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

[1]Shaik Hussain Basha and [2]M. Murali Krishna
[1,2]Department of General Medicine, Fatima Institute of Medical Sciences, Kadapa, A.P. India

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Corresponding Author
M. Murali Krishna,
Department of General Medicine, Fatima Institute of Medical Sciences, Kadapa, A.P. India

Author Designation
[1,2]Assistant Professor

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ABSTRACT
The current study analyzes the prevalence of metabolic syndrome in diabetic and nondiabetic subjects and its association with individual risk factors. To estimate the prevalence of metabolic syndrome in diabetic and non-diabetic patients. The data for this study were collected from 100 patients with diabetes mellitus and 100 non-diabetic patients (gender and BMI matched controls) who presented to the Department of Medicine. A detailed history, clinical examination and anthropometric measurements were undertaken and relevant investigations were done. Subjects were classified in to different groups for comparison of important variables and the data collected were analyzed statistically. The prevalence of Metabolic Syndrome in diabetic subjects (cases group) was found to be high, i.e., 67%, which is statistically significant (P=0.0001) compared to non-diabetic subjects (Control group), which was 38%. The prevalence of the metabolic syndrome is high in people with diabetes of duration <0.05). In this study, the prevalence of metabolic syndrome in diabetic subjects was found to be higher than in non-diabetics. Hypertension was found to be more prevalent in diabetic subjects with metabolic syndrome than in non-diabetic subjects with metabolic syndrome. Raised triglyceride levels and low HDL cholesterol levels were observed in diabetic subjects with metabolic syndrome, though not statistically significant. Higher BMI and increased waist circumference are observed in patients with metabolic syndrome in subjects with diabetes but are statistically not significant. Increased WHR is observed in diabetics with MS, which is statistically significant. Lifestyle modifications, along with therapies for different risk factors, should be advised to prevent the progression to diabetes and atherosclerotic cardiovascular diseases.

INTRODUCTION

The metabolic syndrome, also known as syndrome x, has become one of the major public health challenges worldwide due to raising urbanization, surplus energy intake, obesity and sedentary lifestyle habits[1]. Furthermore, there is a 5-fold increase in risk for development of type 2 diabetes mellitus[2]. In the prospective Framingham cohort, both metabolic syndrome and diabetes and were powerful risk factors. 10-year risk assessment of ischemic stroke associated with diabetes is 14% in men and 10% in women when compared with 8% and 6% in nondiabetic men and women, respectively, with the metabolic syndrome alone[3]. Metabolic syndrome is considered a first-order risk factor for atherothrombotic complications and, therefore, be considered an indicator of long-term risk[4]. In 1988 Gerald Reaven defined the clustering of insulin resistance, dysglycemia, dyslipidemia and hypertension as Syndrome X[5]. Between1999 and 2001, the European Group for the Study of Insulin Resistance (EGIR., Balkau and Charles, 1999), World Health Organization (WHO Consultation, 1999) and the National Cholesterol Education Program (NCEP) Expert Panel on Detection, Evaluation and Treatment of High Blood Cholesterol in Adults [also known as Adult Treatment Panel (ATP III)] included central Obesity in the Definitions of the metabolic syndrome measure.

Components of the Metabolic Syndrome[6]:

- Abdominal obesity
- Atherogenic dyslipidemia.
- Raised blood pressure.
- Insulin resistance±glucose intolerance.
- Proinflammatory state.
- Prothrombotic state.

Obesity, Diabetes and Metabolic Syndrome: Obesity is a condition where there will be an abnormal increase in adipose tissue in the form of an increase in fat cell number (hyperplastic obesity)enlargement of fat cell size (hypertrophic obesity) or both[7]. Metabolic syndrome comprises a set of conditions of which obesity, in particular, visceral obesity, is an important component. There is a positive correlation between obesity and the incidence and severity of diabetes[8]. With increase indegree of obesity, the risk of Type 2 DM also rises markedly[8]. However, traditional tools for measuring obesity like BMI do not take into account the distribution of body fat. Of late, central obesity (visceral fat) has been shown to have a positive correlation with insulin resistance as well as a strong risk factor for CVD and a strong future predictor DM[9]. Thus came to the concept of measuring waist circumference as an indicator of insulin resistance and Insulin resistance is thought to be the primary pathophysiological process involved in metabolic syndrome[10].

Aims and Objectives:

- The study aims to estimate the prevalence of Metabolic Syndrome in diabetic patients and non-diabetic patients.
- To know the association of various risk factors with metabolic syndrome in diabetic patients and non-diabetic patients.

MATERIALS AND METHODS

Source of Data: The non-randomized comparative study comprises of patients of Type-2 diabetes mellitus and non-diabetes (who were with patients or any others who were matched for gender and BMI with the cases) both outpatients and inpatients in the Department of Medicine.

Method of Collection of Data: The data were collected from 100 patients with diabetes mellitus and 100 matched controls (non-diabetics) by detailed history taking, clinical examination, Anthropometric measurements and relevant investigations. The data collected in this the study was analyzed statistically.

Duration of Study: Two years.

Inclusion Criteria: Type-2 diabetes mellitus patients with a duration greater than six months and BMI and gender-matched non-diabetics.

Exclusion Criteria:

- Gestational diabetes patients.
- Volume overloaded conditions.

Clinical History:

- A detailed clinical history, general physical examination, systemic examination and relevant investigations were done.
- History regarding the duration of diabetes mellites, systemic hypertension, dyslipidemia, cerebrovascular accidents, coronary artery disease was recorded.
- Treatment history regarding diabetes Mellitus, systemic hypertension, dyslipidemia, cerebrovascular accidents coronary artery disease was recorded.
- History regarding smoking and alcoholism was taken.
- general physical examination was done in all patients
- Waist circumference (WC), waist-hip ratio (WHR), body mass index (BMI) were calculated for all patients
- Vital parameters of each patient were recorded.
- Relevant clinical examination was done for the evidence of complications of diabetes, hypertension and dyslipidemia.

Investigations:

- Fasting plasma glucose.
- Postprandial plasma glucose.
- Blood urea.
- Serum Creatinine.
- Fasting Lipid profile.
- Glycosylated hemoglobin (HbA1c %).
- Serum uric acid levels.
- Urine examination.
- Electrocardiogram (ECG).

Analysis of Data: A descriptive statistical analysis was done on the data collected. The results for continuous measurements are presented on Mean±SD (Min-Max), and results on categorical measures are shown in Number (%). Statistical evidence is at 5% level of significance. The student t-test has been used to find the significance of parameters on a continuous scale between controls and cases. A chi-square test has been used to find the significance of parameters on categorical between controls and cases.

RESULTS AND DISCUSSIONS

A Cases-Control clinical study on 100 Non-diabetic subjects (Control Group) and 100 Type 2 Diabetic patients (Cases group) is undertaken to study the prevalence of metabolic syndrome, to identify the risk factors associated with the metabolic syndrome. The study groups (Controls and Cases) were matched for Gender and BMI, to compare the important variables. The majority of study subjects in both groups are in the age group of 51-70 years (55%). There is a statistically significant difference in age distribution among two groups with a p-value of 0.011. Gender is matched in both groups. Samples are gender-matched with P=1.000. 50% males and 50% females were studied in both the groups. More percentage of subjects (52%) were found to be diabetic of $\leq$5 years duration. Hypertension was found in 55% and 40% of cases and controls, respectively, with a p-value of 0.589. This difference is statistically insignificant. CAD was found in 15% and 13% of cases and controls, respectively, with a p-value of 0.684. This difference is statistically insignificant. CVA was found in 5% and 6 % of cases and controls, respectively, with a p-value of 0.756. This difference is statistically insignificant. Dyslipidemia was found in 61% and 51 % of cases and controls, respectively, with a p-value of 0.154. This difference is statistically insignificant. The mean BMI in case and control groups is 26.5±3.94 and 26.9±3.58, respectively. This mean difference is statistically insignificant (p-value of 0.863). The mean waist circumference in case and control groups is 98.68±10.50 and 98.08 ± 11.22, respectively. This mean difference is not statistically significant, with a p-value of 0.697. The mean difference in FBS, PPBS, HBAIC, HDL and Uric acid was statistically significant among two groups with a p-value of 0.0001, 0.0001, 0.0001, 0.011 and 0.001 respectively. Metabolic syndrome is present in 67% of diabetic subjects and 38% of non-diabetic subjects, which is statistically significant with a p-value of 0.0001. More number of males had metabolic syndrome when compared with females. But this is statistically insignificant (p-value is 0.229). Age, WHR and uric acid levels are the parameters that are significantly associated with metabolic syndrome ($p<0.05$). The mean age in patients with metabolic syndrome in cases is 54.670±8.76 and in controls is 48.92±10.14. This mean difference between the two groups is statistically significant, with a p-value of 0.003. As the duration of diabetes is increased, the prevalence of the metabolic syndrome is decreased. The prevalence of the metabolic syndrome is increased with increased hba1c levels. Raised TGL level is associated with metabolic syndrome in 91% of diabetics whereas 58% in nondiabetics. Low HDL cholesterol is associated with Mets in 72% of diabetics whereas 58% in nondiabetic subjects. CAD is associated with MS in 60% of diabetics whereas 46% in nondiabetic subjects CVA is associated with MS in 40% of diabetics whereas 50% in nondiabetic subjects. Hyperuricemia is associated with MS in 85% of diabetics whereas 75% in nondiabetic subject. Metabolic Syndrome is a group of risk factors of metabolic origin and is associated with elevated risk for cardiovascular disease and diabetes mellitus. Obesity and insulin resistance are the two primary underlying risk factors for metabolic syndrome a. the metabolic syndrome culminates in diabetes in many patients, which further increases the risk for cardiovascular disease. Simple clinical criteria are available to identify the people most likely to have metabolic syndrome. The study was conducted to compare the prevalence of metabolic syndrome in diabetic and non-diabetic subjects. The study included 200 subjects, of whom 100 were non-diabetic (controls) and 100 were diabetic subjects (cases). In this study, the total prevalence of metabolic syndrome in males is 58.1% and 41.9% in females. The prevalence of MS is more in males when compared with females in both diabetic and nondiabetic groups. This difference is not statistically significant, with a p-value of 0.229. Similar to the study done by Earl S. Ford *et al.* and Louis Guize[11] Indian research done by Vatakencherry *et al.* in Kochi also showed a prevalence of Mets more in men when compared with women[12]. These two studies showed less prevalence of metabolic syndrome among nondiabetics when compared to the present study suggesting the overall increasing trend in the prevalence of metabolic syndrome. The possible explanation could be because of improving socio-economic status, excess food intake and

Table 1. Duration of Diabetes in Cases and Controls

Duration of diabetes	Number of diabetics (n)	Percentage(%)
≤5 years	52	52
6-10 years	33	33
>10 years	15	15
Total	100	100

Table 2. Distribution of Hypertension, CAD, CVA and Dyslipidemia

Parameters		Cases	Controls	p-value
Hypertension	Yes	55	40	0.589
	No	45	60	
CAD	Yes	15	13	0.684
	No	85	87	
CVA	Yes	5	6	0.756
	No	95	94	
Dyslipidemia	Yes	61	51	0.154

Table 3. Comparison of Lab Parameters

Lab parameter	Cases (Mean±SD)	Control (Mean±SD)	p-value
FBS	137.02±55.64	104.78±34.67	0.0001
PPBS	190.94±79.28	136.10±42.96	0.0001
HBA1C	6.87±1.86	4.76±1.12	0.0001
TRIGLYCERIDES	158.77±42.54	174.27±80.71	0.091
HDL	43.63±8.93	47.00±9.57	0.011
URIC ACID	5.10±0.91	4.53±0.90	0.001

Table 4. Metabolic Syndrome in Diabetes and Non Diabetics

Metabolic syndrome	Cases (n=100)	Controls(n=100)	Total	P value
Yes	67(67%)	38(38%)	105(52.5%)	0.0001
No	33(33%)	62(62%)	95(47.5%)	

Table 5. Association of Risk Factors in the Presence and Absence of Metabolic Syndrome

Risk factors	Metabolic syndrome	Cases (mean±SD)	Controls (mean±SD)	p-value
Age	Present	54.67±8.76	48.92±10.14	0.003
	Absent	53.78±7.12	51.14±11.28	0.225
BMI	Present	25.66±4.24	26.85±3.40	0.144
	Absent	25.28±3.23	25.02±3.72	0.224
Waist	Present	100.6± 9.63	97.32±10.64	0.110
	Absent	94.79±11.23	98.55±11.62	0.13
Waist hip ratio	Present	0.96±0.63	0.93±0.56	0.002
	Absent	0.96±0.17	1.10±1.14	0.482
FBS	Present	137.03±53.51	107.73±13.46	0.004
	Absent	137.01±60.60	102.96±33.03	0.001
PPBS	Present	192.74±73.35	142.63±49.80	0.0001
	Absent	187.27±91.45	132.11±38.06	0.0001
HBA1C	Present	7.01±1.84	5.03±1.11	0.0001
	Absent	6.56±1.88	4.59±1.10	0.0001
TGL	Present	161.16±43.891	185.13±86.78	0.63
	Absent	153.91±39.89	167.67±76.71	0.341
HDL	Present	43.04±8.16	47.95±11.02	0.11
	Absent	44.82±10.36	46.62±8.60	0.424

Table 6. Association of Hypertension CVA, CAD, Dyslipidemia with Metabolic Syndrome in Diabetics And Non Diabetics

Parameter	Metabolic syndrome	Cases(n)	Controls (n)	Total	p-value
Hypertension	Present	40(57.9%)	12(31.6%)	52(49.5%)	0.006
	Absent	15(45.5%)	28(45.2%)	43(45.3%)	0.978
CVA	Present	2(3%)	3(7.9%)	5(4.8%)	0.256
	Absent	3(9.1%)	3(4.85%)	6(6.3%)	0.417
CAD	Present	9(13.4%)	6(15.8%)	15(14.3%)	0.74
	Absent	6(18.2%)	7(11.3%)	13(13.7%)	0.35
Dyslipidemia	Present	43(64.2%)	22(57.9%)	65(61.9%)	0.524

Table 7. HBA1C and Metabolic Syndrome

hba1c	number n	metabolic syndrome n	percentage of metabolic syndrome among the subjects
<6	45	32	71%
6.1-7	21	15	71
7.1-8	9	7	77
8.1-9	9	7	77
9.1-10	12(12%)	10	83
>10.1	4(4%)	4	100

sedentary lifestyle with reduced physical activity contributing to obesity in particular abdominal obesity and proinflammatory state, which triggers the excess release of insulin and insulin resistance states. Among 100 diabetic subjects, more percentage of subjects, i.e., 50.7%, were found to be diabetic of less than five years duration and 49.2% of subjects were found to be diabetic of >5 years. Raised incidence of metabolic syndrome, i.e., 50.7%, has been observed in the diabetic subjects in those with a duration of diabetes <5 years, whereas the prevalence of metabolic syndrome in diabetic subjects with a period of diabetes

6-10 years was 35.8% and >10 years was 13.4% years. This implies that the prevalence of metabolic syndrome decrease as the duration of diabetes increases. 10 and >10 respectively. Dyslipidemia was seen in 64.2 % in diabetic subjects with metabolic syndrome and in non-diabetic subjects, it was present in 57.4%. Low HDL Cholesterol levels in diabetics with metabolic syndrome were found to be 72.13%, whereas, in non-diabetic subjects, low HDL Cholesterol levels were seen to be 58%. Again, there is no statistically significant difference in mean HDL level in cases and controls with metabolic syndrome, indicating that though low HDL was found in more number of diabetics with metabolic syndrome, this is not statistically significant with a p-value of 0.11. CAD was present in 13.4% of diabetic subjects with MS and 15.8% of nondiabetic subjects. There is no statistically significant difference in the prevalence of CAD between both groups with metabolic syndrome with a p-value of 0.7. Metabolic syndrome was present in 60% of the subjects with CAD in diabetic group and 46%of subjects with CAD in non-diabetic groups.53% of people without diabetes and metabolic syndrome had CAD, which is higher than the group with MS without diabetes. This is in contrast to other studies. A study was done in the united states to know the association between diabetes, metabolic syndrome and heart attack[13]. CVA is present in 11% of diabetic patients with metabolic syndrome and 12.1% of non-diabetics with metabolic syndrome. There is no statistically significant difference in the prevalence of CVA between both the groups with metabolic syndrome with a p-value of 0256. In the diabetic group, metabolic syndrome observed in 40 percent of patients with CVA. In the non-diabetic group, 50% of patients with CVA had metabolic syndrome. This indicates it is metabolic syndrome, which is more associated with stroke than diabetes, although diabetics have an increased risk of stroke regardless of the level of metabolic control. Several studies have evaluated the relationship between insulin resistance and stroke. ARIC study showed an increase in RR for ischemic stroke with an increase in basal insulin levels among the nondiabetic population[14].

There are very limited studies that were done to compare the metabolic syndrome in diabetics and nondiabetics. More studies are needed to be done in this area to know the association of various risk factors with metabolic syndrome, to know risk factor that is contributing more for the incidence of metabolic syndrome and predicting the onset of metabolic syndrome based on the individual risk factor. Raised triglyceride and low HDL levels were noted in both groups with metabolic syndrome, though it is higher in the diabetic group with metabolic syndrome. But, it is statistically not significant. Serum uric acid levels are found to be more in the diabetic group with MS than the controls and this difference is statistically significant. The mean BMI is almost similar in both the groups with metabolic syndrome and the difference between mean BMI in both the groups with MS is not statistically significant, concluding that BMI is not contributing to the increased prevalence of Mets in the present study. Age, WHR and uric acid levels are the parameters that are significantly associated with metabolic syndrome ($p<0.05$). The prevalence of the metabolic syndrome is high i.e., 67% in diabetic subjects and 38% in non-diabetic subjects indicating the presence of high risk for metabolic syndrome in our population.

CONCLUSION

The prevalence of metabolic syndrome is more in people with diabetes compared to nondiabetics .The prevalence of Mets is more in diabetics of duration <5 years. Age, WHR and uric acid levels are the parameters that are significantly associated with metabolic syndrome ($p<0.05$). There is no statistically significant difference in the levels of TGL, HDL, BMI, Waist circumference between cases, and controls with metabolic syndrome. Lifestyle modifications along with therapies for different risk factors to prevent the progression to diabetes and atherosclerotic cardiovascular disease.

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