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Original Article

Prevalence and Clinical Correlates of Metabolic Syndrome in Newly Diagnosed Type 2 Diabetes Mellitus Patients

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ABSTRACT

Background: Metabolic syndrome is a cluster of metabolic abnormalities including central obesity, hypertension, dyslipidemia, and impaired glucose metabolism that significantly increases the risk of cardiovascular disease and type 2 diabetes mellitus. The coexistence of metabolic syndrome in diabetic patients further increases the risk of cardiovascular complications and mortality. Early identification of metabolic syndrome among newly diagnosed diabetic patients is therefore important for timely intervention and prevention of long-term complications. Aim of the study was to determine the prevalence of metabolic syndrome among newly diagnosed type 2 diabetes mellitus patients and to evaluate its association with anthropometric, clinical, and biochemical parameters.

Material and Methods: This cross-sectional observational study was conducted among 100 patients with newly diagnosed type 2 diabetes mellitus attending the Department of General Medicine at NRI Medical College. Anthropometric measurements including body mass index, waist circumference, and waist–hip ratio were recorded. Clinical parameters such as systolic and diastolic blood pressure were measured. Biochemical investigations including fasting blood glucose, postprandial blood glucose, HbA1c, and lipid profile were analyzed. The presence of metabolic syndrome was assessed using standard diagnostic criteria. Statistical analysis was performed using the chi-square test and Student's t-test.

Results: Metabolic syndrome was present in 41% of patients with newly diagnosed type 2 diabetes mellitus. Patients with metabolic syndrome had significantly higher body mass index, waist circumference, waist–hip ratio, systolic and diastolic blood pressure, fasting blood glucose, postprandial blood glucose, HbA1c levels, and triglyceride levels. HDL cholesterol levels were significantly lower among patients with metabolic syndrome. However, LDL cholesterol, VLDL cholesterol, and total cholesterol levels did not show statistically significant differences between the groups.

Conclusion: Metabolic syndrome is highly prevalent among newly diagnosed type 2 diabetes mellitus patients. Early screening and management of metabolic syndrome components are essential to reduce cardiovascular risk and improve long-term outcomes.

Keywords: *Metabolic syndrome; Type 2 diabetes mellitus; Central obesity; Dyslipidemia; Insulin resistance; Cardiovascular risk.*

INTRODUCTION

Metabolic syndrome is a cluster of metabolic abnormalities that significantly increase the risk of cardiovascular disease and type 2 diabetes mellitus (T2DM). It is characterized by central obesity, insulin resistance, dyslipidemia, hypertension, and impaired glucose metabolism. According to the National Cholesterol Education Program Adult Treatment Panel III (NCEP ATP III), metabolic syndrome is diagnosed when at least three of the following are present: increased waist

circumference, elevated blood pressure, high triglyceride levels, reduced high-density lipoprotein (HDL) cholesterol, and elevated fasting blood glucose [1]. These abnormalities share a common pathophysiological basis primarily related to insulin resistance and visceral adiposity.

Type 2 diabetes mellitus is one of the most common chronic metabolic disorders worldwide and represents a major public health problem. The increasing prevalence of T2DM is attributed to rapid urbanization, sedentary lifestyle, obesity, and dietary changes. Individuals with type 2 diabetes frequently exhibit other metabolic abnormalities such as hypertension, dyslipidemia, and central obesity, which together constitute metabolic syndrome [2]. The coexistence of metabolic syndrome with diabetes substantially increases the risk of cardiovascular complications including coronary artery disease, stroke, and peripheral vascular disease.

Insulin resistance plays a central role in the development of both metabolic syndrome and type 2 diabetes mellitus. In insulin-resistant states, peripheral tissues fail to respond adequately to insulin, resulting in impaired glucose uptake and increased hepatic glucose production. This metabolic dysfunction is often associated with increased visceral fat accumulation and chronic low-grade inflammation, which contribute to endothelial dysfunction and cardiovascular complications [3]. Because of these shared mechanisms, metabolic syndrome and type 2 diabetes are closely interrelated conditions.

Several diagnostic criteria have been proposed for metabolic syndrome by organizations such as the World Health Organization (WHO), the NCEP ATP III, and the International Diabetes Federation (IDF). Although the criteria differ slightly, they all emphasize the clustering of metabolic risk factors that increase the risk of cardiovascular disease and diabetes. Studies have reported that the prevalence of metabolic syndrome among patients with type 2 diabetes is particularly high because many of the diagnostic components overlap with those of diabetes itself [4].

Many studies have evaluated the prevalence of metabolic syndrome among patients with type 2 diabetes mellitus. Nsiah et al. reported that approximately 58% of individuals with T2DM had metabolic syndrome, with hypertension and central obesity being the most common components [5]. Similarly, Osuji et al. found that metabolic syndrome was highly prevalent among newly diagnosed diabetic patients, with hypertension being the most frequently observed component [6]. Tamrakar et al. reported prevalence rates exceeding 60% depending on the diagnostic criteria used [7].

In Asian populations, especially among Asian Indians, the prevalence of metabolic syndrome is particularly high due to genetic susceptibility, central obesity, and lifestyle factors. Studies have demonstrated that Asian Indians develop insulin resistance and metabolic complications at lower body mass index levels compared to Western populations [8]. Recent hospital-based studies have also shown that more than half of newly diagnosed diabetic patients already exhibit features of metabolic syndrome at the time of diagnosis [9].

Despite numerous global studies, there remains a lack of region-specific data regarding the prevalence and clinical profile of metabolic syndrome among newly diagnosed type 2 diabetes patients. Many earlier studies have focused on patients with long-standing diabetes rather than those newly diagnosed. Early identification of metabolic syndrome at the time of diagnosis is important because timely lifestyle modification and treatment of associated risk factors can significantly reduce cardiovascular morbidity and mortality. Therefore, the aim of the present study is to study the presence (prevalence) of metabolic syndrome in newly diagnosed patients with type 2 diabetes mellitus. The objectives of the present study are to determine the triglyceride levels, HDL cholesterol levels, blood pressure, and waist circumference among newly diagnosed type 2 diabetes mellitus patients. The study also aims to determine the correlation between metabolic syndrome and new onset type 2 diabetes mellitus.

MATERIALS AND METHODS

Study Design and Setting

This observational cross-sectional comparative study was conducted in the Department of General Medicine, NRI Medical College, Chinakakani, Andhra Pradesh, India, over a period of one year (January 2023 to January 2024). The study evaluated the presence of metabolic syndrome among patients with newly diagnosed type 2 diabetes mellitus (T2DM).

Study Population and Sample Size

The sample size was calculated using the formula $N = Z^2PQ/E^2$, based on a reported prevalence of metabolic syndrome of 53% among diabetic patients from a previous study. With a margin of error of 6% and confidence interval of 80%, the calculated sample size was 114. After excluding patients who did not meet the eligibility criteria or had incomplete data, 100 patients were included in the final analysis. Participants were selected using convenience sampling.

Inclusion Criteria

- Patients aged 31–60 years
- Patients with newly diagnosed type 2 diabetes mellitus

Exclusion Criteria

- Pregnant and lactating women
- Patients with severe renal, hepatic, cardiac, or pulmonary disorders
- Patients already receiving treatment for T2DM
- Women using hormonal therapy or anti-obesity medications
- Patients who did not provide informed consent

Study Tool

Data were collected using a structured clinical proforma that included demographic information, clinical examination findings, anthropometric measurements, and biochemical investigations.

Data Collection

- The following parameters were recorded:
- Demographic variables: Age, gender
- Anthropometric measurements: Body mass index (BMI), waist circumference, waist-hip ratio
- Clinical parameters: Systolic blood pressure (SBP), diastolic blood pressure (DBP)
- Biochemical parameters: Fasting blood glucose (FBG), total cholesterol (TC), triglycerides (TG), high-density lipoprotein (HDL), and low-density lipoprotein (LDL)

After overnight fasting of 12–14 hours, approximately 10 ml of venous blood was collected under aseptic conditions. Serum was separated by centrifugation and analyzed for biochemical parameters. Total cholesterol and HDL cholesterol were measured using the enzymatic CHOD-PAP method, triglycerides by the enzymatic glycerol phosphate oxidase method, and LDL cholesterol was calculated using the Friedewald formula.

Definitions

Body mass index was calculated as weight (kg)/height (m^2) and classified according to WHO criteria. Diabetes mellitus was defined as fasting blood glucose ≥126 mg/dl or post-prandial glucose ≥200 mg/dl. Hyperlipidemia was defined as total cholesterol >200 mg/dl, LDL >150 mg/dl, triglycerides >150 mg/dl, or HDL <39 mg/dl. Blood pressure was measured using a sphygmomanometer after 5 minutes of rest, and the average of three readings was recorded. Hypertension was defined as BP ≥140/90 mmHg.

Statistical Analysis

Data were analyzed using appropriate statistical methods. Frequencies and percentages were calculated for categorical variables. Unpaired Student's t-test was used to compare continuous variables between groups, while Chi-square test was used for categorical variables. A p-value <0.05 was considered statistically significant.

Ethical Considerations

Ethical approval was obtained from the Institutional Ethics Committee of NRI Medical College, Chinakakani, and written informed consent was obtained from all participants prior to enrollment.

RESULTS

Table 1: Demographic Characteristics of Patients With and Without Metabolic Syndrome

Variable	MetS – No (n=59)	MetS – Yes (n=41)	Total (n=100)	Statistical test	p-value
Age (years)	46.63 ± 8.34	44.29 ± 8.22	—	t = 1.38	0.169
Gender				$\chi^2 = 5.71$	0.0168
Female	33	13	46		
Male	26	28	54		

The mean age of patients without metabolic syndrome was 46.63 ± 8.34 years, whereas patients with metabolic syndrome had a mean age of 44.29 ± 8.22 years. The difference in age between the two groups was not statistically significant (p = 0.169).

Regarding gender distribution, 54% of the study participants were males and 46% were females. Metabolic syndrome was more commonly observed among males (28/54) compared to females (13/46). This association between gender and metabolic syndrome was statistically significant ($\chi^2 = 5.71$, p = 0.0168).

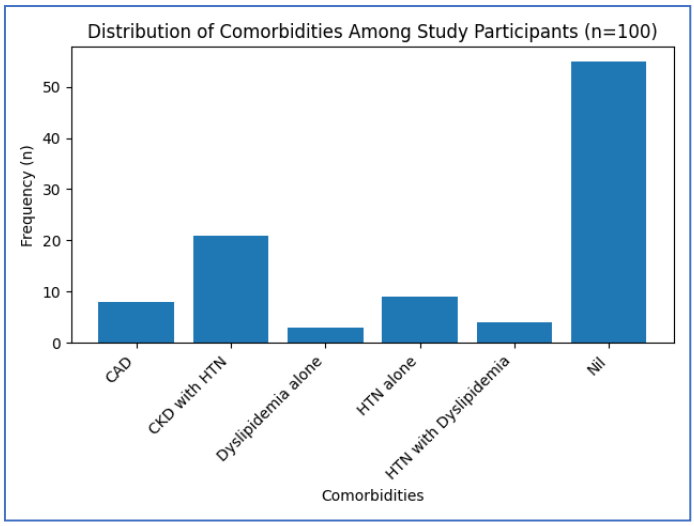

Figure 1: Distribution of Comorbidities Among Study Participants (n = 100)

Figure 1 show, among the study participants, 55% had no associated comorbid conditions. The most common comorbidity observed was chronic kidney disease with hypertension (21%), followed by hypertension alone (9%) and coronary artery disease (8%). Dyslipidemia alone was present in 3% of patients, while 4% had both hypertension and dyslipidemia.

Table 2: Clinical Features Among Patients With and Without Metabolic Syndrom

Clinical Features	MetS – No (n=59)	MetS – Yes (n=41)	Total (n=100)
Asymptomatic	8	7	15
Fatigue	10	5	15
Giddiness	1	3	4
Leg ulcer	5	5	10
Numbness	10	11	21
Polyuria	18	9	27
Weight loss	7	1	8
Total	59	41	100
Chi-square test	P value - 0.296		

Among the clinical features observed in the study population, polyuria (27%) was the most common presenting complaint, followed by numbness (21%), fatigue (15%), and asymptomatic presentation (15%). Leg ulcers were observed in 10% of patients, while weight loss was reported in 8% of cases. The distribution of clinical features between patients with and without metabolic syndrome did not show a statistically significant difference ($\chi^2 = 7.28$, $p = 0.296$).

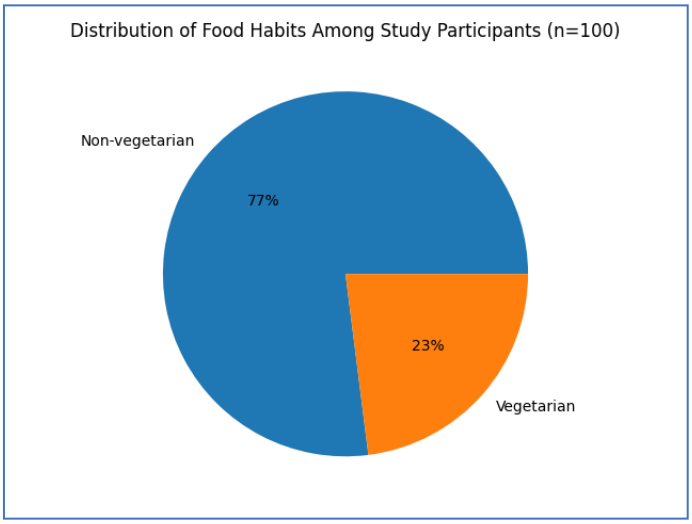

Figure 2: Distribution of Food Habits Among Patients With and Without Metabolic Syndrome

Among the study participants, 77% were non-vegetarians and 23% were vegetarians. Metabolic syndrome was observed in 30 non-vegetarian and 11 vegetarian patients. However, the association between dietary pattern and metabolic syndrome was not statistically significant ($\chi^2 = 0.575$, $p = 0.448$).

Table 3: Comparison of Glycemic Parameters Between Patients With and Without Metabolic Syndrome

Parameter	MetS – No (n=59) Mean ± SD	MetS – Yes (n=41) Mean ± SD	t value	p value
Fasting Blood Sugar (mg/dl)	164.83 ± 25.11	178.20 ± 21.27	-2.78	0.0065
Postprandial Blood Sugar (mg/dl)	227.73 ± 43.52	246.95 ± 44.16	-2.16	0.0333
HbA1c (%)	7.63 ± 0.84	8.21 ± 1.06	-3.05	0.0030

Patients with metabolic syndrome demonstrated significantly higher glycemic parameters compared to those without metabolic syndrome. The mean fasting blood sugar (FBS) was significantly higher in patients with metabolic syndrome (178.20 ± 21.27 mg/dl) compared to those without metabolic syndrome (164.83 ± 25.11 mg/dl, $p = 0.0065$). Similarly, the mean postprandial blood sugar (PPBS) was higher among patients with metabolic syndrome (246.95 ± 44.16 mg/dl) than those without metabolic syndrome (227.73 ± 43.52 mg/dl, $p = 0.0333$). The mean HbA1c level was also significantly elevated in patients with metabolic syndrome (8.21 ± 1.06%) compared to those without metabolic syndrome (7.63 ± 0.84%, $p = 0.003$).

Table 4: Comparison of Anthropometric Parameters Between Patients With and Without Metabolic Syndrome

Parameter	MetS – No (n=59) Mean ± SD	MetS – Yes (n=41) Mean ± SD	t value	p value
Body Mass Index (kg/m²)	24.12 ± 2.16	26.68 ± 2.53	-11.80	<0.001
Waist Circumference (cm)	94.54 ± 7.94	99.59 ± 4.98	-3.60	0.0005
Waist–Hip Ratio (WHR)	0.854 ± 0.037	0.976 ± 0.052	-13.74	<0.001

Anthropometric parameters were significantly higher among patients with metabolic syndrome. The mean body mass index (BMI) was significantly greater in patients with metabolic syndrome (26.68 ± 2.53 kg/m²) compared to those without metabolic syndrome (24.12 ± 2.16 kg/m², $p < 0.001$). Similarly, the mean waist circumference was significantly higher in patients with metabolic syndrome (99.59 ± 4.98 cm) compared to those without metabolic syndrome (94.54 ± 7.94 cm, $p = 0.0005$). The waist–hip ratio (WHR) was also markedly elevated among patients with metabolic syndrome (0.976 ± 0.052) compared to those without metabolic syndrome (0.854 ± 0.037, $p < 0.001$). These findings indicate a strong association between generalized and central obesity with metabolic syndrome.

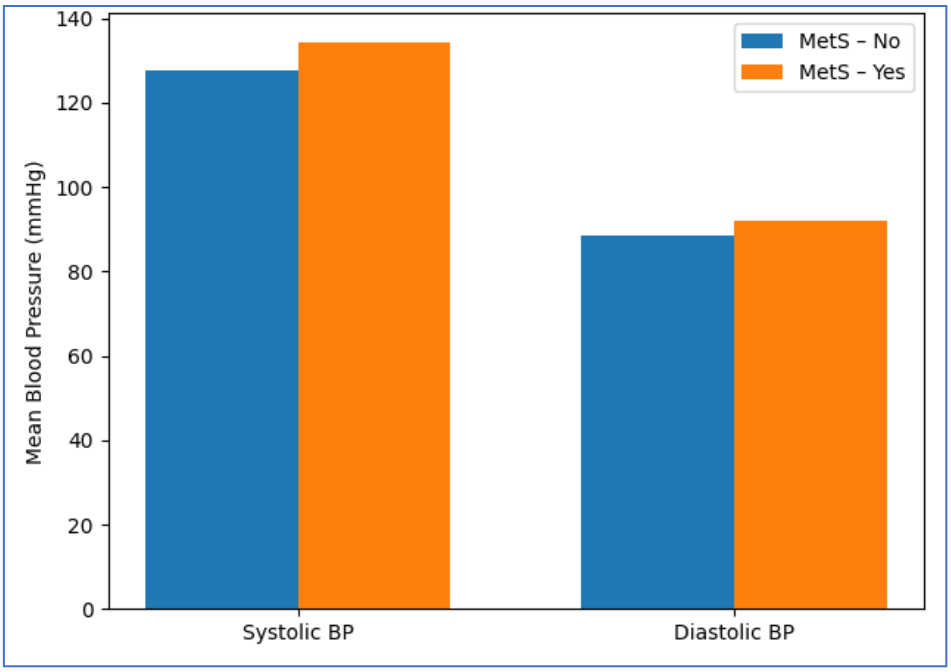

Figure 3: Comparison of Blood Pressure Parameters Between Patients With and Without Metabolic Syndrome

Blood pressure parameters were significantly higher among patients with metabolic syndrome. The mean systolic blood pressure (SBP) was significantly greater in patients with metabolic syndrome (134.39 ± 9.85 mmHg) compared to those without metabolic syndrome (127.66 ± 10.90 mmHg, $p = 0.0028$). Similarly, the mean diastolic blood pressure (DBP) was significantly higher in patients with metabolic syndrome (92.12 ± 5.60 mmHg) compared to those without metabolic

syndrome (88.61 ± 8.62 mmHg, p = 0.024). These findings indicate a significant association between elevated blood pressure and metabolic syndrome.

Table 5: Comparison of Lipid Profile Between Patients With and Without Metabolic Syndrome

Parameter	MetS – No (n=59) Mean ± SD	MetS – Yes (n=41) Mean ± SD	t value	p value
Triglycerides (mg/dl)	176.93 ± 47.94	235.93 ± 35.63	-6.70	<0.001
HDL Cholesterol (mg/dl)	32.66 ± 6.87	25.76 ± 6.96	4.92	<0.001
LDL Cholesterol (mg/dl)	155.68 ± 36.17	153.93 ± 33.82	0.24	0.807
VLDL Cholesterol (mg/dl)	26.56 ± 11.54	29.05 ± 10.10	-1.12	0.267
Total Cholesterol (mg/dl)	223.73 ± 38.32	226.87 ± 35.71	-0.41	0.679

Lipid profile parameters showed significant differences in triglycerides and HDL cholesterol between the two groups. The mean serum triglyceride level was significantly higher among patients with metabolic syndrome (235.93 ± 35.63 mg/dl) compared to those without metabolic syndrome (176.93 ± 47.94 mg/dl, $p < 0.001$). Conversely, the mean HDL cholesterol level was significantly lower among patients with metabolic syndrome (25.76 ± 6.96 mg/dl) compared to those without metabolic syndrome (32.66 ± 6.87 mg/dl, $p < 0.001$). However, there were no statistically significant differences in LDL cholesterol, VLDL cholesterol, or total cholesterol levels between the two groups ($p > 0.05$).

DISCUSSION

Metabolic syndrome is a cluster of metabolic abnormalities including central obesity, hypertension, dyslipidemia, and impaired glucose metabolism that significantly increases the risk of cardiovascular disease and type 2 diabetes mellitus. The present study was conducted to determine the prevalence of metabolic syndrome among newly diagnosed type 2 diabetes mellitus patients and to evaluate its association with anthropometric, biochemical, and clinical parameters.

In the present study, metabolic syndrome was observed in 41% of newly diagnosed type 2 diabetes mellitus patients, indicating that many patients already have multiple cardiovascular risk factors at the time of diagnosis. Similar findings have been reported in earlier studies. Tamrakar et al. reported a prevalence of 62% among newly diagnosed diabetic patients, while other studies have reported prevalence rates between 45% and 80% depending on diagnostic criteria and population characteristics [10,11]. The slightly lower prevalence in the present study may be due to differences in lifestyle and demographic characteristics.

The mean age of patients without metabolic syndrome was 46.63 ± 8.34 years, while patients with metabolic syndrome had a mean age of 44.29 ± 8.22 years, and the difference was not statistically significant. Previous studies have shown that although metabolic syndrome tends to increase with age, it may occur across a wide age range in diabetic patients [12].

In the present study, metabolic syndrome was significantly more common among males compared to females. Similar findings have been reported in earlier studies where lifestyle factors such as reduced physical activity, smoking, and dietary patterns contribute to higher prevalence among males [13]. However, some studies have reported higher prevalence among females, indicating that gender differences may vary across populations.

Anthropometric parameters were significantly associated with metabolic syndrome in the present study. Patients with metabolic syndrome had significantly higher body mass index, waist circumference, and waist–hip ratio, highlighting the role of central obesity in the development of metabolic syndrome. Visceral adiposity contributes to insulin resistance through increased release of free fatty acids and inflammatory mediators from adipose tissue [14].

The present study demonstrated significantly higher systolic and diastolic blood pressure levels among patients with metabolic syndrome. Hypertension is a major component of metabolic syndrome and contributes significantly to cardiovascular risk. Previous studies have reported that insulin resistance and endothelial dysfunction play important roles in the development of hypertension in metabolic syndrome [15].

Patients with metabolic syndrome had significantly higher fasting blood glucose, postprandial blood glucose, and HbA1c levels compared to those without metabolic syndrome. Elevated HbA1c reflects poorer glycemic control and greater insulin resistance. Insulin resistance is considered the central mechanism underlying metabolic syndrome and contributes to worsening glycemic control in diabetic patients [16].

The present study demonstrated significant differences in lipid parameters between the two groups. Patients with metabolic syndrome had significantly higher triglyceride levels and significantly lower HDL cholesterol levels, which are characteristic features of diabetic dyslipidemia [17]. However, no significant differences were observed in LDL cholesterol, VLDL cholesterol, or total cholesterol levels. Similar findings have been reported in earlier studies where triglycerides and HDL cholesterol were identified as the major lipid abnormalities associated with metabolic syndrome [18].

Polyuria and numbness were the most common presenting complaints among the study participants. More than half of the patients had no associated comorbidities, while chronic kidney disease with hypertension was the most common comorbid condition observed. Previous studies have shown that metabolic syndrome significantly increases the risk of cardiovascular and renal complications, highlighting the importance of early detection and management.

CONCLUSION

The present study demonstrates that metabolic syndrome is common among patients with newly diagnosed type 2 diabetes mellitus. Significant associations were observed between metabolic syndrome and anthropometric parameters, blood pressure, glycemic control, and lipid abnormalities.

Patients with metabolic syndrome had significantly higher body mass index, waist circumference, waist–hip ratio, blood pressure, fasting and postprandial blood glucose levels, HbA1c levels, and triglyceride levels, along with significantly lower HDL cholesterol levels. These findings emphasize the importance of early screening and management of metabolic syndrome in newly diagnosed diabetic patients to reduce the risk of cardiovascular complications.

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