ORIGINAL ARTICLE

A Comparative Study of Metabolic Syndrome Among Diabetic & Non-Diabetic Patients

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ABSTRACT

BACKGROUND: Metabolic syndrome encompasses a set of condition of which obesity in particular visceral obesity is an important component. Obesity has positive correlation with incidence and severity of diabetes. The risk of Type 2 Diabetes mellitus has been shown to rise markedly with increase in degree of obesity. **AIM**: The present study was conducted to compare the incidence of metabolic syndrome in diabetic and non-diabetic subjects. **MATERIAL AND METHODS**: The study included 100 subjects, of whom 50 were non-diabetic and 50 were diabetic patients. The subjects were studied by detailed history taking, clinical examination, anthropometric measurements and relevant investigations using a proforma specially designed for this study. The study group was matched with the Age, Gender &Body mass Index, to compare the important variables. Relevant Statistical analysis was done. **RESULTS:** Study shows that the incidence of metabolic syndrome in diabetic subjects is positively associated with increasing age. The incidence of Metabolic Syndrome in diabetic subjects was found to be high i.e, 70%, which is statistically significant when compared to non-diabetic subjects i.e, only in 26%. Over 90.9% diabetic subjects with duration of diabetes >5 years had metabolic syndrome. On the other hand only 53.5% of subjects with a duration of diabetes <5 years had metabolic syndrome. Hypertension was found to be more prevalent in diabetic subjects with metabolic syndrome i.e, 70%. In the diabetic subjects with metabolic syndrome all 100% had raised triglyceride & LDL levels and 66.7% had low HDL levels. The BMI of $\geq$25 kg/m^2 was found in 70% of diabetic subjects with metabolic syndrome whereas in non-diabetic subjects with metabolic syndrome, it was only 27.6%.In our study, raised waist circumference in diabetic subjects with metabolic syndrome was found to be in 70%, whereas in non-diabetic subjects with metabolic syndrome the waist circumference was found to be raised in 86.7%. Insulin resistance was found in all 100% subjects with metabolic syndrome among diabetic & non-diabetic groups. **CONCLUSION:** In this study, the incidence of Metabolic Syndrome in diabetic subjects was found to be high which is statistically significant when compared to non-diabetic subjects.

Key Words: Metabolic syndrome, Diabetes mellitus, Insulin Resistance, Obesity.

INTRODUCTION

Diabetes mellitus is a group of metabolicdisorderscharacterizedbyhyperglycemiaresulting from defects in insulin secretion, insulin action or both.The clustering of insulin resistance, dysglycemia, dyslipidemia and hypertension was originally defined as Syndrome X in 1988 by Gerald Reaven.[1] Definitions of the metabolic syndrome that also include a measure of central obesity have been developed between 1999 and 2001.In 2001, the US National Cholesterol Education Program Adult Treatment Panel (NCEP ATP III) released a new definition of the metabolic syndrome.[2] This definition was intended to be more clinically oriented, and required subjects to have at least three of five clinical/metabolic abnormalities, which included the following:1) abdominal obesity(defined as a waist circumference > 35 inches for women and >40 inches for men); 2) hypertriglyceridemia (fasting triglycerides >150mg/dL); 3) low high-density lipoprotein cholesterol(LDL) (< 50mg/dL for women or < 40 mg/dL for men); 4) elevated blood pressure (130/85 mm Hg); or 5) hyperglycemia (a fasting glucose >110 mg/dL, impaired glucose tolerance, or diabetes). Notably evidence

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of insulin resistance was not a requirement for diagnosis with these criteria, reflecting the uncertainty that the expert committee about the etiology of the syndrome. Metabolic syndrome encompasses a set of condition of which obesity in particular visceral obesity is an important component. The metabolic syndrome seems to have 3 potential etiologicalcategories: obesity and disorders of adipose tissue; insulinresistance; and a constellation of independent factors (eg,molecules of hepatic, vascular, and immunologic origin) thatmediate specific components of the metabolic syndrome.[3]Otherfactors—aging, proinflammatory state, and hormonal changes—havebeen implicated as contributors as well. Individuals with metabolic syndromes are at the highest risk of future cardiovascular diseases.Obesity has usually shown positive correlation with incidence and severity of diabetes. The risk of Type 2 DM has been shown to rise markedly with increase in degree of obesity. it has been shown that central obesity (visceral fat) has positive correlation with insulin resistance and is a strong risk factor for CVD(Cardio Vascular Disease)and a strong predictor of future DM. This realization has brought the concept of measuring waist circumference as an indicator of insulin resistance. Insulin resistance is thought to be primary pathophysiological process involved in metabolic syndrome.

OBJECTIVES OF THE STUDY:

Objective ofthe study is to estimate the incidence of Metabolic Syndrome in diabetic patients and non-diabetic patients.

MATERIAL &METHODS

The Non-randomized comparative study comprises of patients of Type-2 diabetes mellitus & non-diabetes (who may be the spouses or relatives of the patients or any others who will be matched with the cases) both inpatients and outpatients in the Department of Medicine, Kempegowda Institute of Medical Sciences Hospital, Bangalore. An informed consent was taken from all the subjects in the study and control groups. The study protocol was approved by the ethical committee of the hospital. The data for this study was collected from 50 patients with diabetes mellitus and 50 matched controls (non-diabetics) by detailed history taking, clinical examination, anthropometric measurements and relevant investigations. The data collected in this study was analyzed statistically. Inclusion Criteria**:** Type-2 diabetes mellitus patients with duration greater than 6 months and matched non-diabetics. Exclusion Criteria: Patients who are on insulin therapy and gestational diabetes patients. A detailed clinical history, physical examination and relevant investigations were undertaken. Routine physical examination was done and anthropometric measurements like body mass index (BMI), waist circumference (WC), waist-hip ratio (WHR) were calculated in all patients. Vital parameters like pulse, BP etc..of each patient wererecorded. Clinical examination was done for the evidence of complications of diabetes, hypertension, & dyslipidemia. Investigationsincludes: Fasting plasma glucose,Post prandial plasma glucose, Bloodurea,SerumCreatinine, Fasting Lipid profile, Glycosylated haemoglobin (HbA1c %), Fasting Serum Insulin, Urine Routine, ECG.

Body mass index (BMI): BMI was calculated from the formula BMI = weight in kg / height in m2.

Waist Circumference (WC): Waist circumference was measured using an inelastic tape placed midway between the lower ribs and iliac crests on the mid-axillary line.

Waist-Hip Ratio (WHR): WHR = waist circumference (cm) / hip circumference (cm).

Assessment of Insulin Resistance by Homeostasis Model Assessment method

(HOMA): Fasting glucose (mg/dL) X Fasting serum insulin (µU/mL) / 22.5.

STATISTICAL METHODS

Figure 1: Gender Distribution

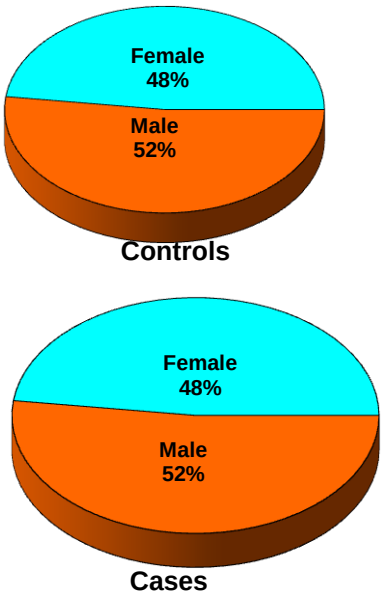

Figure 2: Presence of Hypertension

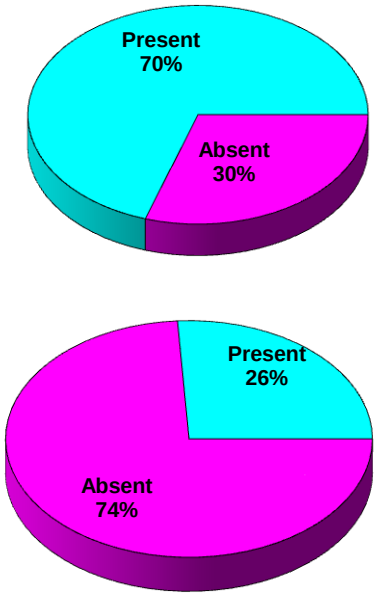

Figure 3: Comparison of Waist Circumference

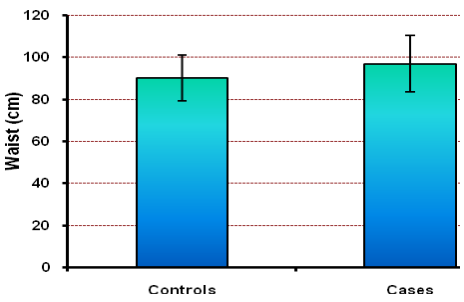

Table 1: History of dyslipidemia and CAD

History	Controls (n=50)		Cases (n=50)		P value
	No	%	No	%	
Dyslipidemia	4	8.0	35	70.0	<0.001**
CAD	2	4.0	5	10.0	0.240

Table 2: Comparison of Metabolic Syndrome in cases and controls

Metabolic syndrome	Controls (n=50)	Cases (n=50)
Absent	37(74.0%)	15(30.0%)
Present	13(26.0%)	35(70.0%)
Inference	Incidence of metabolic syndrome is significantly more (6.64 times more) in cases when compared to controls with χ^2=19.391; P<0.001**	

The data thus obtained was tabulated and represented in figures. Subjects were studied after sub-classifying them in to different groups for comparison of important variables. Data collected for the study was analyzed statistically. Statistical Methods: Descriptive statistical analysis has been carried out in the present study. Results on continuous measurements are presented on Mean ± SD (Min-Max) and results on categorical measurements are presented in Number (%). Significance is assessed at 5 % level of significance. Z-test for proportion has been used to find the significant incidence of metabolic syndrome with study characteristics. Student t test has been used to find the significance of parameters on continuous scale between controls and cases. Chi-square test has been used to find the significance of parameters on categorical between controls and cases.

RESULTS

The study group (Controls & Cases) was matched with the Age, Gender & BMI, to compare the important variables. The subjects were also grouped based on duration of diabetes & duration of hypertension. Maximum numbers of subjects were in the age group of 51-60 years, and minimum were in the age group of 35-40 years. Mean age in controls was 52.44 (Standard Deviation, SD: 9.19) and in cases was 52.66 (SD: 9.1). Gender is matched in both the groups. Samples are gender matched with P=1.000. 52% males and 48% females were studied in both the groups.

Hypertension was found to be more in cases group i.e 70% than in control group i.e 26% . More percentage of subjects were found to be hypertensive of ≤ 5 years duration in cases group, whereas in controls group, more percentage of subjects were found to be hypertensive of 6-10 years duration.

History of Dyslipidemia in controls was observed to be 8.0% and in cases it was 70.0%. There is significantly more incidence of dyslipidemia in cases., while the incidence of CAD is statistically similar with P=0.240.

Mean BMI in cases and controls is statistically similar (P=0.918) when compared to waist circumference, which is significantly more in cases with P=0.008*.

HOMA levels >2.5 in diabetic subjects with metabolic syndrome & in non-diabetic subjects with metabolic syndrome were found in all 100% subjects

Incidence of Metabolic Syndrome was significantly more in cases when compared to controls (6.64 times more).

DISCUSSION

The Metabolic Syndrome is a constellation of risk factors of metabolic origin that are accompanied by increased risk for cardiovascular disease and type 2 diabetes. The two major underlying risk factors for the metabolic syndrome are obesity and insulin resistance. In many patients, the metabolic syndrome culminates in type 2 diabetes, which further increases risk for cardiovascular disease. Simple clinical criteria are available to identify persons most likely to have the syndrome. Statistical analysis in this study shows that the Incidence of metabolic syndrome in diabetic subjects is positively associated with increasing age i.e 28.6%, 45.5% & 81.8% in the age groups of 35-40, 41-50 & 51-60 years respectively. However, the similar association is not found in the non-diabetic subjects. The study done by Earl S. Ford et al [4] and Louis Guize et al[5]also shows the increasing prevalence of metabolic syndrome with the age. The incidence of metabolic syndrome in diabetic subjects is associated with elevated levels of FBS &PPBS.In this study, the incidence of Metabolic Syndrome in diabetic subjects (cases group) was found to be high i.e, 70%, which is statistically significant (6.64 times more) when compared to non-diabetic subjects (P <0.001). Similar resultsi.e, 64% were shown in the Indian study done by Vijay Achari et al in Patna.[6]Similar, and higher prevalence of metabolic syndrome in diabetic population was found in the study done by Isomaa& coworkers from Finland & Sweden where they found that 80% of diabetics had metabolic syndrome.[7] Likewise, the study done by Haffner& coworkers also shows the higher prevalence i.e, 85% of diabetic population had metabolic syndrome. [8]

Conversely in non-diabetic subjects (Control group), the metabolic syndrome was found to be less prevalent i.e, only 26%. Chennai Urban Population Study -7 (CUPS-7) done by Deepa R et al in South Indian population[9]also shows less prevalence of metabolic syndrome i.e, only 18.7% in general population, which correlates with this study. Indian study done by S.R. Mahadik et al in non-obese Indians shows 35.2% prevalence which signifies more prevalence than our study.[10]Study done by DogfengGu et al in China[11] during 2000-2001 shows 18.2% prevalence of metabolic syndrome in general population .

Raised incidence of metabolic syndrome i.e, 90.9% has been observed in the diabetic subjects in those with duration of diabetes > 5 years whereas the incidence of metabolic syndrome in diabetic subjects with duration of diabetes <5 years was only 53.5%.It implies that the prevalence of metabolic syndrome increases as the duration of diabetes increases. Study done by S.H. Song et al in United Kingdom also shown the similar results i.e, >90% prevalence of metabolic syndrome in subjects with duration of diabetes >5 years.[12]

Hypertension was found to be more prevalent in diabetic subjects with metabolic syndrome i.e, 70%, whereas in non-diabetic subjects with metabolic syndrome, it was found to be less prevalent i.e, only 26%. The study done by

Herman Taylor et al in African Americans during 2000-2004 also shows similar results i.e, 70.4% of diabetic subjects with metabolic syndrome had hypertension.[13]The raised triglyceride levels in diabetic subjects with metabolic syndrome was found to have in all 100% subjects, whereas in non-diabetic subjects with metabolic syndrome it was found in only 86.7% subjects, indicating that higher triglyceride levels in diabetic subjects with metabolic syndrome was statistically significant and positively associated with incidence of metabolic syndrome. Similar results were also shown by Louis Guize et al in French people during 1999-2002.[14] Metabolic syndrome was present in all the subjects with CAD in both the diabetic & non-diabetic groups. It alarmingly shows that the metabolic syndrome needs to be identified earlier to prevent the CAD.The BMI of ≥25 kg/m^2 was found in 70% of diabetic subjects with metabolic syndrome whereas in non-diabetic subjects with metabolic syndrome, it was only 27.6%. It indicates that higher BMI is positively associated with metabolic syndrome in subjects with diabetes but not in non-diabetics. HOMA levels >2.5 in diabetic subjects with metabolic syndrome & in non-diabetic subjects with metabolic syndrome were found in all 100% subjects. HOMA >2.5 in adults is considered to be indicative of insulin resistance. [15]

It indicates that all the metabolic syndrome subjects were prone to have insulin resistance irrespective of the diabetes. Evaluation of waist circumference and BMI for predicting the metabolic syndrome by using the regression analysis revealed that the waist circumference is the better predictor of metabolic syndrome in both diabetic and non-diabetic subjects. Metabolic Syndrome in our population is quite prevalent in both diabetic and non-diabetic groups. A simple measurement of waist circumference & or BMI which can be done at any clinic or peripheral health care level can identify a patient at risk for metabolic syndrome. Further simple investigations like blood glucose, Triglycerides and HDL Cholesterol can be done to diagnose metabolic syndrome. These patients could then be subjected to life style changes and further follow-up to prevent the progression to Type-2 diabetes mellitus and ASCVD.

CONCLUSION

Different criteria are available to diagnose metabolic syndrome at the peripheral level with the use of simple parameters. Population at high risk for metabolic syndrome are to be advised for intensive life style modifications along with therapies for different risk factors to prevent the progression to diabetes and atherosclerotic cardiovascular diseases.

LIST OF ABBREVIATIONS

ASCVD -Atherosclerotic Cardio Vascular Diseases
CAD - Coronary Artery Diseases
DM - Diabetes mellitus
FBS - Fasting Blood Sugar
PPBS - Post Prandial Blood Sugar
BMI - Body Mass Index
WHR - Waist Hip Ratio
TG - Triglycerides
TC - Total Cholesterol
HDL - High Density Lipoprotein
IDF - International Diadetes Federation
VLDL - Very Low Density Lipoprotein
LDL - Low density Lipoprotein
HTG - Hypertriglyceridaemia
HOMA - Homeostasis Model Assessment of Insulin Resistance
WHO - World Health Organization
WC - Waist Circumference

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