesity is one of the main causes of MS, which is responsible for insulin resistance at peripheral tissues [(6)]. Grundy *et al*, 2005 reported in their study, MS is age dependent and associated with high prevalence worldwide [(7)]. In 2004, Popkin and Gordon-Larsen revealed increase prevalence of MS in type 2 diabetic patients or in those with impaired glucose tolerance (IGT).

Recently Fauci and his team attributed the pathogenesis of MS to Free Fatty Acids (FFAs) which is an expanded adipose tissue. FFAs results in an increase production of liver glucose, triglyceride as well as liver secretion of VLDL. Meanwhile, FFAs in periphery cause high LDL, low HDL as well as low peripheral insulin sensitivity [(8)].

The term MS refers to the clustering of a number of cardiovascular risk factors (obesity, hypertension, dyslipidemia, and hyperglycemia) believed to be related to insulin resistance. It is estimated that about 20–25% of the world's adult population have MS, and they are twice as likely to die of and three times as likely to have a heart attack or stroke compared with people without MS. In addition, people with MS have a fivefold greater risk of developing type 2 DM [(9)]. Despite of highly prevalence for patients with type 2 DM, hypertension, dyslipedimia as well as sedentary lifestyle, the information about the prevalence of MS in Al-Hilla City is still lacked. This study has been carried out to determine the proportion of MS among patients with type 2 DM and its association with MS risk factors at Merjan Teaching Hospital in Al-Hilla City.

Materials and Methods

Study design/Study Location

This hospital-based cross-sectional study was carried out in a tertiary centre (diabetic outpatient clinic in Merjan Teaching Hospital).

Study population

All patients with diagnosed type 2 DM seen at the diabetic outpatient clinic in Merjan Teaching Hospital between December 2011 and December 2012 were included in this study.

Instruments and procedures

The outcome variable was the Metabolic Syndrome (absence or presence), meanwhile, the independent variables were

age, sex, residence, waist circumference, Body Mass Index (BMI), triglyceride, HDL, sedentary life style and presence of hypertension.

Blood Pressure Measurement

Blood pressure has been measured using mercury sphygmomanometer (used for all patients who are not diagnosed previously), while the patients sitting for five minutes. The cut off was equal ≥ 130/ 85 mmHg according to the NCEP or ATP III and did not depend on WHO criteria for diagnosis of hypertension.

Abdominal Obesity

NCEP or ATP III was the depending criteria to measure the waist circumference and determining abdominal obesity. A waist circumference of > 102 cm for male and > 88 cm for female have been obtained while the patient was standing up and the measurement at the level of umbilicus as the smallest girth between the costal margin and the iliac crests.

Biochemical Estimation

After a minimum of six fasting hours, five millilitres of venous blood was drawn from the antecubital vein of each participant. Separation was done using a centrifuge at 3000 round/ minute for about 15 minutes, the high density lipoprotein cholesterol (HDL-C) fraction was measured after precipitation of LDL-C and VLDL-C with dextran sulphate magnesium technique. Triglyceride estimation was measured by the enzymatic method. Accuracy was mentioned using commercial-quality control sera. The diagnosis of MS was confirmed by obtaining the measurements of FBS, waist circumference, triglyceride, HDL-C and blood pressure. According to ATP III criteria, patient who have three or more of the following criteria will defined as having MS: Abdominal obesity (> 102 and > 88 cm for men and women, respectively), hypertriglyceridemia (> 1.7 mmol/ L), low HDL-C (< 1 and < 1.2 mmol/L for men and women, respectively) as well as blood pressure of (> 130/ 85 mmHg).

Statistical Analysis

Statistical analysis was carried out using SPSS version 18. Categorical variables were presented as frequencies and percentages. Continuous variables were presented as means with their 95% confidence interval (CI). The Pearson's chi-square test (x^2) test was used to determine the associations between categorical variables. Independent sample t-test was used to compare means between two groups. Binary Logistic regression was done for multivariate analysis. A *p*-value of ≤ 0.05 was considered as statistically significant.

Results

Out of 300 patients with type 2 DM, 226 (75.3%) had with MS (Figure 1). The overall mean age of patients was 57.26± 7.07 years. Meanwhile, the mean age of diabetic patients with MS was 57.53± 6.99 years. There was significant differences of mean age for male 58.60± 6.30 years and female 55.70± 7.01 years (t= 3.649, df =298 and p <0.001), (66.7%) of male patients were aged ≥ 60 years (Figure 2). (45.7%) of patients were from urban area (Figure 3). Figure 4 shows that, (73.3%) of women were obese.

Metabolic Syndrome and Its Associated Risk Factors

Table 1 shows the distribution of metabolic syndrome by its risk factors waist circumferences, BMI, abdominal obesity, life style, triglyceride, HDL and blood pressure. (60.0%) of patients had abdominal obesity, meanwhile, (61.0%) of the study patients adapted sedentary life style. (76.7%) of patients had high triglyceride as well as, (60.3%) of patients had low HDL. (73.7%) of patients had hypertension.

Association of Metabolic Syndrome and Patient's Socio-Demographic Characteristics

Table 2 shows the association of metabolic syndrome and patient's socio-demographic characteristics. There were significant

association between metabolic syndrome with sex and residence, meanwhile there was no significant association between metabolic syndrome and age.

Association of Metabolic Syndrome with Its Associated Risk Factors

Table 3 shows the association of metabolic syndrome with its risk factors. There were significant association between metabolic syndrome with abdominal obesity, life style, triglyceride, HDL and blood pressure.

Logistic Regression Analysis of Metabolic Syndrome as a Function of Associated Risk Factors

Table 4 shows the logistic regression. Only eight independent variables showed significant contribution to the model (sex, residence, abdominal obesity, lifestyle, triglyceride and hypertension). The strongest predictor of reporting MS was triglyceride. Diabetic patients with high triglyceride were 71 times more likely to report MS than those with normal triglyceride. Patients from urban area, adapted sedentary life style female sex, hypertensive and obese patients were 15, 12, 6 as well as 5 times more likely to report MS than other patients.

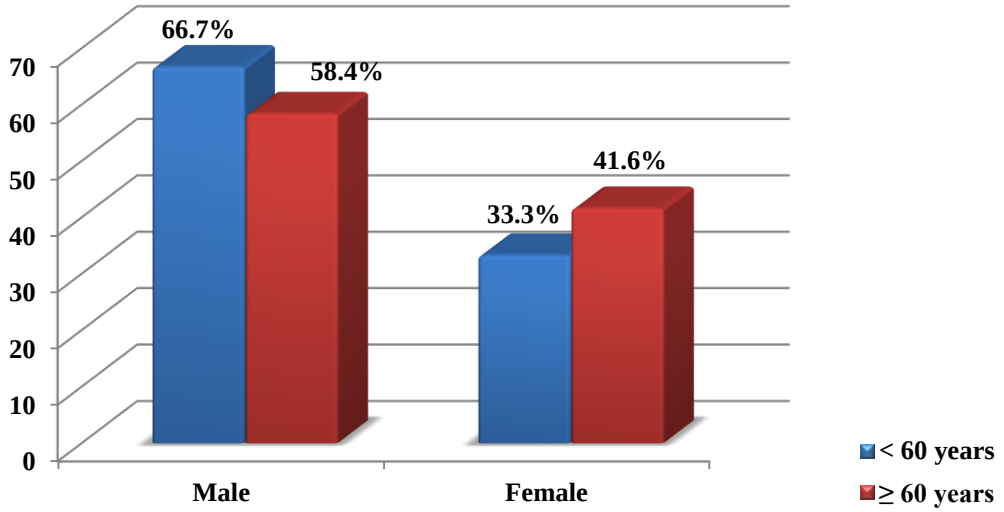

Figure 1. Distribution of patients by metabolic syndrome

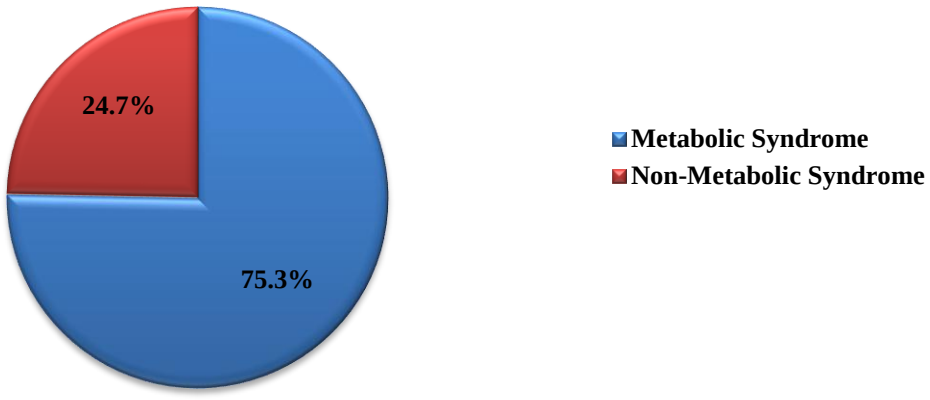

Figure 2. Mean differences of sex by age groups

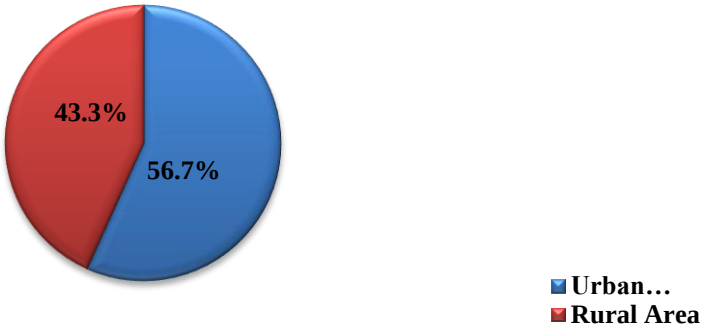

Figure 3. Distribution of patients by residence

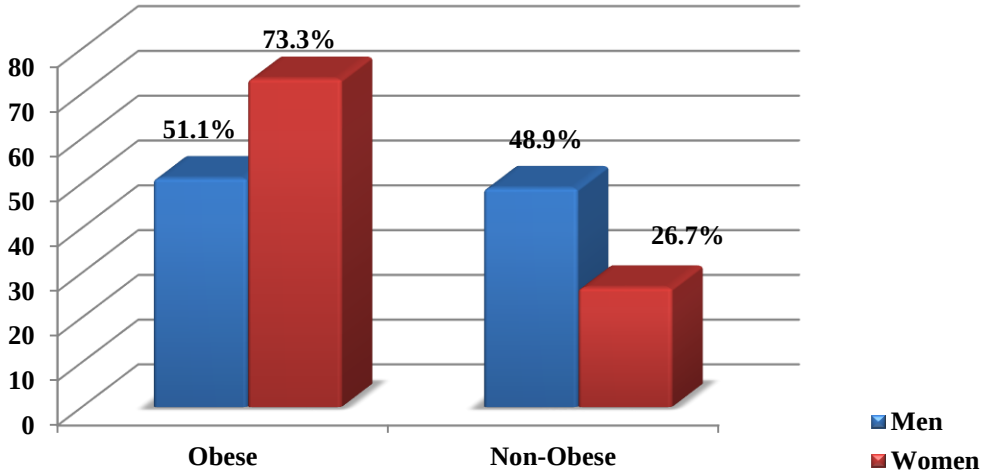

Figure 4. Distribution of sex by abdominal obesity

Table 1. Distribution of metabolic syndrome by its associated risk factors

Variable	Mean ± SD	Frequency (%)
Waist circumference	114. 60± 3.91	
BMI	31.78± 2.05	
Abdominal obesity		
Yes		180 (60.0%)
No		120 (40.0%)
Life style		
Sedentary life style		183 (61.0%)
Non-Sedentary life style		117 (39.0%)
Triglyceride	3.33± 0.60	
High		230 (76.7%)
Normal		70 (23.3)
HDL	0.75± 0.06	
Normal		119 (39.7%)
Low		181 (60.3%)
Blood pressure		
Hypertension		221 (73.7%)
Non-Hypertension		79 (26.3%)

Table 2. Association of metabolic syndrome and patient's socio-demographic characteristics

Variable	Metabolic Syndrome		χ^2	*P* values
	Yes (%)	No (%)		
Age Groups (years)				
< 60 years	144 (63.7)	48 (64.9)	0.032	0.858
≥ 60 years	82 (36.3)	26 (25.1)		
Sex				
Male	**160 (70.8)**	20 (27.0)	**44.499**	**<0.001***
Female	66 (29.2)	45 (73.0)		
Residence				
Urban area	**160 (70.8)**	10 (13.5)	**74.494**	**<0.001***
Rural area	66 (29.2)	64 (86.5)		

*p value ≤ 0.05 is significant

Table 3. Association of metabolic syndrome with Its Associated Risk Factors

Variable	Metabolic Syndrome		χ^2	*P* values
	Yes (%)	No (%)		
Abdominal obesity				
Obese	**158 (69.9)**	22 (29.7)	**37.503**	**<0.001***
Non-Obese	68 (30.1)	52 (70.3)		
Life style				
Sedentary life style	**169 (74.8)**	14 (18.9)	**73.118**	**<0.001***
No sedentary life style	57 (25.2)	60 (81.1)		
Triglyceride				
High	**223 (98.7)**	7 (9.5)	**248.02**	**<0.001***
Normal	3 (1.3)	67 (90.5)		
HDL				
Low	**119 (52.7)**	0 (0.0)	**64.58**	**<0.001***
Normal	107 (47.3)	74 (100.0)		
Blood pressure				
Hypertension	**189 (83.6)**	32 (43.2)	**46.86**	**<0.001***
Non-Hypertensive	37 (16.4)	42 (56.8)		

*p value ≤ 0.05 is significant

Discussion

MS is increasing in prevalence, paralleling an increasing epidemic of obesity. In the United States, more than one fourth of the population meets diagnostic criteria for MS which is approximately the same prevalence for European population and Latin America [10]. Meanwhile, the prevalence of MS in East Asia may range from 8-13% in men and from 2-18% in women, depending on the population and definitions used [11-14]. Many reports have been published on the prevalence of the MS in the Middle East.

A community-based, cross-sectional survey in Basrah (Iraq) reported the optimal cutoff point of waist circumference for the diagnosis of MS as 99 cm in women and 97 cm in men [15-17]. However, a larger study on the prevalence of MS in the Middle East have been conducted in Iran, the age-standardized prevalence of the MS was about 34.7% and 37.4% based on the ATP III and IDF definition, respectively [18].

Table 4. Logistic Regression Analysis of Metabolic Syndrome as a Function of Associated Risk Factors

Predictor	B	S.E.	Wald	df	P value	OR	OR (95% C.I.)	
							Lower	Upper
Age groups								
< 60 years[a]								
≥ 60 years	0.050	0.280	0.032	1	0.858	1.051	0.607	1.820
Sex								
Male[a]								
Female	1.879	0.300	39.255	1	**<0.001***	**6.545**	**3.637**	**11.78**
Residence								
Rural[a]								
Urban	2.742	0.370	54.862	1	**<0.001***	**15.515**	**7.510**	**32.051**
Abdominal obesity								
Non-Obese[a]								
Obese	1.703	0.293	33.845	1	**<0.001***	**5.492**	**3.094**	**9.749**
Lifestyle								
No sedentary lifestyle[a]								
Sedentary lifestyle	2.542	0.334	57.930	1	**<0.001***	**12.707**	**6.603**	**24.453**
Triglyceride								
Normal[a]								
High	6.567	0.704	87.026	1	**<0.001***	**71.19**	**17.93**	**282.78**
HDL								
Normal[a]								
Low	20.834	3684	0.001	1	0.995	0.001	0.001	0.005
Blood pressure								
Non-Hypertension[a]								
Hypertension	1.903	0.296	41.435	1	**<0.001***	**6.704**	**3.756**	**11.967**
Constant	0.712	1.944	0.134	1	0.714	2.038		

[a]Reference category,
*p significant when $p \leq 0.05$
Nagelkerke R^2=0.483,
Binary Logistic Regression: Enter

Meanwhile, a multinational study from 65 centers in six Middle Eastern countries (Bahrain, Kuwait, Qatar, Oman, United Arab Emirates, and Yemen) evaluated the prevalence and effect of MS based on IDF diagnostic criteria. MS was highly prevalent among patients presenting with acute coronary syndrome [(19)]. Furthermore, in a nationwide study in Egypt, central obesity was estimated in the study to be 29% with a more prevalence in women [(20)]. In addition Turkey survey according to ATP III guideline reported a prevalence of 33.9% for MS, with a higher prevalence in women (39.6%) than in men (28%) [(21)].

The present study had been carried out to determine the presence as well as the components of MS for patients with type 2 DM at diabetic outpatient clinic in Merjan Teaching Hospital Al-Hilla City. According to NECP and ATP III criteria that had been depended in this study, the proportion of MS was 75.3% among type 2 DM patients, however, there are differences between this finding and other findings by western countries attributed to the societies, lifestyles and races differences. In this study, women were more than men to developing MS, however, majority of women in the current study were obese (Figure 4) as well as adapted lower level of physical activities and higher calories food. Furthermore, these findings were in agreement with other local, regional as well as global studies [(12-24)]. , this study was not in agreement with Finish study which reported that the prevalence of MS was higher among men than women due to higher men waist to hip ratio than women [(25)]. Patients from urban area were 15 times

more likely to develop MS, however, these finding have been attributed to adaptation sedentary lifestyle, physical inactivity as well as unhealthy food habits of people from urban area as reported in regional studies of Turkey, Iran and other studies [24, 26 and 27]. Majority (69.9%) of diabetic patients with MS in current study were obese, and they were five times more likely to have MS. These finding were in agreement with Singaporean cohort study on central obesity in 2007, which revealed that central obesity could be as optional component of MS according to International Diabetes Federation (IDF), and these patients with central obesity were at a higher risk to develop Ischemic Heart Diseases (IHD) [12-19 and 28]. Although hypertension is one of components that may be involved in diagnosis of MS, diabetic patients with hypertension in this study were six times more likely to have MS. However, adapting poor lifestyle and food habit as well as highly elevated fasting triglyceride by those patients lead to poorly controlled blood pressure [28].

Patients with highly triglyceride level were the strongest predictor to develop MS in this study, patients with high triglyceride were 71 times more likely to develop MS than patients with normal triglyceride. Hypertriglyceridemia commonly occurs along with other components of the metabolic syndrome [29]. An elevated triglyceride is the most available laboratory marker to uncover the coexistence of multiple risk factors, including non-lipid risk factors, such as hypertension [29 and 30], elevated plasma glucose, and a prothrombotic state [29]. Hypertriglyceridemic patients thus must be carefully evaluated for the other metabolic risk factors that occur with the metabolic syndrome. Any patient whose triglyceride concentrations exceed 150 mg/dL is suspect for the metabolic syndrome [29-31]. Elevated serum triglycerides commonly associate with insulin resistance and represent a valuable clinical marker of the metabolic syndrome. The connections between insulin resistance and atherogenic dyslipidemia, hypertension, a prothrombotic state, and glucose intolerance are complex and may be mediated through multiple metabolic pathways.

Conclusion

Developing countries are undergoing an epidemiologic transition accompanied by increasing burden of CVD linked to urbanization and lifestyle modifications. MS is a cluster of CVD risk factors whose extent remains unknown. Among all the patients with type 2 DM have been received at outpatients diabetic clinic in Merjan Teaching Hospital from December 2011 to December 2012, the proportion of MS was (75.3%). Diabetic patients with high triglyceride were 71 more likely to develop MS, followed by patients from urban area, sedentary lifestyle, female patients and patients with hypertension as well as abdominal obesity. However, there were no significant association between MS and age. This study has been provided appropriate data for MS in Al-Hilla City as well as a proper prediction of the main risk factors that highly associated with development of MS.

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