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Assessment of metabolic syndrome in type 2 diabetes mellitus

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Abstract
Background: The diabetic condition is influenced by several factors, some of which can accelerate the disease's progression to various complications that aggravate the morbidity.
Aims: This study aimed at determining the prevalence of metabolic syndrome (MetS) and its individual components and the most critical predictive risk factors of MetS in type 2 diabetic patients.
Materials and Methods: This cross-sectional study involved 100 type 2 diabetes mellitus patients and was conducted at the outpatient and inpatient departments at Sri Aurobindo Institute of Medical Sciences and Post Graduate Institute, from April 2021 to September 2022. The study involved the use of a questionnaire to obtain some information on the diabetics, undertaking anthropometric measurements, as well as collecting blood samples for the measurement of some biochemical parameters; fasting blood glucose and lipid profile. MetS was defined according to the National Cholesterol Education Program/Adult Treatment Panel III criteria.
Results: The study population comprised 100 type 2 diabetes mellitus patients, made up of 33 males (33%) and 67 females (67%). The overall mean age of the population was 51.31 (SEM = 0.97) years the prevalence of MetS was 58% in the studied population. For the overall population, hypertension was the commonest component (60%) of the MetS, followed by high waist circumference, or central obesity. Female type 2 diabetics had a higher prevalence of MetS, and carried more components than their male counterparts.
Conclusion: With hypertension being the commonest component, future cardiovascular disease prevention strategies should focus attention on its management and prevention, through education.

Keywords: Metabolic syndrome (MetS), diabetic patients, hypertension, cardiovascular disease

Introduction

Diabetics with hyperglycemia are more likely to have complications, which add to morbidity. Diabetics are predisposed to problems due to both changeable and unmodifiable risk factors. There is currently increased interest in metabolic syndrome (MetS), a group of risk factors that predicts cardiovascular disease and type 2 diabetes mellitus [1]. It includes the following major characteristics: hyper triglyceridemia, low levels of high density lipoprotein cholesterol (HDLC), central obesity (abdominal) obesity, hypertension, and concomitant insulin resistance/glucose intolerance (hyperinsulinemia) [2]. It is associated with a three to five fold increased risk of developing type 2 diabetes mellitus [3], which has now reached high proportions in many countries [4]. The worldwide prevalence of MetS is between 7.9% and 43% in males and 7% to 56% in females [5]. The worldwide prevalence of diabetes mellitus in the adult population is assumed to be 4%. MetS is believed to be caused by insulin resistance or insulin resistance linked obesity, a condition in which the cells of the body are unable to absorb glucose from the blood. Obesity induced by insulin resistance is caused by poor diet and a lack of regular exercise. Other genetic or behavioral risk factors/predictor variables contribute to metabolic MetS in the same way. They are rising age (more than 40 years), cigarette smoking, alcohol use, being overweight, leading a sedentary lifestyle, and having a family history of type 2 diabetes [9].

Type 2 diabetes mellitus has been responsible for an increase in mortality throughout the years. However, due to a lack of published data on the frequency of MetS and its connection with type 2 diabetes mellitus, there is little information on its aetiology on a local level. This study aims to determine the most important risk factors for MetS that predispose these populations to prediabetes and type 2 diabetes mellitus, as well as the impact of MetS on diabetes progression.

Methods

This study was approved by the Institutional Ethics Committee at the SAIMS. This study was conducted between April 2021 to September 2022. The source of data was patients coming to outpatient and inpatient departments at Sri Aurobindo Institute of Medical Sciences and Post Graduate Institute. Diabetes has been defined as HBA1C ≥6.5% the procedures and rationale for the study will be explained to all patients and informed written consent where possible will be taken in their local language. Socio-demographic data and clinical information will be collected on a semi-structured Performa. One hundred (100) participants of the Diabetic Centre of the Medical College Teaching Hospital (33 males and 67 females) were involved. The study participants were of ages between 20 and 86 years. Participants fasted overnight before blood sampling. Excluded from the study were type 1 diabetics and pregnant women. The participants who were all consented to take part in the study after a thorough explanation of the aim of the study. Information on demographic and clinical factors, such as age, gender, age of beginning of diabetes, and family history of diabetes, were retrieved using a questionnaire and patients' medical records. Blood pressure was tested using a sphygmomanometer. In the sitting position, blood pressure was taken in the right arm. Two blood pressure readings were taken 5 minutes apart, and the mean of the two was used. Height was measured to the nearest 0.1 cm without shoes, using a stadiometer and weight to the nearest 0.1 kg in light clothing, using a bathroom scale. Body mass index (BMI) was computed by dividing weight (kg) by height squared (m2). Waist circumference was measured to the nearest 0.1 cm, using a measuring tape midway between the inferior angle of the ribs and the suprailiac crest.

Results

The study population comprised 100 type 2 diabetes mellitus patients, made up of 33 males (33%) and 67 females (67%). The overall mean age of the population was 51.31 (SEM = 0.97) years, whereas the ages of the males and females were 52.86 (SEM = 1.56) and 50.54 (SEM = 1.22), respectively [Table 1]. The overall mean value of BMI was 26.43 kg/m2, and the mean BMI of females was significantly higher (p<0.0244) than that of males. Though waist circumference of female was higher, there was no statistical significance. None of the subjects were smokers or had ever smoked. On the whole, 47% of the subjects said they exercised, 56% being males and 41% being females while 12% of the subjects were still taking fast foods. With respect to the biochemical parameters, none showed statistical significance between the males and females.

Table 1: General Characteristics of the Studied Population

Parameter	Total (n=100) (%)	Male (n= 33) (%)	Female (n=67) (%)	p
Age	51.31±0.97	52.86±1.56	50.54±1.22	0.2588
Anthropometry and BP				
WC	91.58±1.22	89.73±1.81	92.51±1.59	0.2838
BP (systolic)	135.90±1.53	134.50±2.72	136.60±1.84	0.5101
BP (diastolic)	79.11±1.01	78.00±2.12	79.67±1.09	0.4394
BMI	26.43±0.42	25.10±0.66	27.09±0.52	0.0244
Socio-demographic				
Smoking				
Ever drank	0 (0)	0 (0)	0 (0)	
	0 (0)	0 (0)	0 (0)	
Alcohol				
Ever drank	47 (47)	25 (76)	22 (33)	0.3542
Never drank	53 (53)	8 (24)	45 (67)	
Exercise				
Do Exercise	47 (47)	18 (56)	27 (41)	0.1253
Do Not Exercise	53 (53)	15(44)	40 (59)	
Fast Foods				
Still Taking	12 (12)	5 (14)	7(11)	0.7236
Stopped Taking	88(88)	28 (86)	60(89)	
Biochemical Indices				
FBS	9.77±0.36	9.76±0.64	9.78±0.44	0.9782
TG	1.54±0.08	1.49±0.15	1.57±0.08	0.6291
HDL	1.32±0.05	1.27±0.06	1.35±0.06	0.4445

Table 2 show that the overall percentage prevalence of MetS was 58%. Males had a lower percentage prevalence of 23%, compared to a higher percentage prevalence of 77% for the females. For the overall population, hypertension was the commonest component (60%) of the MetS, followed by high waist circumference, or central obesity. In females, central obesity was the most common component (87%), followed by lowered HDL (77%). In males, hypertension was the most common component (31%), followed by hyper triglyceridemia (25%). Central obesity and low HDL were the only components that showed statistically significant difference between males and females.

Table 2: Prevalence of the individual components of MetS

Parameter	Male (N=33) (%)	Female (N=67) (%)	Total (N=100) (%)	P
High WC	6 (12)	43 (87)	49 (49)	0.001***
Elevated FBS	33 (33)	67 (67)	100 (100)	0.691
Elevated TG	8 (25)	25 (75)	33 (33)	0.110
Lowered HDL	9 (23)	32 (77)	41 (41)	0.019*
Elevated systolic BP	19 (31)	41 (69)	60 (60)	0.480
MetS	13 (23)	45 (77)	58 (58)	

Table 3 shows that Individuals having three or more of the risk factors were reckoned as having the MetS. With respect to age, individuals within the age group of 50–59 had the highest prevalence of the MetS (39%), whereas individuals of age 70 years and above, had the lowest prevalence (5%). The prevalence of MetS in the females was about 3 times higher (77%), compared to males. Obese people had more of the metabolic components (40%), compared to normal weight individuals (22%). Based on the level of education, majority of the junior high school or form four leavers had the highest prevalence of the MetS (55%). Factors like sex, BMI and educational status caused statistically significant differences, unlike the other independent variables.

Table 3: A comparative analysis of the influence of the risk factors on MetS

Risk factors	MetS components (%)		P
	3 or more (N=58)	2 or less (N=42)	
Age			
20-39	5 (8)	9 (22)	0.083
40-49	18 (31)	10 (24)	
50-59	22 (39)	11 (27)	
60-69	10 (17)	8 (19)	
70+	3 (5)	3 (8)	
Sex			
Male	13 (23)	20 (47)	0.001***
Female	45 (77)	22 (53)	
BMI			
Under weight	3 (5)	2 (5)	0.001***
Normal weight	13 (22)	25 (60)	
Over weight	19 (33)	12 (28)	
Obese	23 (40)	3 (7)	
Exercise			
Yes	27 (47)	19 (45)	0.745
No	31 (53)	23 (55)	
Family History			
Yes	46 (79)	37 (88)	0.422
No	7 (12)	3 (7)	
I do not know	6 (9)	2 (5)	
Fast food			
Yes	8 (13)	5 (11)	0.756
No	50 (87)	37 (89)	
Ever taken soft drinks			
Yes	1 (2)	1 (2)	0.978
No	57 (98)	41 (98)	
Education			
Uneducated	7 (13)	6 (13)	0.044*
Primary	9 (15)	1 (3)	
JHS/form 4	32 (55)	25 (60)	
SHS	2 (4)	6 (13)	
Tertiary	7 (13)	4 (10)	
Ever drank alcohol			
Yes	26 (45)	24 (57)	0.470
No	32 (55)	18 (43)	

Discussion

The prevalence of non-communicable diseases like type 2 diabetes mellitus and cardiovascular diseases has increased in proportion due to the increase in metabolic syndrome. In contrast to Felix-Val *et al.* findings [8],'s the current investigation found that type 2 diabetics had a high prevalence (58%) of MetS. In line with earlier research by Felix Val *et al.* [8] and Ford *et al.* [9], females had a higher prevalence of MetS (77%) and had more risk factors associated with it than males (23%). [10] Given that most women in this region of the world are traders or jobless, the cause may be related to their generally sedentary lifestyles, or it may be genetic.

Obesity was quite common, accounting for 40% of the entire diabetic study sample. Obesity exacerbates insulin resistance, which in turn causes the liver to produce more very low density lipoprotein, which in turn causes excessive levels of TG to be released into the bloodstream.

People who have type 2diabetes and reduced glucose tolerance also have hypertriglyceridemia and enhanced HDL catabolism, which lowers HDL levels [20]. The negative link between hypertriglyceridemia in insulin resistant conditions and enhanced HDL catabolism, resulting in low plasma HDL concentrations, could be explained by a variety of different possible processes. One potential is a decrease in lipoprotein lipase (LPL) activity, which would affect how well HDL particles mature. In people with insulin resistance, the typical insulin-mediated activation of LPL activity has been demonstrated to be muted [12]. LPL activity is decreased in type 2 diabetes, especially in patients with poor glycemic control and those who are somewhat insulin deficient [13]. In order to prevent type 2 diabetes mellitus or to stop or slow the development of some problems, obesity is a serious risk factor that must be managed.

Similar to a 2007 study by Moebus *et al.*, there was a considerably greater prevalence of MetS among diabetics with poor educational status [14]. In comparison to diabetics with senior high school education (4%) and those with tertiary level education (13%), those with elementary school education (15%) and those who were junior high school or form four leavers (56%) had higher prevalence. This can be as a result of their lack of knowledge about healthy eating practices including consuming excessive amounts of saturated fats and high-carbohydrate diets, as well as sporadic exercise and inactivity. Fast food (13%) and soft drinks (2%), which were avoided by the majority of diabetics both before and after getting the condition, did not significantly contribute to the development of MetS in this study sample.

It has been suggested that family history may hasten the acquisition of MetS. [15] In this study, respondents with a family history of diabetes were 79% more likely to have three or more MetS components.

The most prevalent factor in the total type 2 diabetes study population, according to the current study, was determined to be hypertension. Central obesity and a decreased HDL-C were the next most prevalent factors. The most common factor in males was hypertension, which was then followed by hypertriglyceridemia and decreased HDL levels [Table 2]. This finding is reasonably consistent with Felix-Val *et al.* findings.'s from 2008 [8] using the NCEP/ATP III, which showed that hypertension and hypertriglyceridemia were the two conditions that were most prevalent among males. Prior to receiving a diabetes diagnosis, the majority of the men (76%) engaged in significant alcohol use [Table 1], and alcohol is known to cause hypertension [16]. Patients with hypertension who are also diabetic are more likely to experience micro and macro vascular problems.

The most frequent factor in females was central obesity, which was followed by low HDL, high triglycerides, and hypertension [Table 2]. This may be caused by the less frequent physical activity that women engage in, their sedentary lifestyle, which is likely related to their trading activities, as well as their regular consumption of starchy foods, refined carbs, and late-night snacking. Furthermore, it was discovered that the prevalence of central obesity and low HDL-C was much higher in women than in men. It is commonly known that having lower HDL-C levels raises your chance of developing cardiovascular or coronary disorders [17].

According to Table 3, 39% of people in the 50-59 age group and 31% of people in the 40-49 age group each had three or more MetS components. This suggests that regardless of sex, a higher percentage of people between the ages of 40 and 59 are likely to have a high prevalence of the MetS components. Since the prevalence of MetS rises with age, serious preventive and control measures should be done as one approaches these age groups [18]. People should be encouraged to exercise more, control their diet by consuming meals with low amounts of saturated fats, cholesterol, and foods with refined sugars, and instead consume more foods high in fibre. High-fiber diets have been found to have a low glycemic index and the potential to reduce blood levels of triglycerides, total cholesterol, and fasting plasma glucose. They merely lessen the intestinal absorption of carbs and cholesterol [19]. On the whole, there was a high prevalence of MetS among the type 2 diabetics studied, similar to the study of Felix-Val *et al.* [8]

Conclusion

This study has demonstrated an increased prevalence of MetS (58%), Most of the individual risk variables were more prevalent in women, compared to men; women were 3 times more likely to have MetS. Hypertension was the most common component, followed by central obesity, low HDLC, and hypertriglyceridemia. Obesity and low educational status are also strong predictors of MetS in type 2 diabetes.

Conflict of Interest

Not available

Financial Support

Not available

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