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A COMPARATIVE STUDY OF METABOLIC SYNDROME AMONG DIABETIC AND NON-DIABETIC PATIENTS IN A TERTIARY CARE HOSPITAL

General Medicine

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ABSTRACT

Background: Relationship of diabetes with metabolic syndrome is often temporal in nature as diabetes is not only one of the component factors of metabolic syndrome but it is also a metabolic disorder that increases the risk of metabolic syndrome too. 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. **Materials and Method:** A case control study was conducted among 100 patients(50cases and 50 control) at MIMS, Uttar Pradesh for the period of January 2021 to December 2022. Upon obtaining informed consent, demographic information, history taking, general and systemic examination, anthropometric data, blood pressure measurements, fasting and post prandial blood sugar, HbA_{1c}, blood urea, serum creatinine, triglyceride, low density lipoprotein and HDL assessment done.Inclusion of anthropometry matched cases led to matching of two groups for certain metabolic syndrome risk factors like central obesity. **Results**: Study suggestive of higher incidence of metabolic syndrome in diabetic patients(80%) compared to non diabetic patients(38%). Significantly higher proportion of cases as compared to controls had history of dyslipidaemia(case=58%,control=6%) and respiratory disease(case=6%,control=0%). Mean BMI of cases(62%) was significantly higher as compared to that of controls(26%). Cases as compared to controls had significantly higher triglyceride and significantly lower HDL levels. Incidence of low HDL levels and insulin resistance was significantly higher in cases as compared to that of controls. **Conclusion:** Incidence of metabolic syndrome was found to be higher in diabetic patient compared to non diabetic patients which was statistically significant.

KEYWORDS

Metabolic syndrome(MetS), Diabetes mellitus, Obesity, BMI, dyslipidaemia

INTRODUCTION

Diabetes is an endocrinal disease that is characterized primarily by persistent hyperglycemia and is associated with a number of complications in the long-term, *viz.*, retinopathy, nephropathy, neuropathy, cardiovascular disease and other organ systems of the body[1]. The primary metabolic reflection of the diabetes is in terms of impaired glucose metabolism, however, its metabolic impact is not only limited to glucose metabolism. Diabetes impairs the lipid metabolism too[2]. Moreover, other lipid disorders such as obesity[3] and hypertension[4] are also found to be highly prevalent in diabetic patients owing to altered glucose and lipid metabolisms. The relationship of different metabolic factors is complex and their cause-effect relationships are not fully understood. However, coexistence of other metabolic factors in diabetic patients is not uncommon and is widely documented.

The coexistence of various metabolic disorders in diabetic patients with insulin resistance is intriguing and has attracted the attention of researchers. A collective combination of these metabolic factors was first recognized by "Raeven" in 1988[5] who termed it "syndrome X". It was later recognized that insulin resistance not only triggers diabetes but is also associated with risk of cardiovascular diseases like obesity, dyslipidaemia and hypertension[6].

The common causality for risk of these cardiovascular risk factors was recognized as insulin resistance. Subsequent exploration of this problem led to its recognition as Metabolic Syndrome by WHO in the year 1998 as a distinct disorder that does not attribute to all the risk factors of insulin resistance[7]. Nevertheless, the association between insulin resistance and metabolic syndrome still continues to be widely observed and leads to the impression that diabetic patients are at an increased risk of having metabolic syndrome.

Interestingly, MetS is characterized as "an asymptomatic, patho physiological state characterised by obesity, insulin resistance, hypertension, dysglycaemia, and dyslipidaemia"[8] and defines as a useful and widely accepted term for a cluster of metabolically related cardiovascular risk factors. However, it is as much associated with a high risk of developing diabetes (if not already present)[9,10]. Thus, the relationship between diabetes and metabolic syndrome seems to be bidirectional and a number diabetic patients seem to have metabolic syndrome even before the diagnosis of diabetes.

Though, high incidence of metabolic syndrome in diabetic patients has been documented in various parts of world, however, there are few studies that quantify the risk of metabolic syndrome in diabetic patients in comparison with an age and sex-matched non-diabetic population. Hence, the present study was planned to study the incidence of metabolic syndrome in diabetic patients as compared to an age-, sex- and anthropometrically matched population without diabetes at a tertiary care teaching hospital in North India.

Objectives Of The Study:

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

MATERIAL AND METHODS

This case control study was conducted among 100 participants(50 diabetic and 50 non diabetic) at Mayo Institute of Medical Sciences, Barabanki, Uttar Pradesh after approval from the institute ethical committee. An informed consent was taken from all the subjects in the study and control groups.

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 analysed statistically. The data collected in this study was analyzed statistically. Inclusion Criteria for cases:Type-2 diabetes mellitus patients with duration of disease more than 6 months were enrolled as cases. Inclusion criteria for controls:Age, sex and anthropometrically (waist circumference)-matched non-diabetic OPD patients were enrolled as controls. Exclusion criteria 1.Diabetic patients on insulin therapy 2.Gestational diabetes.

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 of each patient were recorded. Clinical examination was done for the evidence of complications of diabetes, hypertension, & dyslipidemia. Investigations includes: Fasting plasma glucose ,Post prandial plasma glucose, Blood urea, Serum Creatinine, Fasting Lipid profile, Glycosylated haemoglobin (HbA1c %), 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).

Criteria for identifying metabolic syndrome are National Cholesterol Education Program (NCEP) ATP-III[19]. According to these criteria metabolic syndrome can be defined as follows:
Central obesity - M > 102 cm, F> 88 cm or BMI≥30 kg/m^2
Triglycerides->150 mg/dl, HDL- M< 40 mg/dl, F< 50 mg/dl , Hypertension-≥130/ 85 mm Hg , Fasting glucose -≥100 mg/dl.

Statistical Analysis:
The data was entered in an MS-Excel 2013 worksheet. Data analysis was performed using IBM SPSS Stats 21.0 version. Chi-square test and Independent samples 't'-test were used to compare the data. A 'p' value less than 0.05 was considered as statistically significant.

RESULTS

A total of 50 T2DM patients (Age range 36-84 years; Mean age 56.18±10.80 years; 52% males; mean waist circumference 88.72±10.94 cm) were enrolled as cases and a total of 50 non-diabetic OPD patients (Age range 33-69 years; Mean age 52.64±8.58 years; 52% males; mean waist circumference 88.12±9.07 cm) were enrolled as controls. Body mass index (BMI) of study population ranged from 18.90 to 30.75 kg/m². Majority of participants (56%) had BMI in 18.5-24.9 kg/m^2 (normal weight) range followed by those having BMI in overweight (25.0-29.9 kg/m^2) range and obese (BMI≥30 kg/m^2) category. Mean BMI of study population was 25.00±4.05 kg/m^2. BMI of case group ranged from 19.04 to 40.75 kg/m². Among cases majority (62%) were in overweight and obese category and only 19 (38%) were in normal weight category. Mean BMI of cases was 26.68±4.36 kg/m^2. On the other hand, in control group, BMI ranged from 18.90 to 30 kg/m^2. Majority of controls (74%) were in normal weight category followed by overweight (24%) and obese (2%) respectively. Mean BMI of controls was 23.23±2.78 kg/m^2. On comparing the BMI of cases and controls, the difference was found to be significant (p<0.001).

History of hypertension, dyslipidemia, coronary artery disease and respiratory illness was revealed by

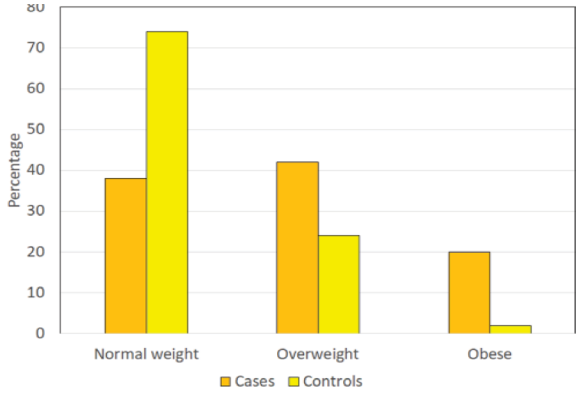

Fig. 1: Comparison of BMI profile of cases and controls

35 (70%), 29 (58%), 5 (10%) and 20 (40%) of cases and 26 (52%), 3 (6%), 3 (6%) and 3 (6%) of controls respectively. Statistically, there was a significant difference between the two groups with respect to history of dyslipidemia and respiratory illness (p<0.001).

Table-1 Comparison of cases and controls for medical history

SN	History	Cases (n=50)		Controls (n=50)		Statistical significance	
		No.	%	No.	%	2	P
1.	Hypertension	35	70	26	52	3.405	0.065
2.	Dyslipidemia	29	58	3	6	31.066	<0.001
3.	Coronay artery disease	5	10	3	6	0.543	0.461
4.	Respiratory disease	20	40	3	6	16.318	<0.001

Mean blood urea and serum creatinine values were 44.50±27.30 and 1.03±0.61 mg/dl respectively in cases and 43.76±11.16 and 0.89±0.34 mg/dl respectively in controls. Though both the parameters were higher in cases as compared to that in controls yet this difference was not significant statistically (p>0.05).

Mean triglyceride, HDL and LDL levels were 218.85±98.70, 41.82±13.46 and 95.86±37.54 mg/dl respectively in cases as compared to 176.96±23.26, 47.40±7.39 and 96.48±17.92 mg/dl respectively in controls. Cases as compared to controls had significantly higher triglyceride and significantly lower HDL levels. Statistically, there was no significant difference between the two groups with respect to mean LDL levels (p=0.917)

Table -2 Comparison of Blood urea, creatinine and lipid parameters between cases and controls

S.no.	Parameter	Cases (n=50)		Controls(n=50)		Statistical Significance	
		Mean	SD	Mean	SD	't'	p
1.	Blood urea (mg/dl)	44.50	27.30	43.76	11.16	0.178	0.859
2.	Creatinine (mg/dl)	1.03	0.61	0.89	0.34	1.350	0.180
3.	Triglyceride (mg/dl)	218.85	98.70	176.96	23.26	2.921	0.004
4.	HDL (mg/dl)	41.82	13.46	47.40	7.39	2.568	0.012
5.	LDL (mg/dl)	95.86	37.54	96.48	17.92	0.105	0.917

NCEP ATP III Metabolic syndrome factors like central obesity/BMI, high triglyceride, low HDL, hypertension and insulin resistance were prevalent in 40%, 74%, 66%, 74% and 100% of cases as compared to 24%, 84%, 38%, 60% and 10% of controls. Statistically there was a significant difference between the two groups for low HDL and insulin resistance (p<0.05) both these factors were prevalent in significantly higher proportion of cases as compared to that of controls.

Overall incidence of metabolic syndrome as per NCEP ATP-III criteria was 80% in cases as compared to 38% in controls, thus showing a statistically significant difference between the two groups (p<0.001).

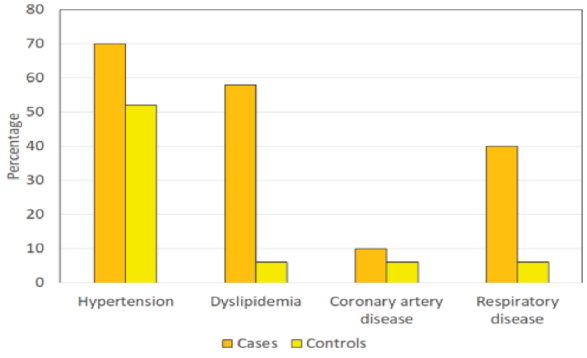

Fig. 2: Comparison of cases and controls for medical history

DISCUSSION

Diabetes is an endocrinal disease that is characterized primarily by persistent hyperglycemia and is associated with a number of complications in the long-term, *viz.*, retinopathy, nephropathy, neuropathy, cardiovascular disease and other organ systems. The primary metabolic reflection of the diabetes is mainly in terms of impaired glucose metabolism , however, it also impairs the lipid metabolism too ,which may cause other disorders such as obesity and hypertension, found to be highly prevalent in diabetic patients owing to altered glucose and lipid metabolisms.

Though, high prevalence of metabolic syndrome in diabetic patients has been documented in various parts of world, however, there are few studies that quantify the risk of metabolic syndrome in diabetic patients in comparison with an age and sex-matched non-diabetic population. Hence, the present study was planned to study the incidence of metabolic syndrome in diabetic patients as compared to an age-, sex- and anthropometrically matched population without diabetes at a tertiary care teaching hospital in North India.

In the present study, as per NCEP ATP-III criteria the incidence of central obesity, hypertriglyceridemia, low HDL, hypertension and insulin resistance was 40%, 74%, 66%, 74% and 100% respectively in cases as compared to 24%, 84%, 38%, 60% and 10% respectively in controls. A significant difference between two groups was observed only for low HDL and insulin resistance which were found to be significantly higher in diabetic cases as compared to non-diabetic controls. Thus in age, sex- and anthropometrically matched controls, only low HDL and insulin resistance were significantly higher in cases as compared to that in controls. This implies that diabetic status primarily enhanced the risk of insulin resistance and slightly affected the HDL levels adversely.

In the present study, thus we did not find a significant difference between diabetic and non-diabetic population for central obesity. One of the reasons for this could be the fact that in the present study, we included age, sex- and anthropometrically matched controls. Thus anthropometric matching has resulted in checking of additional risk of central obesity in the study population. In a previous study, Akholkar *et al.*[11] also failed to find a significant difference in mean body mass index and hip circumference of diabetic and non-diabetic population, though they found a significant difference between the two groups with respect to prevalence of obesity using both BMI as well as waist circumference criteria. In the present study, however, we did not find a significant difference in age-, sex- and anthropometrically matched groups. In fact, the relationship between obesity and diabetes is interesting. Obesity rather than being an effect of diabetes, is recognized as a triggering factor for diabetes associated with insulin resistance[12,13]. International Diabetic Federation20 also recognizes central obesity as an independent metabolic syndrome risk factor and focuses on its essentiality as they consider it to be the most important metabolic risk factor that might in turn trigger the syndromal effects contributing to development of metabolic syndrome.

With respect to lipid levels, we found higher incidence of dyslipidemia in diabetic patients in terms of low HDL but not in terms of hypertriglyceridemia. However, Yadav *et al.*[14] in their study on obese type 2 DM and obese non- diabetic individuals did not find a significant difference between two groups for HDL levels but instead found triglyceride levels to be significantly higher in diabetic as compared to non-diabetic patients. Veeramalla and Madas[15] in another study found both hypertriglyceridemia and low HDL to be higher in diabetic patients as compared to non-diabetic individuals.

In the present study, incidence of metabolic syndrome as per NCEP **ATP-III criteria was 80% in diabetic and 40% and 38%** respectively in non-diabetic controls. Thus, risk of MetS was 2.11 times higher in diabetic patients as compared to non-diabetic controls using NCEP ATP-III criteria. Workers like Lone *et al.*[16] reported the prevalence of MetS in Kashmiri T2DM patients using NCEP ATP- III to be 78% which is >2 times higher as compared to a general Kashmiri population (irrespective of diabetic status) where this prevalence has been reported as 36.3% using IDF criteria[17].

Most of the studies from India report the prevalence of MetS in T2DM patients to be 60% or above irrespective of the criteria used by them. Shankar and Agrawal[18] in a hospital based study reported it to be 84% using IDF criteria while Sabarathinam *et al.*[19] found it to be 66.7% using IDF criteria and Bhatti *et al.*[20] and Raman *et al.*[21] reported it to be 71.9% and 73.8% using harmonized and IDF criteria respectively. Though some workers like Yadav *et al.*[22] reported it to be 45.8% and 57.7% using NCEP-ATP III and IDF criteria.

CONCLUSION

The findings of the study showed that type 2 diabetes mellitus patients as compared to age-, sex- and waist circumference matched non-diabetic controls were at a higher risk of developing metabolic syndrome. Apart from insulin resistance which is a characteristic feature of T2DM, dyslipidemia was the other major factor that was responsible for this high incidence.

One of the limitations of the study was the fact that it drew controls from amongst OPD patients instead of otherwise healthy volunteers. Moreover, inclusion of anthropometry matched cases led to matching of two groups for certain metabolic syndrome risk factors like central obesity. Further studies on a larger sample size with inclusion of age, sex-matched volunteers from community is recommended to discriminate between the cases and controls in a better manner.

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