



PREVALENCE OF METABOLIC SYNDROME IN PATIENTS WITH TYPE 2 DIABETES MELLITUS IN NORTH EAST INDIA

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ABSTRACT

Aim: Prevalence of metabolic syndrome in patients with type 2 diabetes mellitus in North East India

Introduction: Metabolic syndrome is an increasingly prevalent condition which predisposes the individual to diabetes mellitus (DM) and atherosclerotic cardiovascular disease (ASCVD). The diagnosis of metabolic syndrome is made as per the AHA/NHLBI 2005 criteria. As per this criteria, metabolic syndrome can be diagnosed by the presence of any 3 of the five factors (elevated waist circumference, elevated triglycerides, reduced HDL-C, elevated blood pressure and elevated fasting glucose). This study is being conducted to study the prevalence of metabolic syndrome among patients with type 2 diabetes mellitus. **Materials and Methods:** In this prospective cross-sectional study, 100 adult patients of type 2 diabetes mellitus were selected. Physical examination was conducted including BMI, waist circumference and blood pressure. Blood samples were collected after 14 hours fasting for estimation of serum fasting glucose, serum HDL-C, serum LDL-C, serum triglyceride (TG) and serum cholesterol. The prevalence of metabolic syndrome among the study subjects was accordingly calculated. **Results:** Among the participants, 57 % were males and 43 % were females. The median age was 57 years (range from 34-78 years). 67% of patients with type 2 diabetes mellitus in this study had metabolic syndrome while 33% did not have metabolic syndrome. The prevalence of metabolic syndrome among males and females was 61% and 74% respectively. **Conclusion:** This study showed that the prevalence of metabolic syndrome is quite high among patients with diabetes mellitus. Increased waist circumference was the most common abnormal parameter among others for the diagnosis of metabolic syndrome. Application of lower cut-off values for waist circumference among Asians may help in increasing the diagnostic yield.

KEYWORDS :

INTRODUCTION:

Metabolic syndrome is an increasingly prevalent condition which predisposes the individual to diabetes mellitus (DM) and atherosclerotic cardiovascular disease (ASCVD). It is characterized by the constellation of inter-related metabolic conditions such as increased blood pressure, increased blood glucose levels and dyslipidemia.¹ The prevalence of metabolic syndrome as seen in the National Health and Nutrition Examination Survey (NHANES III) study (1988-1994 cohort) was 22% with an age-dependent increase among both males and females.² The subsequent NHANES 2011-2016 dataset showed an increase in prevalence to 34%.³

The underlying risk factors for metabolic syndrome are obesity, age, physical inactivity, insulin resistance and hormonal imbalance. In addition, there are multiple genetic loci and epigenetic changes that increases the susceptibility to develop metabolic syndrome. Of these, insulin resistance and subsequent compensatory hyperinsulinemia have the strongest influence. Obesity, especially abdominal or upper-body, leads to increased non-esterified fatty acids (NEFA) in blood. The increased production of NEFA augments insulin resistance in muscles and alters the liver metabolism too. Increased adipose tissue also increases the production of adipokines like proinflammatory cytokines and plasminogen activator inhibitor-1 (PAI-1). At the same time, it decreases the levels of adiponectin. This leads to the initiation and persistence of a low-grade chronic inflammatory and prothrombotic state.⁴

Clinically, insulin resistant individuals are usually obese,

however, may even have a normal weight or body mass index (BMI). The non-obese insulin resistant phenotype is particularly common among the South Asian population. Such individuals are prone for exacerbation of the insulin resistance even with mild obesity.⁵

The diagnosis of metabolic syndrome is made as per the AHA/NHLBI 2005 criteria⁴ which was constructed on the lines of the NCEP ATP III criteria. As per this criteria, metabolic syndrome can be diagnosed by the presence of any 3 of the five factors (elevated waist circumference, elevated triglycerides, reduced HDL-C, elevated blood pressure and elevated fasting glucose). The management goal in metabolic syndrome is to modify the three major features in order to reduce the risk of ASCVD.¹ If metabolic syndrome criteria are not fulfilled, prevention of diabetes mellitus by treating the modifiable risk factors is the mainstay of treatment. This can be achieved by a combination of physical exercise, weight reduction, diet modification, smoking and alcohol cessation.

This study is being conducted to study the prevalence of metabolic syndrome among patients with type 2 diabetes mellitus.

MATERIALS AND METHODS:

In this prospective cross-sectional study, 100 adult patients of type 2 diabetes mellitus were selected from OPD and in-patient departments after informed written consent. A targeted history was taken regarding duration of diabetes, alcohol intake, history of liver disease, history of hypertension, dyslipidemia and cigarette smoking. Physical examination

was conducted including BMI, waist circumference and blood pressure. Blood samples were collected after 14 hours fasting for estimation of serum fasting glucose, serum HDL-C, serum LDL-C, serum triglyceride (TG) and serum cholesterol. The samples were processed in VITROS 5600 biochemistry autoanalyzer machine.

The diagnosis of metabolic syndrome was made as per the AHA/NHLBI 2005 criteria which is as follows:⁴

Metabolic syndrome can be diagnosed by the presence of any 3 out of the following 5 criteria.

1. Elevated waist circumference (The cut-off used in this study was ≥ 90 cm for males and ≥ 80 cm for females).
2. Elevated triglycerides ≥ 150 mg/dl or on treatment for the same.
3. Reduced HDL-C < 40 mg/dl for males and < 50 mg/dl for females OR on treatment for the same.
4. Elevated blood pressure ≥ 130 mmHg systolic blood pressure or ≥ 85 mmHg diastolic blood pressure or on treatment for the same.
5. Elevated fasting glucose ≥ 100 mg/dl or on treatment for the same.

The prevalence of metabolic syndrome among the study subjects was accordingly calculated.

Statistical analysis:

Baseline characteristics of the participants are expressed as percentage. Continuous data is presented as mean \pm standard deviation. Statistical analysis has been done in SPSS (Statistical Package for Social Sciences) software and Microsoft Excel. Descriptive statistics, Unpaired t-test, Chi-square/Fisher's exact test (for categorical variables) and the Pearson/Spearman correlation test have been used to find a significant difference, association and correlation between two or more groups, respectively. P value < 0.05 is taken as statistically significant.

RESULTS:

Among the participants, 57 % were males and 43 % were females. The median age was 57 years (range from 34-78 years). Majority of the participants belonged to the age group of 51-60 years closely followed by the age group of 61-70 years. All the participants had type 2 diabetes mellitus (Type 2 DM). The duration of type 2 DM had a wide range from 1 year to 26 years (median duration of diabetes mellitus was 6.5 years). The median HbA1c was 7.35%. Only 36% subjects had achieved the glycemic target of HbA1c $< 7\%$. 64% participants had uncontrolled DM despite being on medical therapy. Amongst the type 2 DM patients, 98% were taking oral anti-hyperglycaemic agents (OHA) while 21% were using insulin therapy with or without OHA. Many of the participants had concomitant hypertension and were on antihypertensive medications. 67% participants had essential hypertension as per the International Society of Hypertension Guidelines 2020.⁶ Of these 67, only 26 had their blood pressure within normal limits with the help of medications while 41 had uncontrolled hypertension. 66 % of participants had dyslipidemia with at least one abnormal lipid profile parameter. 50 % of the patients had total cholesterol more than 200 mg/dl. Serum LDL-C was more than 130 mg/dl in 47 % subjects. Serum HDL-C was < 40 mg/dl in 16 % patients and serum triglycerides (TG) was > 150 mg/dl in 41 % of patients.

The association of various lipid profile parameters with other baseline characteristics was tested (Table 1 and 2). Higher diastolic blood pressure was associated with significantly elevated total cholesterol and triglyceride levels. HbA1c level was strongly associated with increased LDL-C levels. Increased waist circumference (> 102 cm in males and > 88 cm in females) was significantly associated with higher triglyceride levels and LDL-C levels were higher in this group

(though not statistically significant). Higher BMI was associated with higher TG levels and low HDL-C levels.

As per the 2015 AHA criteria, 67% of patients with type 2 diabetes mellitus in this study had metabolic syndrome while 33% did not have metabolic syndrome. The prevalence of metabolic syndrome among males and females was 61% and 74% respectively. The proportion of various parameters of metabolic syndrome was calculated. It was seen that presence of fasting hyperglycaemia or diabetes mellitus was the commonest factor followed by increased waist circumference, elevated systolic blood pressure and hypertriglyceridemia (Table 3).

Table 1: Association of total cholesterol and LDL-C with baseline characteristics.

| Parameter | Total cholesterol, mg/dl | | P | LDL-C, mg/dl | | P |
|--------------------------------|--------------------------|----------------------|-------|-------------------------|----------------------|-------|
| | < 200 mg/dl (n=50) | > 200 mg/dl (n=50) | | ≤ 130 mg/dl (n=53) | > 130 mg/dl (n=47) | |
| Age, years | 56.28 \pm 10.36 | 55.16 \pm 9.53 | 0.575 | 55.68 \pm 10.60 | 55.77 \pm 9.21 | 0.965 |
| Duration diabetes, years | 7.87 \pm 5.96 | 7.39 \pm 4.57 | 0.652 | 7.54 \pm 5.94 | 7.72 \pm 4.50 | 0.868 |
| HbA1c, % | 7.19 \pm 0.95 | 7.49 \pm 0.95 | 0.112 | 7.14 \pm 0.95 | 7.57 \pm 0.92 | 0.025 |
| Systolic blood pressure, mmHg | 129.04 \pm 19.19 | 132.82 \pm 15.67 | 0.283 | 130.11 \pm 19.79 | 131.85 \pm 14.74 | 0.623 |
| Diastolic blood pressure, mmHg | 74.42 \pm 1.41 | 79.24 \pm 9.86 | 0.026 | 75.26 \pm 12.73 | 78.60 \pm 8.10 | 0.127 |
| BMI, kg/m ² | 25.43 \pm 3.01 | 24.72 \pm 3.26 | 0.260 | 25.45 \pm 2.99 | 24.64 \pm 3.28 | 0.200 |
| Waist circumference, Cm | 87.16 \pm 7.97 | 84.48 \pm 9.07 | 0.119 | 87.40 \pm 7.89 | 84.04 \pm 9.10 | 0.051 |

Table 2: Association of serum triglyceride and HDL-C with baseline characteristics.

| Parameter | TG, mg/dl | | P | HDL-C, mg/dl | | P |
|--------------------------------|-------------------------|----------------------|-------|---------------------|--------------------|-------|
| | ≤ 150 mg/dl (n=59) | > 150 mg/dl (n=41) | | < 40 mg/dl (n=16) | 40-60 mg/dl (n=84) | |
| Age, years | 56.46 \pm 10.23 | 54.66 \pm 9.48 | 0.375 | 55.38 \pm 9.37 | 55.79 \pm 10.08 | 0.880 |
| Duration diabetes, years | 8.04 \pm 5.67 | 7.03 \pm 4.68 | 0.352 | 6.68 \pm 3.45 | 7.81 \pm 5.56 | 0.439 |
| HbA1c, % | 7.22 \pm 0.93 | 7.52 \pm 0.98 | 0.126 | 7.66 \pm 0.99 | 7.28 \pm 0.95 | 0.140 |
| Systolic blood pressure, mmHg | 130.07 \pm 18.63 | 132.17 \pm 15.97 | 0.557 | 128.69 \pm 17.67 | 131.36 \pm 17.58 | 0.579 |
| Diastolic blood pressure, mmHg | 74.97 \pm 11.49 | 79.51 \pm 9.44 | 0.039 | 77.50 \pm 0.70 | 76.70 \pm 10.97 | 0.789 |
| BMI, kg/m ² | 25.54 \pm 3.19 | 24.40 \pm 2.98 | 0.075 | 23.74 \pm 2.13 | 25.33 \pm 3.25 | 0.064 |
| Waist circumference, Cm | 87.69 \pm 8.67 | 83.12 \pm 7.85 | 0.008 | 82.88 \pm 7.78 | 86.38 \pm 8.83 | 0.135 |

Table 3. Proportion of parameters of metabolic syndrome.

| Parameters of Metabolic syndrome | Metabolic syndrome (N=67) |
|--|---------------------------|
| Systolic blood pressure ≥ 130 mmHg | 59.7 % |
| Diastolic blood pressure ≥ 85 mmHg | 20.89 % |
| Antihypertensive therapy | 52.23 % |
| Fasting glucose ≥ 110 mg/dl or on OHA | 97 % |
| Triglyceride level ≥ 150 mg/dl | 59.7 % |
| HDL-C level < 50 mg/dl and < 40 mg/dl for females and males respectively | 52.23 % |
| Waist circumference ≥ 90 cm and ≥ 80 cm for males and females respectively | 64.17 % |

DISCUSSION:

This study showed that the prevalence of metabolic syndrome is quite high among patients with diabetes mellitus. 67% of the patients had metabolic syndrome and it was more common in females than males. Among these diabetic individuals, increased waist circumference was the most common abnormal parameter among others for the diagnosis of metabolic syndrome.

The study conducted by Uprey et al found similar results with a prevalence of 68.5% among patients with diabetes. However, they found that metabolic syndrome was more common among males and that dyslipidemia was the most common abnormal parameter. This discrepancy can be explained by the fact that they used the NCEP-ATP III criteria for diagnosis. The cut-off for waist circumference was > 102 cm for males and > 88cm for females.⁷ However, the 2005 AHA criteria states that Asians have an increased prevalence of 'lean' metabolic syndrome and need different cut-off to define increased waist circumference. Our study used lower cut-off for the same and hence, waist circumference was the most common abnormal parameter. Another larger study done by Essafi et al. showed that the prevalence of metabolic syndrome is 78.7% in type 2 diabetes mellitus while it is 21.3% in type 1 diabetes mellitus patients. They found that hypertension and visceral obesity were the most common abnormal parameters as per the IDF and AHA/NHLBI 2009 joint statement criteria.⁸ Many other studies conducted in India as well as in other countries found similar prevalence.⁹⁻¹¹

CONCLUSION:

The prevalence of metabolic syndrome among individuals with type 2 diabetes mellitus is high. Application of lower cut-off values for waist circumference among Asians may help in increasing the diagnostic yield.

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Conflict of Interest: None declared.

Ethical approval: The study was approved by the Institutional Ethics Committee (IEC)

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