

Metabolic Syndrome (MetS) Prevalence, Associated Factors and Nutritional Practices in the Type 2 Diabetes Mellitus Patients

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ABSTRACT

Aim: The aims of this study were to determine the prevalence of metabolic syndrome (MetS) and its associated factors among type 2 diabetes patients and to study the most important nutritional practices among them.

Materials and Methods: The study was included 100 patients with type 2 diabetes it was conducted at the Diabetes Centers in Alexandria Hospitals, Egypt, from June 2018 to February 2019. The study included the use of a questionnaire to obtain some information about diabetic patients, such as socioeconomics Characters, medical history of diabetes their most important nutritional practices, Waist circumference was done. Also, the blood samples were collected to measure some biochemical parameters; fasting blood glucose, lipid profile {total cholesterol (TC), triglyceride (TG), high-density lipoprotein cholesterol (HDL-C)}, and blood pressure level. MetS was defined according to the criteria of the NCEP/ATP III to include individuals with any three or more of the five components.

Results: Data showed that the prevalence of MetS in the sample was 71% and 29% was non-metabolic syndrome. High fasting blood glucose was the most common risk factor, followed by Waist circumference (65%), high TG (47%), lowed HDL (39%).

The studying of the nutritional practices showed that the metabolic syndrome patient preferred baking (24%) and boiling (17%) while (9%) of non-metabolic syndrome preferred boiling. On the other hand, (28%) of the total patients preferred baking in oven, and the metabolic syndrome patients preferred fruit (31%) and sweets (18%) between meals, while (19%) of non-metabolic syndrome patients preferred fruit and (5%) preferred vegetables between meals. Also, the study showed that 12% of metabolic syndrome patients had a poor level of practices, and 14% had good practices, 45% moderate nutritional practices.

Our findings indicated that metabolic syndrome had become a common public health problem, and therefore, we need to develop strategies, which aim to prevent and treat the of metabolic syndrome.

Key Words: Metabolic syndrome, predictive risk factors, type 2 diabetes, Nutritional Practices.

INTRODUCTION

Metabolic syndrome (MetS) is defined as a cluster of glucose intolerance, hypertension, dyslipidemia and central obesity with insulin resistance as the source of pathogenesis. Although several different combinations of criteria have been used to define metabolic syndrome, a recently published consensus recommended the use of ethnic specific criteria, including waist circumference as an indicator of central obesity, triglyceride and high density lipoprotein cholesterol (HDL) as indicators of dyslipidemia and blood pressure greater than 130/85 mmHg (Shin *et al.*, 2013).

The hyperglycemic condition in diabetics makes them able to develop some complications which contribute to the morbidity. The susceptibility of diabetics to complications is driven by both modifiable and non modifiable risk factors. Currently, there is heightened interest in a cluster of some risk factors called metabolic syndrome (MetS) that predicts cardiovascular disease and type 2 diabetes mellitus (Lorenzo *et al.*, 2003). It comprises the following major characteristic: Hypertriglyceridemia, low levels of high-density lipoprotein-cholesterol (HDL-C), central (abdominal) obesity, hypertension and concomitant insulin resistance/glucose intolerance (Alberti *et al.*, 2006).

Metabolic syndrome (MetS) is associated with a three to five fold increased risk for the development of type 2 diabetes mellitus (Wilson *et al.*, 2005). According to Lesser *et al.* (2014), knowledge regarding diet can change the unfavorable dietary pattern among the diabetic patients. Positive attitude towards dietary management may be control the blood glucose level among diabetic patients (Wang *et al.*, 2014). Proper practices according to the dietary recommendation prevent further complications of diabetes (Negrato *et al.*, 2014).

The MetS is known to be caused by insulin resistance or insulin resistance-linked obesity, a condition whereby the body's cells are incapable of

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taking up glucose from the blood. Insulin resistance-linked obesity is caused by poor dieting and lack of regular exercise. Other genetic or lifestyle risk factors as predictor variables equally lead to the metabolic MetS. They are increasing the factors of MetS by the age (greater than 40 years), smoking of cigarette, alcohol intake, overweight, sedentary life-style and family history of type 2 diabetes (Ferrannini., 1995, Walker., 2006).

In managing the type 2 diabetes of patients' lifestyle and dietary pattern, changes must be required. This change should be influenced by one's attitude, knowledge and practices; therefore, it is necessary to know about the risk factors in an effective way before managing the diabetes type 2 patients as these major determinants will help to treat the T2DM (Nsiah et al., 2015).

The American Diabetes Association (ADA) recommended that diabetic patients need to be aware of their nutrition requirements; as carbohydrates should be 45% - 65% of daily total caloric intake. The kind of carbohydrates such as fruits, green leafy vegetables, whole grains and beans are important. Fats should be 25 %- 35 % of the daily caloric intake. It is preferred to take skimmed or low-fat dairy instead of whole milk products. Protein should be 12 - 20% of the daily calories although this may differ depending on a patient's requirement of health (American Heart Association., 2012).

MetS and T2DM are associated with risks of cardiovascular disease (CVD) and other related disorders. One major underlying cause of CVD in patients with MetS or T2DM is a characteristic form of atherogenic dyslipidemia (Ginsberg and MacCallum., 2009).

Aim: The aims of this study were to determine the prevalence of metabolic syndrome (MetS) and its associated factors among type 2 diabetes patients and the most important nutritional practices among them.

MATERIALS AND METHODS

Subjects

This study was conducted between June 2018 and February 2019 in the Diabetic Centers of Alexandria hospitals. One hundred (100) Type 2 diabetics participated in this study as a case study (18 males and 82 females).

Their ages ranged between 20 years to more than 60 years. A questionnaire was used to collect the study information data from the diabetic patients sample; namely; the, Socioeconomics Characters, medical history of diabetics and the most important nutritional practices and their food habits. Participants were fasted over night before blood sample. Blood samples were

collected by hospital nursing to measure some biochemical parameters: fasting blood glucose and a lipid profile in the hospital laboratory.

Nutritional practices

To study nutritional practices, 11 questions were prepared and scores were given to the questions according to the correctness and error of the answer, where (3) was given to the good, (2) to the moderate and (1) to the weak, and the highest score for the respondent was 29 and the lowest score is 15, according to his answers. Three levels by calculating the range and dividing it by 3, giving 15 -19 for the weak, 20 -24 for the moderate , and 25- 29 for the good.

Blood Sample Collection and Processing

About 5 ml of venous blood samples were collected by the hospital nurse after fasting overnight. The sample was taken to the hospital laboratory; Blood samples were received into clean dry centrifuge tubes and left to clot at room temperature, then centrifuged for 10 minutes at 3000 R.P.M to separate the serum. Serum was carefully aspirated and transferred into clean covet tee tubes and stored frozen at -20°C for analysis (Malhotra, 2003). Parameters that were determined included: fasting blood glucose (FBG), Lipid Profile (Total cholesterol (TC), triglyceride (TG), high-density lipoprotein cholesterol (HDL-C) and low-density lipoprotein cholesterol (LDL-C), The blood pressure and the anthropometric variables were measured.

Biochemical parameters

lipid profiles:

i. Tri glycerides (T.G):

Serum triglycerides (T.G) were measured using the modified kinetic method according to the method described by *Fossatiand Principe (1982)*.

ii. Total cholesterol (T.C):

Serum cholesterol was measured using the modified kinetic method according to *Richmond (1973)*.

iii. High density lipoprotein cholesterol (HDL-C):

Serum high density lipoprotein cholesterol (HDL-C) was measured using the modified kinetic method according to *Allain (1974)*

Waist circumference measurements:

The waist circumference of the sample was measured to the nearest 0.1 cm using a tape measure midway between the lower corner of the ribs and the top of the suprailiac crest.

Metabolic Syndrome Definition:

Metabolic syndrome was defined according to the criteria to have "MetS" of the National Cholesterol Education Program / Adult Treatment Panel (NCEP/ATP III) which assumes that individuals with

any three or more of the following five components have MetS: (1) Abdominal obesity according to (Waist circumference >102 cm for men or >88 cm for women), (2) high TG ≥ 1.7 mmol/L. (150 mg/dl.), (3) low HDL-C: Men < 0.9 mmol/L (<40 mg/dl) or women <1.0 mmol/L (<50 mg/dl), (4) high blood pressure (systolic BP ≥ 130 mm Hg or diastolic BP ≥ 85 mm Hg or treatment of hypertension and (5) high FBG ≥ 6.1 mmol/L (110 gm/ dl) (Lorenzo et al., 2003).

Statistical Analysis

The quantitative data are expressed as means \pm standard deviation and t-test was used to a significance of the for differences in two mean values of grouped data. Qualitative data are expressed as percentage and Chi square test is used for comparison. A level of significance 5% was considered as statistically significant. By using SPSS (version 20.0) of statistical software.

RESULTS AND DISCUSSION

Prevalence of the individual components of MetS Type 2 diabetic Patient

Table (1) explains the prevalence of the individual components of MetS Type 2 diabetic patient, the overall prevalence percentage of MetS was 71%, for the overall population, high fasting glucose level was the commonest component (71%) of the MetS, followed by high waist circumference (65%), high TG (47%) and lowered HDL (39%).

Chandalia et al., (2000) found that in females, the most common component was waist circumference, followed by, high triglycerides, and this may be due to lack of physical activity, high stable lifestyle, and eating at night. Furthermore, it was found that waist

circumference and lowered HDL-C prevalence were significantly higher in females than males. It is well documented that lowered HDL-C levels are associated with an increased risk of coronary heart diseases or cardiovascular diseases.

This result is disagreement with Felix-Val et al. in (2008) who, using the NCEP/ATP III, they found that hypertension was the commonest in males, followed by hyper triglyceridemia.

A number of possible mechanisms can explain the inverse relationship between increased triglycerides in cases of insulin resistance and increased HDL undermining, leading to lower plasma HDL concentrations. One possibility is the decreased activity of lipoprotein lipase (LPL), which will have an effect on weak maturity of HDL molecules. It has been shown that normal insulin-mediated stimulation of LPL activity decreased insulin resistance (Moebus et al., 2007). In type 2 diabetes, especially when blood sugar control is weak and in patients with relatively insulin deficiency, LPL activity is reduced (Grundy et al., 2005).

People with low glucose tolerance and type 2 diabetes tend to have high triglycerides in the blood (hypertriglyceridemia) in addition to further increasing in HDL catabolism, which results in lower HDL levels (Pietzsch et al., 1998).

A Socioeconomics Characters of MetS Type 2 diabetic Patients

Table (2) shows socioeconomic characters of MetS type 2 diabetic patients. The prevalence of MetS in females was about 9 times higher (64%) than males (7%), 57% of MetS were married, and the number of family members is more than 5 members (35%).

Table 1. Prevalence of the individual components of MetS type 2 diabetic patients (NCEP/ ATP111)*

Sex type	Male	Female	Total
	7	64	71
Component of Metabolic Syndrome (MetS) **	Mean \pm S.D (MetS)	Metabolic Syndrome (MetS)	%
FBS mg/ml	181.08 \pm 54.52	No (frequency)	71
wc cm	112.41 \pm 19.18	71	65
TG mg/dl	165.27 \pm 60	65	47
HDL mg/dl	38.8 \pm 15	47	39
BP mm Hg	140/100 \pm 20	39	36

*National Cholesterol Education Program / Adult Treatment Panel (NCEP/ ATP111) (Lorenzo et al., 2003).

**MetS 71 % (Patient which have three or more of the five components)

Table 2. Socioeconomics Characters of MetStype 2 diabetic patients

Socioeconomics Characters		3 or more (MetS) (n=71)	2 or less (Non -MetS) (n=29)	Total (n=100)	P Chi
		No. (%)	No (%)	No. (%)	No. %
Sex Type	Male	7	11	18	** 10.99
	Female	64	18	82	
Material Status	Married	57	21	78	2.7
	Single	4	0	4	
	Widow	8	8	16	
	Divorced	2	0	2	
Number of family members	Less than 3	11	8	19	4.343
	3-5	25	13	38	
	More than 5	35	8	43	
Age (years)	20-30	2	0	2	7.844
	30-40	9	10	19	
	40-50	20	5	25	
	50-60	30	12	42	
	≥60	10	2	12	
Education Level	Illiterate	29	7	36	11.264*
	Read and write	13	3	16	
	Primary	4	2	6	
	Preparatory	6	2	8	
	Secondary	13	5	18	
	University	6	10	16	
Employment Status	Work	22	10	32	3.089
	Doesn't Work	49	19	68	
Occupation (n=32)	Literal	4	2	6	0.163
	Professionals	15	11	26	
Family Income Per month	Less than L.E.2000	48	15	63	** 8.191
	L.E. 2000–L.E.4000	23	14	37	

Significant at 0.05 * Significant at 0.01 **

Regarding age, individuals in the 50-60 age group had the highest prevalence of MetS (30%), while individuals aged 20-30 years and above had the lowest prevalence (2%). Depending on the level of education, it was observed that most of those who were illiterate (29%), and 49% of patients with MetS were unemployed, and the result also showed that the nature of professional work represented a large proportion of the total sample reached 81.2%, as for the level of Monthly income, the results showed that 63% of the monthly income of the participants was from the family less than 2000 pounds, and that 37% of the monthly income of the participants was between 2000-4000 pounds. Which was consistent with previous studies (Felix Fall et al., 2008 and Ford et al. 2002)? The cause of these results may be a relatively unstable lifestyle because most women are unemployed or may be caused by genetic factors.

There was a significantly higher prevalence of MetS among diabetics with a lower educational level (Table 2), which is the result of a similar study by Moebus et al., (2007) and Fan et al., (2013). It was found that diabetics with primary education (14.94%) and those who were in secondary school or from the four levels (56.32%) were more prevalent compared to upper secondary school. (3.45%) diabetics with high level (12.64%). where the value of Chi square was a significant for sex type, education level and family income.

Medical history of MetS Type 2 Diabetic patients

Data in Table (3) showed that 43% of metabolic samples were diagnosed with T2DM more than 5 years ago, and when they were asked about the age of diagnosis with T2DM for the first time, the study

showed that 32% of metabolic samples were 40-50 years old.

On the whole, 38% of metabolic patients accidentally detected the disease. Regarding the family history of T2DM, the study showed that 25% of metabolic patients have a positive family history and 14% of them whose mothers have diabetes. Where the value of the chi square was significant for the duration of the disease and the age at the detected disease. Family history has been reported to contribute to speeding up the acquisition of MetS (Lewis et al., 2005).

Table (4) showed that the medical history of type 2 diabetes of MetS, the results indicated that 24% of metabolic syndrome patients believe that psychological stress was the main cause of their disease. About the use of anti-diabetic medications, 66% of metabolic samples used anti-diabetic medications.

The study also showed that 37% of metabolic samples used oral tablets. It also showed that 12% of metabolic samples used combination therapy for insulin and oral tablets. Regarding the frequency of medications, 20% of metabolism used a single daily dose of oral tablets, 16% of the metabolic syndrome patient's time from metabolic syndrome from the medication dose after a meal, and 12% of metabolic

syndrome that took insulin of moderate effect, preferring take insulin before a meal. Where the value of Chi square was a non-significant.

Nutritional Practices of the subjects:

Table (5) clarifies that 47% of metabolic sample consume three meals per day. Concerning patients of metabolic, 50% of the tested samples consume moderate average of fats. 36 % of metabolic patients drink fenugreek as it assists in controlling diabetes ranges. In addition, 45% of metabolic syndrome sample consume whole wheat bread; whereas 26% of metabolic samples consume two leaves of bread per day, as the value of Chi square was significant in the rates of bread consuming, while 28% of metabolic sample consume medium fat meat. 25% of metabolic sample consume skim milk.

The results (table (5)) elaborate that 24 % of metabolic sample prefer baking, where as 17% prefer boiling. Concerning consuming the preferred type of protein, such as legumes, red meat, white meat, fish and eggs, the data clarifies that 25% of metabolic patients obtain their protein from white meat. Concerning the preferred cheese type in case of metabolism 41 % of the participants prefer Quraysh cheese. Metabolic sample prefer 31% fruit or snacks, while 18% of the samples prefer sweets between the main meals.

Table 3. Medical history of MetS type 2 diabetic patients

Parameters		MetS (71%)	Non- MetS (29%)	Total (n=100) (%)	Chi
Duration of The disease	Less than a year	10	6	16	7.938*
	1<3 years	15	8	23	
	3-5 years	3	5	8	
	More than 5 years	43	10	53	
Age at Illness detected	30-40 years	19	11	30	1.408*
	40 -50 years	32	10	42	
	More than 50 years	20	8	28	
How the disease detected	Accidentally	38	18	56	0.738
	Periodic detection	10	4	14	
	Appearance of some other symptoms	23	7	30	
Presence of diabetes in the family	Yes	25	12	37	0.336
	No	46	17	63	
Family member has diabetes	Father	8	2	10	1.277
	Mother	14	9	23	
	Grandparents from father	3	1	4	

*Significant at 0.05

Table 4. The causes of diabetes and medications for MetS type 2 diabetic patients

Parameters		Metabolic 71%	Non- metabolic 29%	Total 100%	Chi
Causes of diabetes	Genetics	16	9	25	4.157
	Lifestyle	8	4	12	
	Wrong dietary Practices	16	8	24	
	Psychological stress	24	4	28	
	I don't Know	7	4	11	
Anti diabetic medications	Yes	66	28	94	0.472
	No	5	1	6	
Type of anti diabetic medication	Oral tablet	37	17	54	0.254
	Insulin	17	7	24	
	Both of them	12	4	16	
Medicine dose / day	Once	20	8	28	1.036
	Twice	12	10	22	
	Three times	4	0	4	
Time of medicine dose	Before meal	15	10	25	1.863
	Middle of meal	4	5	9	
	After meal	16	4	20	
Insulin effect	Long effect	3	2	5	0.820
	Medium effect	12	4	16	
	Short effect	3	0	3	
Time of Insulin	Before meal	12	6	18	1.935
	Middle of meal	1	1	2	
	After meal	3	1	4	

Archer et al., (2004) and Yeung et al. (2018) assert that consuming poultry, meat, rice, and full-fat milk in large quantities increases diabetes ranges in blood. Thus, it is necessary to consume low-fat meats; in addition, saturated fats must not exceed 10 % in the meals of diabetes's patient and it is better to use non-saturated fats.

Protein is regarded a very important element in the healthy meal as it does not increase diabetes rates. Meat, eggs, dairy, poultry, and fish are regarded very important sources for protein (Clemente et al., 2018).

Here, it is better for diabetes's patient to have complex carbohydrate like full grain and not to have more than 10 % of simple sugars (Thomas et al., 2017).

Eckel et al. (1995) stated that individuals should advised to practice more exercise and eat foods that

contain small amounts of saturated fat, cholesterol, refined sugars and eat more high-fiber foods. Having high-fiber diets can improve their glycemic index, which can reduce plasma fasting glucose level, total cholesterol and triglycerides.

Table (6) shows nutritional practices levels of MetS type 2diabetic patients the results indicated that 12% of metabolic patients had a poor nutritional practices level, 14% had a good, and 45% had a moderate. In the other hand the nutritional practices in non- metabolic were 4% poor, 19% moderate and 6% good; the nutritional practices overall mean for all sample were (41 ± 5) , and the differences were not statistically significant.

Table 5. The differences in nutritional practices between MetS and non MetS type 2 diabetic patients

Nutritional Practices		MetS (71%)	Non-metS (29%)	Total (100%)	Chi
Meal Number	Two	15	2	17	4.167
	Three	47	20	67	
	More than three	9	7	16	
Fat Content	Low	9	3	12	0.906
	Medium	50	23	73	
	High	12	3	15	
Herbal beverages help in diabetes management	Green tea	24	15	39	6.354
	Fenugreek	36	13	49	
	Fennel	1	1	2	
	Cinnamon	8	0	8	
	Ginger	2	0	2	
Type of bread	Refined wheat	13	4	17	0.323
	Whole wheat	45	19	64	
	Unrefined	13	6	19	
Bread consumption(number / day)	One	12	10	22	8.695**
	Two	26	4	30	
	Three	17	11	28	
	Four and more	16	4	20	
Type of meat	Fat-free	35	14	49	4.460
	Medium fat	28	15	43	
	High fat	8	0	8	
Milk Type	Skimmed Milk	25	10	35	0.512
	Semi-Fat	41	18	59	
	Whole Milk	5	1	6	
Favorite cooking way	Boiling	17	9	26	8.99
	Roasting	9	6	15	
	Reddish	4	4	8	
	Frying	10	1	11	
	Sticking	7	5	12	
	Baking	24	4	28	
Favorite type of protein	Legumes	8	4	12	6.352
	Red meat	7	7	14	
	White meat	25	12	37	
	Fish	23	4	27	
	Eggs	8	2	10	
Favorite cheese type	White	26	12	38	2.473
	Quraish	41	13	54	
	Cheddar and Turkey	4	4	8	
Favorite food between meals	Fruit	31	19	50	7.235
	Vegetables	9	5	14	
	Sweets	18	4	22	
	Biscuit	5	1	6	
	Bakery	4	0	4	
	Snacks	4	0	4	

** Significant at 0.01

Table 6. Nutritional practices levels of MetStype 2 diabetic patients

Nutritional Practices	MetS (71%)	Mean ±S.D	Non-MetS (29%)	Mean ±S.D	Total (n=100) (%)	chi-test
Poor	12		4		16	
Moderate	45		19	41± 5	50	
Good	14	41± 5	6		34	0.149
Total	71		29		100	

Minimum degree (15)

Maximum degree (29)

CONCLUSION

This study indicated that approximately 71% of the type 2 diabetes patients had MetS. The 50-60 age group was the most prevalent of MetS and females were about 9 times higher (90.1%) than males, and the most prevalent components were central obesity (65%), followed by high TG (47%) and low HDL (39%). Educational levels, working status, profession, and household income per month have a significant impact on the level of nutritional practices for type 2 diabetes patients with MetS.

The study showed that 12% of metabolic syndrome patients had a poor level of nutritional practices, and 14% had good, 45% had moderate.

RECOMMENDATION

Our findings indicated that metabolic syndrome had become a common public health problem, and therefore, we need to develop strategies ,which aim to prevent and treat the metabolic syndrome, such as changing lifestyle, nutritional habits, increase physical activity and weight control.

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الملخص العربي

انتشار المتلازمة الأيضية: العوامل المرتبطة، الممارسات الغذائية بين مرضى السكري النوع الثاني

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الثلاثية بنسبة 47% ويليها بنسبة 39% انخفاض البروتينات الدهنية عالية الكثافة.

وأشارت الدراسة أن المصابين بالمتلازمة يفضلون من طرق الطهى الخبز بالفرن بنسبة 24% ويليها السلق بنسبة 17% بينما الغير مصابين بالمتلازمة يفضلون السلق بنسبة 9%، وكانت اجمالى العينة بنسبة 28% يفضلون الخبز فى الفرن.

كما تبين أن مرضى المتلازمة يفضلون بين الوجبات تناول الفاكهه بنسبة 31% ويليها الحلويات بنسبة 18%، فى حين كان غير المصابين بالمتلازمة يتناولوا الفاكهه بنسبة 19% يليها الخضروات بنسبة 5% بين الوجبات.

أظهرت الدراسة أن 12% من المرضى المصابين بالمتلازمة لديهم مستوى ضعيف من الممارسات تغذوية و 14% لديهم ممارسات تغذوية جيدة و 45% لديهم ممارسات تغذوية متوسطة.

تشير النتائج التي توصلت إليها الدراسة أن المتلازمة الأيضية أصبحت مشكلة صحية عامة وخطيرة، وبالتالي هناك حاجة ملحة لتطوير استراتيجيات تهدف إلى الوقاية من الإصابة بالمتلازمة الأيضية وكذلك معالجتها.

تهدف هذه الدراسة إلى تحديد مدى إنتشار المتلازمة الأيضية والعوامل المرتبطة بها بين مرضى السكري النوع الثانى والتعرف على أهم الممارسات الغذائية لهم.

شملت هذه الدراسة 100 مريض سكرى من النوع الثانى من المراكز التى تعالج المرضى بمستشفيات محافظة الاسكندرية وذلك خلال الفترة من يونيو 2018 حتى فبراير 2019 وقد تم جمع البيانات والحصول على المعلومات عن طريق الإستبيان بالمقابلة الشخصية وتضمنت بنود الاستبيان التاريخ المرضى وأهم العادات والممارسات الغذائية ونمط الحياه الخاص بهم، وتم تقدير بعض المقاييس الجسميه أهمها محيط البطن كمقياس للسمنة المركزية، وقد تم أخذ عينات دم لعمل بعض المقاييس الكيمائية الحيويه مثل (سكر الدم صائم، الكوليسترول الكلى، الجليسيريدات الثلاثية، والبروتينات الدهنية عالية الكثافة) وقياس ضغط الدم.

وأوضحت النتائج أن 71% من مرضى السكري من النوع الثانى مصابين بالمتلازمة الأيضية و 29% غير مصابين بالمتلازمة الأيضية، وكانت أكثر العوامل خطورة هى (محيط البطن) السمنة المركزية بنسبة 65% يليها الجليسيريدات