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Metabolic syndrome as a predictor of cardiovascular diseases and type 2 diabetes

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***Abstract*---**Background: The incidence of cardiovascular disease (CVD), coronary heart disease (CHD), and type 2 diabetes mellitus (T2DM) in people with the metabolic syndrome has not been thoroughly established (at least 3 of the following: abdominal adiposity, low HDL cholesterol, high triglycerides, hypertension, and impaired fasting glucose). The goal was to look at the relationship between metabolic syndrome traits and the risk of CVD, CHD, and T2DM. Methods and Results: Over the course of two years, the researchers followed a group of 300 middle-aged persons for the development of new CVD, CHD, and T2DM. Out of 300 subjects, who did not have CVD or T2DM at either visit, the prevalence of the metabolic syndrome (≥3 of 5 traits) was 25.67% (n=77). During follow-up, there were 8 cases of total CHD, 13 cases of CVD and 18 cases of T2DM. Waist girth, BMI, systolic and diastolic BP was significantly ($p<0.05$) higher in subjects with metabolic syndrome as compared to subjects without metabolic syndrome. Abnormal cholesterol profile was found more in subjects with metabolic syndrome as compared to subjects without metabolic syndrome. Fasting glucose 100 to 125 mg/dL was reported among 11.21% and 38.96% of the subjects without and with metabolic syndrome respectively. Conclusion: MS was found to be associated with future risk for the development of cardiovascular disease and type 2 diabetes.

***Keywords*---**metabolic syndrome, cardiovascular disease, diabetes, BMI.

Introduction

While the notion of metabolic syndrome was widely understood, and debates over its causes raged, it wasn't until 1998 that an effort was launched to produce an internationally recognised description. A WHO consultation provided a set of criteria in an attempt to reach some agreement on definition and to provide a tool for physicians and researchers. Following that, the Adult Treatment Panel III (NCEP: ATP III) of the National Cholesterol Education Program and the European Group for the Study of Insulin Resistance developed definitions. The core components of these definitions—glucose intolerance, obesity, hypertension, and dyslipidemia—are the same, but the details and criteria differ.[1]

Metabolic syndrome is a collection of physiological risk factors that occur more frequently than would be expected by chance, according to previous research on trait clustering. Increased waist circumference, blood pressure elevation, low HDL cholesterol, high triglycerides, and hyperglycemia are all characteristics of the metabolic syndrome, according to the National Cholesterol Education Program Adult Treatment Panel III (NCEP-ATP III) panel[2]. When at least three of the five features are present, the metabolic syndrome is diagnosed, and affected people are often insulin resistant[3].

However, the syndrome is nonetheless recognized as a potential risk factor for diabetes mellitus, CVD[4] (3-5) and cardiovascular mortality[5]. Other discrepancies in health conditions such as abnormalities in urine albumin ratio, fibrinolysis, endothelial dysfunction, non-alcoholic fatty liver and elevated markers of unremitting inflammation are linked with metabolic syndrome[6].

In the presence of type 2 diabetes, the risk of cardiovascular disease (CVD) is considerably raised (T2DM). In diabetics, the relative risk (RR) for various CVD events is typically increased 2-fold in men and 3-fold in women when compared to middle-aged people without diabetes. The impact of metabolic syndrome on the risk of cardiovascular disease (CVD), coronary heart disease (CHD), type 2 diabetes (T2DM), and changing prevalence in a single population sample in the 1990s have not been thoroughly explored[7-9].

The metabolic syndrome is not nearly as well defined and characterized as commonly claimed, and the idea that it is a helpful marker of CVD risk beyond the risk associated with its individual components is dubious. Furthermore, while specific CVD risk factors do occur together more frequently than one would anticipate by chance, the underlying pathophysiology of the condition is unknown. Furthermore, the cluster's list of risk variables is not based on well-defined criteria.[10]

Also it is well known that the prevalence of the MS differs among ethnic groups. Furthermore, central obesity in Asian populations is not as significant if the Caucasian cutoff point for waist circumference is used, and the impact of central obesity on the development of the CVD appears to be different in Asian populations when compared to Caucasians. The goal of this longitudinal study was to see if having MS is linked to a higher risk of developing CVD in the future.

Material and Methods

The participants were chosen from those who visit the D.Y. Patil Hospital in Kadamwadi, Kolhapur, for a medical checkup as part of a lifelong health care programme. Subjects having missing data on MS characteristics, fasting plasma insulin (FPI), or C-peptide levels, as well as those with a history of CVD at baseline, were ruled out of the study. Finally, 349 patients were given a medical check-up once a year for the duration of the trial. Individuals who developed T2DM during the follow-up time, for example, were eliminated from a study of people at risk for CVD. Individuals who acquired CVD were therefore excluded from studies for T2DM risk. Out of 349, 300 subjects were able to complete the trial at followup.

Exclusion criteria also included the people with T2DM, adopt the impaired fasting glucose (IFG) criterion of 100 to 125 mg/dL, as proposed by recent expert committees, and categorize people on antihypertensive medicine as hypertensive if their blood pressure was 130/85 mm Hg. This kind of study influences the prevalence of metabolic syndrome and enables for the examination of T2DM and CVD outcomes across time. It also allows a fixed cohort to analyze the prevalence of metabolic syndrome at baseline and two years later. We also conducted analyses that took into account a variety of metabolic syndrome features.[11]

A comprehensive physical examination was performed at the start of the study, and a standardized questionnaire was used to identify personal medical history and lifestyle characteristics such as cigarette smoking and alcohol intake. After a 5-minute break, blood pressure was taken using a mercury sphygmomanometer on the right arm with patients in a sitting position. The body mass indices (BMIs) were computed by dividing the weight in kilograms by the square of the height in meters in the morning with the subjects wearing light clothing but no shoes. After a 12 to 14 hour overnight fast, all blood samples were taken in the morning. Using an autoanalyzer, plasma glucose was determined in duplicate using the hexokinase technique. The inter assay variance coefficient was 1.6 percent. An immunoradiometric assay (IRMA) approach was used to quantify plasma insulin in duplicate. An autoanalyzer was used to determine standard liver function tests, as well as serum total cholesterol, triglyceride, HDL cholesterol, and LDL cholesterol, as well as white blood cell counts.[12]

Instead of using the waist circumference, we chose a BMI cutoff value of 25.0 kg/m^2 as the criteria for abdominal obesity in this investigation. Participants were defined as diabetic if their FPG levels were greater than 126 mg/dL (7.0 mmol/L) at the initial visit, or if they were using oral hypoglycemic medications or had a self-reported history of diabetes.[13] This patient group was also included in the MS analysis to predict future CVD, but not in the incident diabetes study. FPG and FPI concentrations were utilized to determine insulin sensitivity and ß-cell function using the HOMA (homeostasis model assessment) model.

Statistical analysis

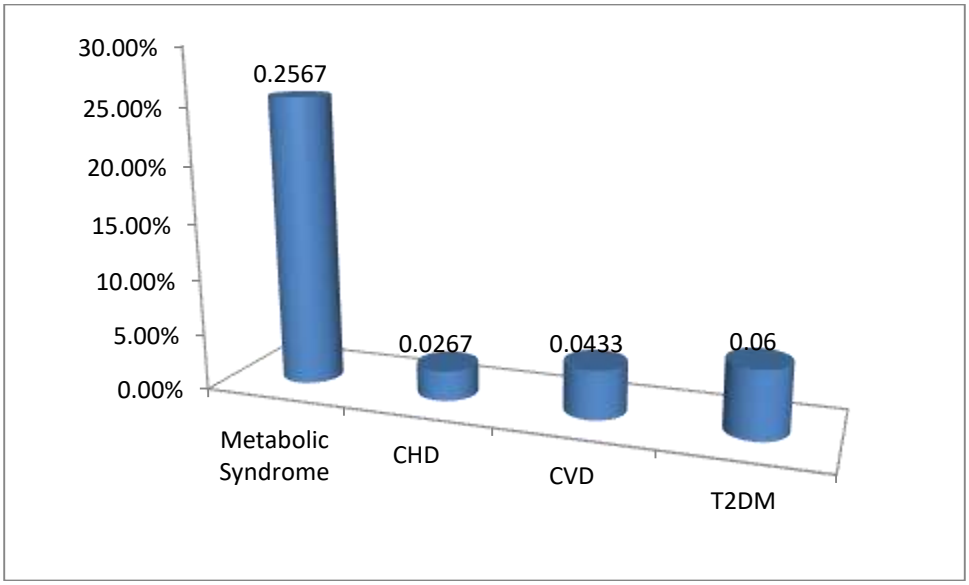
It was done using SPSS software version 24. Test used for comparison were chi square and t test. Level of significance was set at <0.05.

Results

300 subjects completed the follow-up examinations and who did not have CVD or T2DM at either visit, the prevalence of the metabolic syndrome (≥3 of 5 traits) was 25.67% (n=77). During follow-up, there were 8 cases of total CHD, 13 cases of CVD and 18 cases of T2DM (table 1, graph 1).

Table 1: Distribution of subjects based on presence of metabolic syndrome, cardiovascular disease and T2DM

Parameters	N	%
Metabolic Syndrome	77	25.67
Follow up		
CHD	8	2.67
CVD	13	4.33
T2DM	18	6



Graph 1: Distribution of subjects based on presence of metabolic syndrome, cardiovascular disease and T2DM

Table 2 shows descriptive statistics for age and risk factors at baseline, organized by metabolic syndrome status. We divide the subjects into two groups i.e. according to the presence and absence of metabolic syndrome. The relative rates would have been exceedingly low both for those without metabolic syndrome and those with metabolic syndrome if the fasting glucose threshold of 110 to 125 mg/dL had been adopted as a metabolic syndrome criterion. Mean age was comparable among both the groups. Waist girth and BMI was significantly ($p<0.05$) higher in subjects with metabolic syndrome as compared to subjects without metabolic syndrome. Similarly mean systolic and diastolic BP was significantly ($p<0.05$) higher in subjects with metabolic syndrome as compared to subjects without metabolic syndrome. Abnormal cholesterol profile was found

more in subjects with metabolic syndrome as compared to subjects without metabolic syndrome. Fasting glucose 100 to 125 mg/dL was reported among 11.21% and 38.96% of the subjects without and with metabolic syndrome respectively.

Table 2: Comparison of risk factors w.r.t. presence and absence of metabolic syndrome

Variables	Metabolic Syndrome		P value
	Absent (n=223)	Present (n= 77)	
Age in years	42.51±9.02	46.17±7.88	.....
Waist girth, cm	93 ± 10	106 ± 10	<0.01
BMI, kg/m^2	25.5 ± 3.2	29 ± 2.3	<0.01
Systolic BP, mm Hg	125 ± 17	140 ± 15	<0.01
Diastolic BP, mm Hg	79 ± 6	89 ± 7	<0.01
Hypertension Rx, n (%)	22 (9.86%)	25 (32.46%)	<0.01
Cigarette smoking, n (%)	45 (20.17%)	18 (23.37%)	0.39
Total cholesterol, mg/dL	200 ± 35	218 ± 34	<0.01
HDL cholestrol, mg/dL	45 ± 12	36 ± 8	<0.01
LDL cholesterol, mg/dL	136 ± 34	140 ± 34	0.028
Triglycerides, mg/dL	104 ± 70	210 ± 114	<0.01
Glucose, mg/dL	89 ± 7	99 ± 10	<0.01
Waist girth>102cm in men or >88 cm in women, n (%)	N = 33 (14.79%)	N = 40 (51.94 %)	<0.01
Low HDL cholesterol <40 mg/dL in men or <50 mg/dL in women, n (%)	N = 48 (21.52%)	N = 55 (71.42 %)	<0.01
Triglycerides >150 mg/dL, n (%)	N = 31 (13.90%)	N = 57 (74.02 %)	<0.01
Increased BP (⩾130/85 mm Hg, or on therapy), n (%)	N = 82 (36.77%)	N = 64 (83.11 %)	<0.01
Fasting glucose 100 to 125 mg/dL, n (%)	N = 25 (11.21%)	N = 30 (38.96 %)	<0.01

Table 3 shows the association traits of metabolic syndrome and relative risk (RR) for incidence of CVD and T2DM. RRs for CVD and T2DM was found more in subjects with 1/2 or 3 of the metabolic syndrome traits as compared to subjects without any metabolic syndrome traits. This relative risk was found to be associated more w.r.t. T2DM.

Table 3: At a 2-year follow-up, Metabolic Syndrome and Age-Adjusted Risk

Event	No. of metabolic syndrome risk factors	N = 300
CVD	0	Referent
	1 or 2	1.43
	≥ 3	3.94
Hard CHD	0	Referent
	1 or 2	0.95

	≥ 3	2.53
Total CHD	0	Referent
	1 or 2	1.22
	≥ 3	2.99
T2DM	0	Referent
	1 or 2	4.01
	≥ 3	22.99

Discussion

CVD has become one of the most serious dangers to human health, and significant attempts have been made to find improved predictors of CVD occurrence. As a result, the MS has received a lot of attention and the majority of the findings imply that the MS is a strong alternative predictor of the chance of getting CVD[14]. Over a two-year follow-up period, we found a 50 percent rise in the prevalence of metabolic syndrome, adjusted for age. Overweight and obesity, as well as the proclivity for risk variables to cluster with excess adiposity, are probably associated with the increased frequency at the follow-up assessment.[1,15] The current metabolic syndrome trend analysis was limited to people who competed both questionnaire and part of the higher prevalence can be attributable to aging. The NHANES reports show substantially lower trends, and estimates are based on two different cross-sectional surveys.[16]

Several studies have looked at the risk of new CVD events in people who had previously been diagnosed with the metabolic syndrome and identified similar vascular risk elevations as the current study,[17,18] but it's difficult to extrapolate from the experience of a population at high risk for CHD.[19, 20] Hyperinsulinemia has been recommended as a particularly useful marker for identifying those with the metabolic syndrome who are at higher risk of cardiovascular disease.[21] We didn't have fasting insulin measurements at the start of the study, but we did notice a twofold increase in the risk of vascular disease among subjects with metabolic syndrome. A higher number of metabolic syndrome features was associated with a higher risk of events (Table 3). According to previous studies, CVD risk variables have an additive influence on CVD risk, and the same is true for metabolic syndrome features and CVD and T2DM risk.[22,23]

The current prevalence of metabolic syndrome (25.67%) analysis agrees with NHANES survey results from 1988 to 1994, which showed that 23% of US people aged ≥20 had metabolic syndrome.[24] Differential risks for T2DM and CVD have been suggested in Scandinavian research, with people with risk factor clustering having a 4-fold higher chance of T2DM[25] but only a 30% higher risk of CVD.[17,26,27,28] In the Insulin Resistance Atherosclerosis Study, people with low insulin sensitivity had a higher risk of coronary artery disease.[29]

The clustering of metabolic syndrome components results in a 5 and 2 fold increased risk for type 2 diabetes mellitus and CVD, respectively. It has been speculated that the extremely high prevalence of metabolic syndrome among diabetic patients may be due to the large number of patients who already have a history of CVD[30-31]. Incidence of CVD among diabetic patients with metabolic

syndrome was higher than those without metabolic syndrome[32]. A recent review also proposed that metabolic syndrome could be a predictor for type 2 diabetes mellitus and CVD. Moreover the study have suggested metabolic syndrome is useful in clinical practice, especially for the prediction of diabetes[33].

The risk of developing T2DM was shown to be significantly higher among people who had metabolic syndrome at the start of the research. The current findings demonstrate that IFG (impaired fasting glucose) without awareness of other factors, or IFG in combination with one or more metabolic syndrome features, warrants special attention because it predicts poor glycemic control and future T2DM development. However, trait combinations without IFG were linked to an elevated likelihood of incident T2DM, which supports the idea that metabolic syndrome trait combinations reflect an underlying insulin-resistant pathophysiology.

Insulin resistance is a potent risk factor for diabetes and is located in a pivotal stage on the causal pathway,[34] but insulin resistance may play a smaller role in the development of CVD, especially if dyslipidemia, hypertension, and the cohort's age are taken into account.[35] In people with poor glucose tolerance, improving metabolic syndrome features through lifestyle interventions or pharmaceuticals has been proven to successfully prevent or delay the development of T2DM.[36] According to Wong ND[37], the features of metabolic syndrome prolong in numerous diabetics even with aggressive therapy targeted at increased glucose concentration and CVD risks. Thus, therapy targeting multiple factors of CVD risk in type 2 diabetes patient is indispensable. The limitation of present study is small sample size and it require more prolonged followup.

Conclusion

We've proven an upward thrust in the superiority of the metabolic syndrome over two years in a populace-primarily based total pattern that has been tested twice. The metabolic syndrome accelerated the risk for CVD in males and T2DM among both male and female in middle-elderly adults. Our findings endorse that there can be value for diagnosing the metabolic syndrome, not only to manage insulin resistance but also to discover individuals (with a very detrimental metabolic state that warrants specific intervention for precise developments.

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