Original research article

Prevalence and clinical profile of metabolic syndrome in type 2 diabetes mellitus patients

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 Abstract
Aim: This study was aimed to assess the prevalence and clinical profile of MetS among type-II DM patients attending a tertiary care centre.
Methodology: A hospital based cross sectional study was conducted at Department of Medicine of a tertiary care centre. The aim of the study was to find the prevalence and association of metabolic syndrome and its components in Type 2 Diabetes Mellitus cases. Study included 200 known or newly diagnosed type 2 diabetic patients coming at our hospital. Following observations were made during the study:
Results: Most of the diabetics patients belong to age group of 51 to 70 years (64.5%) with mean age of cases as 55.9 years. Out of total 200 diabetic patients, 54% were males and 46% were females. Newly diagnosed diabetics were 7.5% while 92.5% were known cases of diabetes Mean duration of diabetes among cases was 8.13 years with one third (32%) cases having known diabetics for over 10 years. Prevalence of metabolic syndrome among diabetics was observed as 58%. Prevalence of metabolic syndrome was 62% among males and 53.3% among females. The difference was statistically non-significant (p-0.41). Mean age of diabetic cases with MS was significantly higher as compared to cases without MS (58.78 vs 51.96 years; p<0.01). Mean duration of diabetic in cases with MS was significantly higher as compared to cases without MS (10.34 vs 5.01 years; p<0.01). Prevalence of metabolic syndrome was 60.5% among old cases while it was 26.7% among newly diagnosed diabetics (p<0.01). Prevalence of MS in newly diagnosed cases was 26.7%, which increases with increase in duration of diabetes as follow: 35.0% in duration of 1 to 5 years, 60.5% in duration of 6-10 years and 90.6% in duration > 10 years (p<0.01). Among parameters of metabolic syndrome, raise blood pressure was seen in 52% cases, high waist circumference was seen in 13% while low HDL and high TGs was seen in 28.5% and 51% cases respectively. A significant association between derangement of MS parameters was observed with duration of diabetes (p<0.01).
Conclusion: Our study demonstrates that metabolic syndrome is extremely common among diabetic patients. Metabolic syndrome affects every three out of five known diabetics and found in every one out of three newly diagnosed cases. Increasing prevalence was observed to be associated with increasing duration of diabetes.
Keywords: Metabolic syndrome, diabetes, HDL, TG, prevalence

Introduction
Type 2 diabetes mellitus (T2DM) is a non-autoimmune, complex, heterogeneous, and polygenic metabolic disease condition in which the body fails to produce enough insulin and hence characterized by abnormal glucose homeostasis [1]. Metabolic derangement syndrome is one of the causes of DM, and it is frequently associated with permanent and irreversible functional and structural changes in the cells of the body, particularly vascular system changes which lead in turn to the development of well-defined clinical entities, which are called the complications of DM that affect the eye, kidney, and the microvascular and nervous systems.
Diabetes mellitus has become a major health problem in India. It has been estimated that by the year 2030, 87 million of the Indian population would be suffering from this disease. Long-standing type II DM has considerable impact on various organs of the body. It increases morbidity and mortality by decreasing the quality of life [2]. Currently, India leads the world with the largest number of diabetic subjects and this is expected to further rise in the coming years [3].
Metabolic syndrome (MetS) is a group of clinical and biological abnormalities that confers a greater risk of developing type II diabetes, cardiovascular diseases (CVD) and other related health problems [4]. Type II DM, is the one component of MetS which can lead to the development of cardiovascular disease, and MetS is a cluster of metabolic disorders of numerous etiologies [5]. These include abdominal obesity,

raised blood pressure, hyperglycemia and lipid profile derangement [5, 6]. In addition various metabolic disorders were included with MetS later, such as micro-albuminuria, hyperuricemia (gout) and defects in fibrinolysis and blood coagulation [7]. Around 70-80% of the population with DM were diagnosed with the MetS [8, 9]. Worldwide, 20-25% of the adults have been expected to have the MetS. Individuals with MetS are twofold as expected to die and three times as likely to have a heart attack or stroke when compared to people without MetS [10]. This indicates the co- existence effect of type II DM and MetS on cardiovascular risks [11]. Strictly diagnosing of MetS and its components in DM patients is a vital in order to promote patients health care and to minimize CVD related morbidity and mortality.

Data are available regarding the prevalence and rising trends of type II DM in India [12, 13]. However, studies on the prevalence of the MetS among type-II DM patients are still inadequate in developing countries like India. Hence, this study was aimed to assess the prevalence and clinical profile of MetS among type-II DM patients attending a tertiary care centre.

Aims and Objectives
1. To find out prevalence of Metabolic Syndrome in Type 2 Diabetes Mellitus.
2. To find out the clinical profile of cases with Metabolic Syndrome in Type 2 Diabetes Mellitus.
3. To find the association of Type 2 Diabetes Mellitus with components of Metabolic syndrome.

Study area
Department of Medicine of a tertiary care centre.

Study population
Known or newly diagnosed type 2 diabetic patients coming at our hospital.

Study design
A Hospital Based Cross sectional Study.

Study duration
December 2019 to September 2021.

Inclusion criteria
1. Patients of type 2 Diabetes Mellitus attending out-patient/in-patient department.
2. Patient between age ranges of 18-80 years.
3. Willingness to give informed written consent.

Exclusion criteria
1. Patient with type 1 diabetics.
2. Pregnant women.
3. Non willing patients.

Methodology
A total of 200 patients who fulfilled the inclusion and exclusion criteria and gave written informed consent were considered for study. The ethics clearance was obtained from the appropriate authority appointed by the institution (ethics committee). Patients were interviewed as per proforma with appropriate history, examination and necessary investigations.

All patients were studied with the following parameters:
1. Physical examinations.
2. Anthropometry-weight, height, BMI and waist circumference at level of umbilicus.
3. Blood parameters-lipids, renal and liver function tests, serum uric acid level, CBC and blood sugar levels.
4. Imaging like x-ray chest and ultrasonography of abdomen whenever required.

Method of collecting data
A detailed history was obtained from all the patients. Physical examination was done and blood pressure measurements were recorded. Blood pressure was recorded in the sitting position in the right arm with a mercury sphygmomanometer. Three readings were taken 5 minutes apart and the mean of the two was recorded as the blood pressure.

Anthropometric measurements including height, weight, BMI, abdominal girth at umbilicus level, hip circumference and thigh circumference was measured by height scale, weighing machine and inch tape. All female patients were examined in presence of a female attendant.

Blood pressure was measured with a mercury sphygmomanometer and the mean of three seated resting values were recorded. Body mass index (BMI) was calculated as weight in kilograms divided by the square of height in meter.

Glucose tolerance test (GTT) was done in newly diagnosed cases. After a 12-hour overnight fast, the subjects ingested a solution that contained 75 g dextrose and venous blood samples were obtained at 0, 60 and 120 minutes for determination of plasma glucose. Stages of plasma glucose were classified as per American Diabetic Association (ADA) [1]. Blood glucose was measured using glucose oxidase/ peroxidase method.

Low-density lipoprotein (LDL) and HDL fractions were separated from fresh serum by ultracentrifugation, CHOD-PAP method. Lipoprotein fraction cholesterol and triglycerides were measured by standard enzymatic spectrophotometric technique.

Metabolic Syndrome was diagnosed as per NCEP/ATP III report [13], participant who had ≥3 of the following criteria were defined as having the metabolic syndrome:

- **Central obesity:** Abdominal waist circumference: Men >102 cm, women >88 cm (waist circumference were measured at the level of umbilicus).
- Fasting plasma glucose >110 mg/dl or diagnosed T2DM.
- Fasting plasma triglyceride >150 mg/dl or medication.
- Fasting plasma HDL cholesterol: Men<40 mg%, women <50 mg%.

Statistical analysis

All the data was noted down in a pre-designed study proforma. Qualitative data was represented in the form of frequency and percentage. Association between qualitative variables was assessed by Chi-Square test with Continuity Correction for all 2 X 2 tables and Fisher's exact test for all 2 X 2 tables. Quantitative data was represented using Mean ± SD. Analysis of Quantitative data between the two groups was done using unpaired t-test if data passed 'Normality test' and by Mann-Whitney Test if data failed 'Normality test'. A p-value < 0.05 was taken as level of significance. Results were graphically represented where deemed necessary. SPSS Version 21.0 was used for most analysis and Microsoft Excel 2010 for graphical representation.

Results

Table 1: Distribution of study group as per age

Age Group (years)	N	%
18-50	57	28.5%
51-70	129	64.5%
> 70	14	7.0%
Total	200	100.0%
Mean age-55.9 +/- 8.6 years		

Most of the diabetics patients belong to age group of 51 to 70 years (64.5%) with mean age of cases as 55.9 years.

Table 2: Distribution of study groups as per gender

Gender	N	%
Female	92	46.0%
Male	108	54.0%
Total	200	100.0%

Out of total 200 diabetic patients, 54% were males and 46% were females.

Table 3: Distribution of study groups as per type of case

Cases of DM	N	%
Old	185	92.5%
New	15	7.5%
Total	200	100.0%

Newly diagnosed diabetics were 7.5% while 92.5% were known cases of diabetes.

Table 4: Distribution of study groups as per duration of diabetes

Duration of DM	N	%
New Cases	15	7.5%
1-5 yrs	78	39.0%
5-10 yrs	43	21.5%
> 10 yrs	64	32.0%
Total	200	100.0%

Mean duration of diabetes among cases was 8.13 years with one third (32%) cases having known diabetics for over 10 years.

Table 5: Distribution of study groups as per presence of metabolic syndrome

Metabolic Syndrome (MS)	N	%
No	84	42.0%
Yes	116	58.0%
Total	200	100.0%

Prevalence of metabolic syndrome among diabetics was observed as 58%.

Table 6: Association of metabolic syndrome with gender

Gender	MS		Total
	No	Yes	
Female	43	49	92
	46.7%	53.3%	100.0%
Male	41	67	108
	38.0%	62.0%	100.0%
Total	84	116	200
	42.0%	58.0%	100.0%
p- value-0.41			

Prevalence of metabolic syndrome was 62% among males and 53.3% among females. The difference was statistically non-significant (p-0.41).

Table 7: Association of metabolic syndrome with age

Variables	MS	N	Mean	SD	p-value
Age (yrs)	No	84	51.96	7.95	<0.01
	Yes	116	58.78	7.90	

Mean age of diabetic cases with MS was significantly higher as compared to cases without MS (58.78 vs 51.96 years; p<0.01).

Table 8: Mean duration of diabetes in cases with and without metabolic syndrome

Variables	MS	N	Mean	SD	p-value
Duration of DM	No	84	5.01	3.71	<0.01
	Yes	116	10.34	5.35	

Mean duration of diabetic in cases with MS was significantly higher as compared to cases without MS (10.34 vs 5.01 years; p<0.01).

Table 9: Association of metabolic syndrome with duration of diabetes

DM Duration	MS		Total
	No	Yes	
New case	11	4	15
	73.3%	26.7%	100.0%
1-5 yrs	50	28	78
	64.1%	35.9%	100.0%
6-10 yrs	17	26	43
	39.5%	60.5%	100.0%
> 10 yrs	6	58	64
	9.4%	90.6%	100.0%
Total	84	116	200
	42.0%	58.0%	100.0%
p-value <0.01			

Prevalence of MS in newly diagnosed cases was 26.7%, which increases with increase in duration of diabetes as follow: 35.0% in duration of 1 to 5 years, 60.5% in duration of 6-10 years and 90.6% in duration > 10 years (p<0.01).

Table 10: Distribution of diabetic cases as per derangement of metabolic syndrome parameters

Parameters MS	N	%
Raised BP	104	52.0%
High WC	26	13.0%
Low HDL	57	28.5%
Raised TG	102	51.0%

Among parameters of metabolic syndrome, raise blood pressure was seen in 52% cases, high waist circumference was seen in 13% while low HDL and high TGs was seen in 28.5% and 51% cases respectively.

Table 11: Association of diabetes duration with metabolic syndrome parameters

Variables		N	Mean DM Duration	SD	p-value
Raised BP	No	96	5.60	4.66	<0.01
	Yes	104	9.48	5.87	
Raised WC	No	174	6.67	5.21	<0.01
	Yes	26	14.00	4.27	
Raised TG	No	98	5.10	4.30	<0.01
	Yes	102	10.04	5.77	
Low HDL	No	143	6.36	5.08	<0.01
	Yes	57	10.79	5.84	

A significant association between derangement of MS parameters was observed with duration of diabetes (*p*<0.01).

Discussion

Present study aimed tofind the prevalence of metabolic syndrome in Type 2 Diabetes Mellitus (T2DM) cases. We also aimed to find the association of metabolic syndrome components with Type 2 Diabetes Mellitus. Study included 200 known or newly diagnosed type 2 diabetic patients coming at our hospital.

Prevalence of Metabolic Syndrome (MetS)

MetS and T2DM concurrently potentiates significantly higher prevalence of cardiovascular diseases. Numerous risk factors are associated with diabetes which is further intensified by the presence of metabolic syndrome. Diabetes and MetS together can increase the risk of cardiovascular disease by 2 to 4 folds [14].

Only limited research article on prevalence of MetS in T2DM were available conducted among [12, 13, 14]. In present study, Prevalence of metabolic syndrome among diabetics was observed as 58%. In a similar Indian study by Patel JL *et al*. [12], prevalence of metabolic syndrome in T2DM patients was found to be 85% according to NCEP-ATP III. In another Indian study by Yadav D *et al*. [13], prevalence of metabolic syndrome in T2DM was 45.8%. Uprety T *et al*. [14] in their study observed the prevalence as 68.5%. Prevalence of MetS among diabetics in the studies across the world is shown below.

Mean duration of diabetes in cases with MS was significantly higher as compared to cases without MS (10.34 vs 5.01 years; p<0.01). Prevalence of MS in newly diagnosed cases was 26.7%, which increases with increase in duration of diabetes as follow: 35.0% in duration of 1 to 5 years, 60.5% in duration of 6-10 years and 90.6% in duration > 10 years (p<0.01).

Tadewos A *et al*. [19] in their study also observed that duration since the diagnosis of diabetes was also significantly associated with Met S. Kengne AP *et al*. [15] observed median duration of diagnosed diabetes (25th-75th percentiles) as 3 years (0.5-5.0) with significant association with prevalence of MetS. Yadav P *et al*. [12] in their study also observed that prevalence of metabolic syndrome increases with increasing duration of diabetes due to increasing metabolic derangements among diabetics.

Demographic distribution

Most of the diabetics patients belong to age group of 51 to 70 years (64.5%) with mean age of cases as 55.9 years. Out of total 200 diabetic patients, 54% were males and 46% were females. Mean age of diabetic cases with MS was significantly higher as compared to cases without MS (58.78 vs 51.96 years; p<0.01). Prevalence of metabolic syndrome was 62% among males and 53.3% among females. The difference was statistically non-significant (p-0.41).

In the study by Nsiah K *et al*. [17], female type 2 diabetics had a higher prevalence of MetS, and carried more components than their male counterparts. As significant association was also observed with

increasing age. Li X *et al*. [18] in their study observed that increasing age is an independent determinants of MetS. Kengne AP *et al*. [15] observed comparable prevalence of MetS among men and women. Yadav P *et al*. [12] in their study observed prevalence of metabolic syndrome as highest in age group of 50-59 years and a significant association with increasing age. The prevalence among males and females was 52.7% in males and 70.4% in females. Uprety T *et al*. [14] observed the prevalence of MetS as 68.5% among which male were 123 (76.3%) and female were 119 (61.9%). Mean age of cases with MetS was 56.5 years as compared to 51.7 years in cases without MetS (p<0.01).

Diabetes and Metabolic Syndrome components

Among parameters of metabolic syndrome, raise blood pressure was seen in 52% cases, high waist circumference was seen in 13% while low HDL and high TGs was seen in 28.5% and 51% cases respectively. A significant association between derangement of MS parameters was observed with duration of diabetes (p<0.01).

In the study by Nsiah K *et al*. [17], hypertension was the commonest risk factor (60%), followed by central obesity (48.67%) and dyslipidemia (37%). Patel JL *et al*. [12] observed that among T2DM subjects: 90% were hypertensive, 85% had low HDL, 30% males and 80% females had central obesity. Tadewos A *et al*. [19] observed that elevated TGs was 68.1% and it was found to be the most frequently encountered MetS component followed by Low HDL-c (47%) other than hyperglycemia. Osei-Yeboah J *et al*. [20] in their study observed that most predominant MS component among the diabetic population was high blood pressure using the NCEP-ATP III (108 (66.67%)) and WHO (102 (62.96)) criteria and abdominal obesity (112 (69.14%)) for IDF criteria. High blood pressure was the most prevalent component among the males while abdominal obesity was the principal component among the females. Yadav D *et al*. [13] in their study observed that prevalence of high blood pressure in metabolic syndrome subjects is 69% in which 75.5% of males and 57% of female's subjects. The overall percentage of high triglyceride and low high density lipoprotein in metabolic syndrome subjects was 44% and 59% respectively. In male it was 44% and 56% but in female it was 45% and 66% respectively. Raised waist circumference was seen in 87% cases with 83% in males and 94% in females. Uprety T *et al*. [14] in their study observed prevalence of raise blood pressure as 73% cases, high waist circumference was seen in 38% while low HDL and high TGs was seen in 76% and 71.4% cases respectively.

Thus to summarize, our study demonstrates that metabolic syndrome is extremely common among diabetic patients. Metabolic syndrome affects every three out of five known diabetics and found in every one out of three newly diagnosed cases. Increasing prevalence was observed to be associated with increasing duration of diabetes. Associated metabolic derangements were mostly observed as raised blood pressure and dyslipidemia, both of them were significantly associated with increase in duration of diabetes.

Conclusion

In conclusion, our study demonstrates that metabolic syndrome is extremely common among diabetic patients. Metabolic syndrome affects every three out of five known diabetics and found in every one out of three newly diagnosed cases. Associated derangement among metabolic syndrome parameters was mostly observed as raised blood pressure and dyslipidemia, both of them were significantly associated with increase in duration of diabetes.

Therefore it is important for the clinicians treating people with diabetes to be vigilant regarding all these metabolic derangements and to identify persons for interventions to reduce overall burden of cardiovascular disease and prognosis of diabetes.

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