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Original Research Article

The study of prevalence of metabolic syndrome in the first degree relatives of type 2 diabetes mellitus patients

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ABSTRACT

Background: Metabolic syndrome (MetS) is associated with higher incidence of new onset DM. First degree relatives (FDR) of T2DM patients also have an increased risk of new onset DM due to common genetic factors that can lead to obesity and dyslipidemia. Objectives of research work was to study the prevalence of MetS in FDR of T2DM patients.
Methods: Cross-sectional study of FDR of T2DM patients. MetS defined by both IDF and NCEP-ATPIII criteria. All subjects underwent necessary biochemical tests, a detailed history in a pre defined proforma was taken and clinical examination was done as per protocol.
Results: Mean age was 43.61±11.7 years. Prevalence of MetS was 35% by IDF and 25% by NCEP-ATPIII. According to IDF criteria, the most prevalent risk factors among FDR were central obesity and hypertension. Prevalence of MetS was higher in urban, sedentary and obese population.
Conclusions: Prevalence of MetS is more in FDR of T2DM than that reported in the general population. Central obesity is the most prevalent risk factor. Targeted lifestyle intervention in this population may help prevent the development of MetS and T2DM.

Keywords: First degree relatives, Metabolic syndrome, Type 2 DM

INTRODUCTION

Nondiabetic FDR of T2DM patients manifest greater insulin resistance and hyperinsulinemia than those without family history of T2DM. Insulin resistance is the core pathophysiology underlying MetS. So, early recognition of MetS in such subjects and timely intervention along with lifestyle modification can delay emergence of DM, CVD, Stroke and subsequent mortality.[1] Metabolic syndrome by NCEP-ATP III (2001) is defined when a subject meets 3 or more of the following 5 criteria[2]

- Central Obesity: Waist circumference (WC), Male >102cm, Female >88cm.
- Hypertriglyceridemia: Serum Triglycerides (TG) level ≥150 mg/dl or specific medication.
- Serum High Density Lipoprotein (HDL-C) level <40mg/dl (Male) and <50mg/dl (Female) or specific medication.
- Hypertension: Systolic B.P. ≥130mmHg or Diastolic B.P. ≥85mmHg or specific medication.
- Fasting plasma glucose level ≥100mg/dl or specific medication or previously diagnosed type 2 DM.

In 2005, the IDF published new criteria that again modified the ATP III definition. They considered that abdominal obesity is highly correlated with insulin resistance. Thus, the IDF clinical definition makes the presence of abdominal obesity necessary for diagnosis. As per the IDF, waist circumference level for Indian population is: Males ≥90cm and Females ≥80cm.[3-5]

In a study conducted by Siewert et al, of National University of San Louis Argentina, in a small town in Argentina which included 132 FDR of T2DM patients and 112 age matched controls. The prevalence of MetS was 34.8% (34% males and 35.4% females) as per IDF criteria and 26.5% (24.5% males and 27.8% females) as per NCEP-ATP III criteria.[6] Few Indian studies have reported a high prevalence of MetS in FDR of T2DM patients.[1] Other studies from developing countries (like Africa, Iran, etc.) have also shown that the prevalence of MetS is higher in FDR of T2DM.[7-9] This reported prevalence is higher than the prevalence of MetS in general population.[10,11]

The prevalence of the MetS depends upon the methodological factors, the definition of the MetS used, and the composition of the community examined by age and gender.[1] This study was conducted to find prevalence of MetS in FDR of T2DM in a predominantly rural/semi-urban population.

METHODS

We studied a randomly selected cross-sectional population sample of FDR of T2DM patients of Gorakhpur region. Sample subjects were not previously diagnosed with T2DM. The reason for excluding diagnosed T2DM patients is that we aimed to detect subjects at risk for T2DM and associated metabolic abnormalities in a general group of subjects who are genetically at risk.

Informed consent was obtained from all individuals before participation in the study. Blood samples were obtained for the determination of plasma glucose, plasma HDL-C and plasma TG levels. We used the IDF definition for clinical identification of family members with MetS.

For gathering data, a standardized health questionnaire was used, which covered the individuals' medical history, current and previous medication and family history of diabetes and their lifestyle. On the first day, each subject also underwent a structured examination, which included measurement of height, weight and waist circumference (WC). Height and weight were measured to the nearest 0.5cm and 0.1kg, respectively. Body mass index (BMI) was calculated as weight (kg) divided by height (m) squared. WC was determined at the umbilical level (cm) to the nearest 0.1cm using a measuring tape positioned at the midpoint between the lowest rib and iliac crest.

Metabolic measurement

Authors used the IDF guideline to identify individuals with MetS and the data obtained from these individuals were used in the biochemical and clinical analysis. In a separate analysis, MetS defined by NCEP-ATPIII guidelines was compared to MetS defined by the IDF-definition.

Biochemical measurement

Plasma glucose, Plasma TG and cholesterol concentrations were done in B. R. D. Central Pathology Lab.

Statistical Methods

The statistical analysis was performed using EPIINFO software. A p-value of less than 0.05 was considered to be statistically significant and odds ratios (OR) for FDR subjects compared to controls were expressed with 95% confidence intervals (CI).

RESULTS

Our study included 125 FDR of T2DM patients. There were 86 males and 39 females in our study with male to female ratio of 2.2:1. Mean age of our subjects was 43.61±7.8 years. The anthropometric, clinical, and metabolic characteristics of FDR of T2DM patients are shown in Table 1.

Table 1: Physical, clinical and metabolic characteristics of FDR of T2DM patients.

Parameter	FDR
Age (years)	43.61±11.7
Weight (kg)	66.16±12.5
Height (m)	1.63±8.9
BMI (kg/m^2)	24.84±3.92
Waist circumference (CM)	88.47±14.8
Fasting blood sugar (MG/DL)	115.52±29.3
Systolic blood pressure (mmHg)	131.86±16.8
DIASTOLIC blood pressure (mmHg)	86.34±12.02
Triglycerides (mg/dl)	182.34±92.92
High density lipoprotein (mg/dl)	44.99±10.04

Majority of the participants (40.35%) with MetS, both male and female, were 40-55 years in age. About 27 (31.3%) males and 17 (43.5%) females met the criteria for the diagnosis of MetS as per IDF criteria, constituting an overall prevalence of 35.2%. Prevalence of MetS was more in females as compared to males.

Prevalence of MetS was 57.14% in participants having a sedentary lifestyle (32/56) whereas it was only 16% in those with non sedentary lifestyle (11/69).

In the present study, 50.4% (63/125) of the participants had increased BMI. Out of 63 participants with increased BMI 36 (57.14%) had MetS whereas among participants with normal BMI, 8 (13%) had MetS. Among the 125 FDR, only 56 (45%) had increased waist circumference and out of these, 44 (78.5%) had MetS. In the present study, we did not find MetS in any of the participant with normal waist circumference.

There were 67 participants from rural population and 58 from semi-urban population. Comparison of these is shown in Table 2.

Table 2: Comparison of BMI v/s Waist circumference in Semi-urban and rural population.

	Semi Urban (58)	Rural (67)	p-value
Participants with Increased BMI	38/58 (65.5%)	25/67 (37.3%)	P=0.002
Participants with increased waist circumference	32/58 (55.1%)	24/67 (35.8%)	P=0.003
Prevalence of METS	29/58 (50%)	15/65 (23%)	P=0.003
MetS in participants with increased BMI	24/38 (63.1%)	12/25 (48%)	P=0.18
MetS in participants with increased waist circumference	29/32 (90.6%)	15/24 (62.5%)	P<0.001

In the present study, only 15% FDR of T2DM patients had no components while 85% FDR of T2DM patients had ≥1 components of MetS. About 31 (25%) participants had only one component of MetS while no one had all 5 components of MetS. The most frequent combination of 2 components of MetS was hypertension and increased waist circumference. Prevalence of MetS in the FDR of T2DM patients with abnormalities in the individual components as per IDF is shown in Table 3.

Table 3: Prevalence of individual components of MetS in the FDR of T2DM patients.

	Metabolic syndrome		Pearson Chi-Square
Hypertension (n=50) ≥130/85 mmHg	31	62%	Df=1, p value <0.001
Triglyceride (n=32) ≥150mg/dL	27	84.3%	Df=1, p value <0.001
Fasting Blood Sugar (n=36) ≥100mg/dL	21	58.3%	Df=1, p value <0.001
High Density Lipoprotein (n=10) <40 mg/dL (male), <50mg/dL (Female)	7	70%	Df=1, p value =0.03
Waist circumference (n=56) ≥90cm (male), ≥80cm (Female)	44	78.5%	Df=1, p value <0.001

DISCUSSION

FDR of T2DM patients are at higher risk of developing MetS. This may be due to genetic factors and increased insulin resistance and hyperinsulinemia in them.

About 31.3% males and 43.5% females met the criteria for the diagnosis of MetS as per IDF criteria, constituting an overall prevalence of 35.2%. Prevalence is lower (27.2%) if we use NCEP-ATP III criteria for the diagnosis of MetS. NCEP-ATP III criteria has set a higher waist circumference than IDF. Hence, less number of people meet the criteria reflecting a lower prevalence of MetS. Other studies have also shown a better sensitivity of IDF criteria.[6]

In this study, we observed a higher prevalence of MetS in women as compared to men (43.5% females and 31.3% males). The reason(s) for this gender difference in MetS has not been explored, but some studies suggest that female sex hormones may contribute, while others failed to see an effect on glucose metabolism.

We observed in this study that the FDR with T2DM were mostly overweight or obese. A slight increase in body weight may cause a marked metabolic disturbance.[12] In our study, 57.1% of the obese subjects had MetS while 21% of the overweight subjects had MetS. 13% of subjects having normal BMI also had MetS signifying that increased BMI is not only the sole risk factor for the development of MetS. However, despite the importance of adiposity, patients who are of normal weight may also be insulin resistant and may have the MetS.

In this study, we observed that persons having normal BMI but increased waist circumference have MetS while there are very less chances that a person having normal waist circumference can have MetS. This suggest that risk of MetS is more strongly related to central obesity as compared to BMI. Obesity, in particular abdominal

obesity expressed as waist circumference, is a well-known contributor to the development of MetS.[13] Android type fat distribution with abdominal adiposity is closely related to insulin resistance and is an independent cardiovascular risk factor in men and women.[14] Many Asian Indians develop MetS and diabetes at BMI <25kg/m^2, which is generally considered normal.[15,16] This also explains why BMI may underestimate the cardio metabolic risk which may be best evaluated by Waist circumference or Waist-hip ratio.[16]

We observed in this study there is a variation in the prevalence of MetS according to the type of population. The prevalence rates of MetS were significantly higher in semi-urban population than in the rural population. Prevalence of BMI and increased waist circumference were also much higher in semi-urban population. Another study conducted by Misra et al have also demonstrated a high prevalence of MetS in intra country rural to urban migrant population belonging to low socioeconomic stratum residing in urban slums.[17,18]

The prevalence of MetS in semi-urban and rural obese population is not different but semi-urban population having an increased waist circumference has a higher prevalence of MetS as compared to rural population. This suggest that there are some other risk factors too that predisposes the urban population to MetS like sedentary lifestyle, consumption of energy rich foods, stressfull life, etc. As per our study lifestyle seems to play a major role in the development of MetS. Probably this is because lifestyle factors may lead to hyperinsulinemia which increases the risk of MetS.

CONCLUSION

Prevalence of MetS is more in the FDR than that reported in the general population. IDF criteria is more sensitive than NCEP-ATP III criteria for picking up MetS as cut off limits for waist circumference is lower in IDF criteria. Central obesity is more strongly associated with MetS rather than BMI. Prevalence of MetS is higher in urban, sedentary and population with increased waist circumference probably due to the impact of rapid urbanization, mechanization, socioeconomic factors, and alterations to the traditional diet. Targeted lifestyle intervention such as exercise, increased dietary restrictions and weight control strategies among the high-risk population may prevent the development of MetS and DM.

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