# PREVALENCE OF METABOLIC SYNDROME AMONG PATIENTS WITH TYPE 2 DIABETES MELLITUS IN DUHOK

Zana Sidiq Mohammed Saleem *and Hama Najm Jaf**

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## ABSTRACT

### *Background*

The metabolic syndrome is a constellation of risk factors of metabolic origin that are accompanied by increased risk for cardiovascular disease and type 2 diabetes. These risk factors are atherogenic dyslipidemia, elevated blood pressure, elevated plasma glucose, a prothrombotic state, and a proinflammatory state. Metabolic syndrome is associated with overall mortality; with cardiovascular mortality in particular; it has been shown that metabolic syndrome is an independent clinical indicator of macro- and microvascular complications in diabetics.

### *Objective*

The objective of this study was to estimate the prevalence and characteristics of metabolic syndrome among type-2 diabetic patients in Duhok Governorate.

### *Patients and Methods*

This study involved 394 randomly selected patients from those suffering from type-2 diabetes mellitus, from 1st February through 30th June 2009 and who were attending Duhok Diabetic Center. The patients were interviewed and examined, and their lipid profiles and fasting blood sugar were checked 12 hours after an overnight fasting. Metabolic syndrome was defined according to the criteria of the National Cholesterol Education Program Adult Treatment Panel III..

### *Results*

Three hundred ninety four patients (males 33%, females 67 %) were screened and their mean age was (52 ± 8) years, 77% of participants were found to have metabolic syndrome. Metabolic syndrome was more among females (89%), those with high fasting blood glucose (93%), those with high waist circumference (80%), those with high triglyceride (72%), those with low high density lipoprotein (90%), high blood pressure (68%), and those who lacked physical activities.

### *Conclusion*

A comprehensive protocol for management of diabetic patients needs to be adopted involving not only control of blood sugar but also other risk factors like obesity, high blood pressure and dyslipidemia.

**Keywords**: *Metabolic Syndrome, Type 2 Diabetes Mellitus, Duhok.*

*Lecturer in School of Medicine, Faculty of Medical Sciences, University of Duhok. Duhok Dialysis and Transplantation Center. E-mail: zanasidik@yahoo.com

** Head Kurdistan Board for Medical Specializations.

## INTRODUCTION

The Metabolic Syndrome (MS) was originally mentioned in the late 1960's when it was described as a disorder of genetic adaptation becoming manifest following unrestricted food intake and/or muscular inactivity. Over the following 40 years, more scientists and researchers noticed that a cluster of factors commonly appear in patients who have a higher risk of heart attack or stroke [1]. The cluster was named 'Syndrome X', 'Insulin Resistance Syndrome (IRS), MS, dysmetabolic Syndrome X or Reaven's Syndrome [2-4].

The three definitions from the World Health Organization (WHO), The Third Report of the National Cholesterol Education Program Expert Panel on Detection, Evaluation, and Treatment of High Blood Cholesterol in Adults (NCEP-ATP III) and the International Diabetes Federation (IDF) incorporate different diagnostic criteria with varying cut off value [5].

The present American Heart Association/National Heart, Lung and Blood Institute statement, in contrast to IDF, maintains the ATP III criteria except for minor modifications [6]. There has been a tremendous worldwide increase in the prevalence of MS in the last decades; an increase that coincide with the epidemic of obesity and diabetes mellitus [7]. With the elevated risk not only of diabetes but also of cardiovascular disease (CVD) from the MS, there is an urgent need for strategies to prevent the emerging global epidemic [7]. Prevalence of the MS varies across the globe, in part reflecting the age and ethnicity of the populations studied and the diagnostic criteria applied. In general, the prevalence of MS increases with age.

The predominant underlying risk factors for the syndrome appear to be abdominal obesity and insulin resistance. Other associated conditions can be physical inactivity, aging, and hormonal imbalance. An atherogenic diet (e.g. a diet rich in saturated fat and cholesterol) can enhance risk for developing CVD in people with the MS6. DM is included in both the NCEP and IDF definitions of the MS. It is estimated that the large majority (~75%) of patients with type 2 DM or impaired glucose tolerance have the MS [8].

Diabetic patients have a 3 to 5 folds increase in the risk of coronary artery disease [9]. Moreover, diabetes induces metabolic abnormalities all of which contribute to increased atherosclerosis [10]. The increased focus on the MS has drawn attention to the identification and treatment of the dyslipidemia associated with abdominal fat accumulation. The changes in lipid metabolism seen with abdominal fat accumulation have been well characterized and include hyper-triglyceridemia, reduced High density lipoprotein–cholesterol (HDL-Ch), and increased numbers of small dense -Low density lipoprotein (LDL) particles. Elevated LDL cholesterol is not a feature of the dyslipidemia seen with abdominal obesity [11]. It has recently been proposed that apoprotien B should be included in all guidelines as an indicator of cardiovascular risk [12].

The aim of this study is to estimate the prevalence and clustering of the risk factors of metabolic syndrome in type 2 diabetic patients in Duhok province.

## PATIENTS AND METHODS

A cross sectional study was conducted at the Duhok Diabetic Center (DDC) from 1st February through 30th June, 2009. This is the only center in Duhok province where almost all cases of DM cases are registered. A total of 394 diabetic patients (aged 27–82 years) livings in different areas of Duhok Governorate were enrolled in the study. The inclusion criteria were the absence of recent infections, and absence of acute coronary syndrome.

Systematic random sampling was used to recruit participants by selecting every fourth type 2 diabetic patients attending DDC. A verbal consent was obtained from the subjects after explaining to them the nature and objectives of the study.

A specially designed pre-tested questionnaire form was used to collect the data. The questionnaire included background information of the subjects including age, gender, residence and information on smoking habit, alcohol consumption and medications. Further information included measurement of weight, height, waist circumference, blood pressure, lipid profile and fasting blood sugar (FBS).

Physical activity Scale was constructed by considering the responses to questions on job of participants and number of hours per day of activity, which is divided into active and sedentary activity [13]. Alcohol consumption was categorised as alcoholic and non alcoholic. Subjects smoking more than 20 cigarettes per day for more than six months were labeled as smokers

in the present study. Non smokers were those who never smoked [14].

Resting systolic blood pressure (SBP) and diastolic blood pressure (DBP) were measured by using random zero sphygmomanometer and cuffs appropriate for arm size. Blood pressure was assessed as the average of 2 measurements taken after subjects had been seated for at least 5 minutes [15], hypertension was defined as a SBP> 140 mmHg and DBP> 90 mmHg or use of antihypertensive therapy [16].

Weight was recorded to the nearest kilogram using an electronic and bench scale and height was recorded to the nearest centimeter using the Center for Disease Control and Prevention measuring board. Waist circumference was measured at the widest part of the abdomen at relaxed abdomen.

Participants were instructed to attend the Lab-unit of DDC in the morning after overnight fasting for 12-14 hours and avoidance of smoking and heavy physical activity for more than 2 hours before the examinations. Then the serum was processed immediately for measuring serum cholesterol, serum triglycerides (TG), HDL-Ch, blood sugar by clinical chemistry analyzer Lisa.Xs (open, automated, discrete, random access).

Dyslipidemia cut points were based on NCEP guidelines [16]: Total cholesterol (T.C): Desirable < 200 mg/dl, borderline high 200- 239, high > 239 mg/dl. HDL-Ch: low < 40 mg/dl, high > 59 mg/dl, LDL-Ch: Optimal < 100 mg/dl, near optimal 100–129 mg/dL, borderline high 130-159 mg/dl, high 160-189 mg/dl, very high > 189 mg/dl. TG: Normal < 150 mg/d, high 150-199 mg/dl, hypertriglyceridemia 200-499 mg/dl, very high > 499 mg/dl.

Body mass index (BMI) was calculated as weight in kilogram divided by the square of height in meter. Subjects with BMI less than 25 were consider normal, while those with BMI 25- 2 9.9 were considered over weight and those BMI ≥ 30 were considered obese.

Participants were classified as having the metabolic syndrome according to the 2004 revision of ATP III criteria by which a person is considered having metabolic syndrome when 3 or more of the following are present: (1) waist circumference (WC) >102 cm in men or >88 cm in women; (2) TGs ≥150 mg/dL or drug intake for elevated TGs; (3) HDL-Ch-C < 40 mg/dL in men or <50 mg/dL in women or intake of medication for elevated HDL-Ch; (4) SBP≥130 mm Hg, DBP≥85 mm Hg, or use of antihypertensive therapy; and (5) fasting glucose ≥100 mg/dL or use of anti-diabetics [17].

All data were analyzed using the SPSS; independent sample t- test was used to investigate associations between numeric variables. Chi-square test was used to assess associations between categorical variables. Level of statistical significance was set at P< 0.05.

## RESULTS

The study sample comprised of 394 participants. The characteristics of the study participants are shown in table 1, which shows that 58% percent were hypertensive; 37% had hypercholesterol-emia; 61.1% had high triglyceride level; 74% had low HDL-Ch level; and 77.4% had metabolic syndrome based on NCEP/ATP III criteria.

Table 2 shows the difference of various characteristics by gender. Females were more likely to have a high average SBP than males (130 mmHg versus vs. 124 mmHg, p = 0.012). Abnormal WC was significantly higher in females than in males (92% vs. 18%, p < 0.001). The mean BMI in females was significantly higher than the mean in males (32.13 kg/m2 vs. 28.5 kg/m2, p < 0.001). Mean T.C level was significantly higher in females than in males (196 mg/dl vs. 186 mg/dl, p = 0.02). Low HDL-Ch was significantly higher in females than the average in males (82% vs. 52%, p < 0.001). Also, mean LDL-Ch level was significantly higher in females than in males (115.9 mg/dl vs. 101.6 mg/dl, p < 0.001). Mean FBS in females was significantly higher than in males (164.8 mg/dl vs. 153.5 mg/dl, p = 0.011). Females were significantly less likely to practice regular exercise than males (2.6% vs. 28% for exercise, p < 0.001). Also, they were significantly less likely to be smoker than males (3% vs. 12.2%, p < 0.001). There was no statistically significant difference in the mean DBP and TG between males and females. A slightly higher percentage of alcohol consumption in females compared to males can be largely explained by the fact that they were of non Muslim religion for whom alcohol consumption is not a big social stigma.

Table 3 illustrates sociodemographic and clinical characteristics of the study participants by status of MS. Those with MS were less likely to practice regular exercise compared to those without MS (5.6% vs. 7.8%, p < 0.001). Subjects with MS

were more likely to have history of chronic diseases than those without MS (54.4% vs. 55%, $p < 0.001$). Patients with MS were less likely to be males than those without MS (23% vs. 66%, $p < 0.001$). Also, those with MS had less likelihood to be living in urban areas than those without MS (82% vs. 91%, $p = 0.02$).

Table 4 shows the prevalence of ATP criteria among diabetic patients in order of decreasing frequency.

Table 5 shows that most of MS patients had five components of the syndrome (37%); 35% of them had four; and 28% had three components

**Table 1. Characteristics of the study participants (n =394).**

| Variable | |
|---|---|
| Age in years, mean (SD) | 52( 8.12) |
| Gender | |
| Male no. (%) | 131 (33) |
| Female no. (%) | 263 (66) |
| Residence | |
| Urban (%) | 331 (84) |
| Rural (%) | 63 (16) |
| Waist circumference (M >102cm, F >88cm) no. (%) | 267 (68.2) |
| BMI | |
| Overweight no. (%) | 160 (40.6) |
| Obese no. (%) | 202 (51.2) |
| Smokers no. (%) | 44 (11.1) |
| Alcoholics no. (%) | 8 (2) |
| Regular exercise no. (%) | 24 (6.1) |
| Hypertension no. (%) | 228 (58) |
| Hypercholesterolemia no. (%) | 144 (37) |
| Hypertriglyceridemia no. (%) | 241 (61.1) |
| Low HDL-Ch no. (%) | 283 (74) |
| MS no. (%) | 305 (77.4) |

BMI: Body mass index, HDL-Ch: High density lipoprotein-Cholesterol, MS: Metabolic syndrome.

**Table 2. Characteristics of the participants by gender.**

| Characteristics | Male(n131) | Female(n263) | P value |
|---|---|---|---|
| SBP (mmHg) Mean± SD | 124 ± 21.56 | 130 ± 23.45 | 0.012 * |
| DBP (mmHg) Mean± SD | 77.6 ± 11.59 | 79.4 ± 12.1 | 0.15 * |
| High WC (cm) No. (%)† | 24(18) | 243 (92) | < 0.001‡ |
| BMI (kg/m2) Mean± SD | 28.5 ± 3.51 | 32.13 ± 4.93 | <0.001* |
| T.C(mg/dl) Mean± SD | 186.8 ± 39.7 | 196.5 ± 40.1 | 0.023 * |
| TG (mg/dl) Mean± SD | 235.3 ± 223.18 | 199 ± 99.69 | 0.07 * |
| Low HDL-Ch (mg/dl) No. (%)• | 68 (52) | 216 (82) | < 0.001‡ |
| LDL-Ch (mg/dl) Mean± SD | 101.6 ± 40.1 | 115.9 ± 39.5 | < 0.001 * |
| FBS (mg/dl) Mean± SD | 152.5 ± 43.5 | 164.8 ± 48.5 | 0.011 * |
| Exercise No. (%) | 16 (12.2) | 8(3) | < 0.001‡ |
| Smoking No. (%) | 37 (28) | 7(2.6) | < 0.001‡ |
| Alcohol consumption No. (%) | 2(1.5) | 6(2.2) | 0.4‡ |
| Family History of DM No. (%) | 75(57) | 140(53.2) | 0.25‡ |
| Positive MS No. (%) | 72 (55) | 233 (89) | <0.001‡ |

SBP: Systolic blood pressure, DBP: Diastolic blood pressure, WC: Waist circumference, BMI: Body mass index, T.C: Total cholesterol, TG: Triglyceride HDL- Ch: High density lipoprotein-Cholesterol, LDL-Ch: Low density lipoprotein-Cholesterol, FBS: fasting blood sugar, DM: Diabetes Mellitus, MS: Metabolic syndrome.
***** Independent samples t-test.
† High WC in men >102 cm or >88 cm in women.
‡ Chi square test.
• Low HDL-Ch in male is <40 mg/dl or <50 mg/dl in female.

**Table 3. Sociodemographic and clinical characteristics of the study participants by status of MS.**

| Characteristics | MS | Non MS | P value |
|---|---|---|---|
| Exercise No. (%) | 17 (5.60) | 7(7.80) | < 0.001‡ |
| Smoking No. (%) | 37 (12.90) | 7(7.90) | 0.2 ‡ |
| Alcohol ingestion No. (%) | 5 (0.30) | 3(3.30) | 0.8 ‡ |
| Family History of DM No. (%) | 166 (54.40) | 49(55) | 0.8 ‡ |
| History of chronic illnesses No. (%) | 190 (62.2) | 26(25.8) | <0.001 ‡ |
| Male gender No. (%) | 72 (23) | 59 (66) | <0.001 ‡ |
| Living in urban areas No. (%) | 250 (82) | 81(91) | 0.02 ‡ |

MS: Metabolic syndrome, DM: Diabetes Mellitus.
‡ Chi square test.

**Table 4. Prevalence of ATP criteria among patients with MS.**

| ATP Criteria | No. (%) |
|---|---|
| Low HDL no. (%) | 268 (88) |
| High WC no. (%) | 243 (80) |
| High TG no. (%) | 220 (72) |
| High BP no. (%) | 208 ( 68) |

MS: Metabolic syndrome, HDL- Ch: High density lipoprotein-Cholesterol, WC: Waist circumference TG: Triglyceride, BP: blood pressure,

**Table 5. Number of ATP criteria in patients with MS.**

| Number of ATP Criteria | No. (%) |
|---|---|
| 3 | 84 (28%) |
| 4 | 108 (35%) |

## DISCUSSION

In this cross-sectional study of 394 type 2 DM clinic attendees, we found an overall prevalence of MS of 77.4% (305 patients).

Females were more affected by MS than males (89% of the female and 55% of the male). Obesity, hypertension and dyslipidemia were all significant more common among female than males; similar finding was found in Iran and Pakistan [18, 19].

The higher MS prevalence found in female is probably related to higher dyslipidemia, obesity, and higher blood pressure rates in female than in males. This observation is also found in other studies like in Iran (female 71.7% vs. 58% in male) [19]. Prevalence rates in various studies from around the world show considerable variation. The differences in diagnostic criteria for this syndrome are partially responsible for variations in the reported prevalence among different studies [20, 21]. Our clinic-based figure is lower than the values reported in Libya, Brazil and Scandinavia 92%, 85%, 83.1% respectively [19, 22] and higher in comparison to other countries like China, United Kingdom, United States, Italy, Iran, Pakistan and Saudi Arabia 75.1%, 72%, 70%, 68.4%, 65%, 46%, 44% respectively [18,19,22,23]. Lower rates in our study could have been due to different definition criteria of MS; differences in medical care access and therapy, genetic predisposition and environmental factors, such as high caloric diet and lack of exercise or other factors [22].

The most prevalent risk factor in this study was low HDL-CH (74%). Such high prevalence of low HDL-CH was reported in another study in Pakistan [22]. This followed by high WC (68.2%), hypertension (58%).

The most common criteria of MS among males were high TG, followed by low HDL, and hypertension, while the most common criteria among females MS were high WC, followed by low HDL and hypertension.

In this cross sectional study low HDL-Ch was found to be the most common criteria among MS patients (90%) followed by high WC (80%), high TG (72%) and hypertension (68% ). This is similar to the finding of study in Libyan in which low HDL-Ch found to be the most common criteria (83%) followed by hypertension found (78%), High WC (71.4%). While in Pakistan; hypertension was found to be the commonest criterion (58%) followed by dyslipidemia (36%), and high WC (30%) [18, 19].

In this study 113 patients of MS had five criteria (37%) which is unlike the finding of study in Iran where most patients of MS had three criteria (36.2%) 19. MS is common among T2DM (77.4%), and it is significantly more common in females (89%) than males (55%). Obesity, hypertension and dyslipidemia were all significant more common among females than males.

In this study low HDL-Ch found to be the most common criteria among MS patients, followed by High WC, High TG and hypertension. Most patients of MS had five ATP-III criteria.

DM is emerging in our country as a non-infectious epidemic disease. It should be controlled at the earliest, for those who are suffering and for those who are at risk. They should give up sedentary life style and perform regular physical activities. They should be encouraged to stop smoking and take a healthy diet containing low saturated and trans-fatty acids, and low in dietary cholesterol. They should take much more fiber. It should be controlled and propagated by media like newspapers, television, radio, as also by doctors and paramedical staffs and should encourage them to control diabetes mellitus [(18)].

To gain the most benefit from modifying multiple metabolic risk factors, the underlying insulin-resistant state must become a target of therapy. The safest, most effective and preferred way to reduce insulin resistance in overweight and obese people is weight loss and increased physical activity. 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 blood pressure and glycemic control.

Comprehensive treatment of diabetic patients needs to be applied and not just controlling blood sugar. This involves patient education, controlling blood pressure, dyslipidemia and obesity. Health care professionals need to help people to understand the potential benefits that may result from the introduction of dietary patterns and exercise, and support them in adopting and adhering to these behavioral patterns.

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 and prospective follow up studies are needed to identify the impact of MS on long-term complications of DM.

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