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A COMPARATIVE STUDY OF METABOLIC SYNDROME AMONG DIABETIC AND NON-DIABETIC PATIENTS.

General Medicine

Dr. Ahmad Faraz* Junior Resident, Department of General Medicine, Katihar Medical College & Hospital, Katihar, Bihar, India.*Corresponding Author

Dr. M. P. Singh Professor, Department of General Medicine, Katihar Medical College & Hospital, Katihar, Bihar, India.

Dr. P. K. Agrawal Professor & Head, Department of General Medicine, Katihar Medical College & Hospital, Katihar, Bihar, India.

Dr. Saad Bin Saif Senior Resident, Department of General Medicine, Katihar Medical College & Hospital, Katihar, Bihar, India.

ABSTRACT

Objectives: This present study was to estimate the incidence of metabolic syndrome in diabetic patients and non-diabetic patients. Methods: A detail history, clinical examinations and relevant Investigations like as Fasting plasma glucose, Post prandial plasma glucose, Blood urea, Serum Creatinine, Fasting Lipid profile, Glycosylated haemoglobin (HbA1c %), Fasting Serum Insulin, Urine Routine and ECG. Body Mass Index (BMI), Waist Circumference (WC), Waist-Hip Ratio (WHR), Assessment of Insulin Resistance by Homeostasis Model Assessment method (HOMA) IR were performed to all subjects. **Results:** Data was analysed by using IBM SPSS software. Mean and standard deviations were observed. Z-test, student test and chi square test were used. P-value was taken equal to or less than 0.05 ($p \leq 0.05$) for significant differences. **Conclusions:** Different criteria are available to diagnose metabolic syndrome at the peripheral level with the use of simple parameters. Our population is at high risk for metabolic syndrome. However, neither the waist circumference nor the BMI criteria were present in all the subjects with metabolic syndrome. So that, we should advise to the patients for intensive life style modifications along with therapies for different risk factors to prevent the progression to diabetes and atherosclerotic cardiovascular disease.

KEYWORDS

Non-diabetes, diabetes, risk factors, BMI, HOMA

INTRODUCTION

The metabolic syndrome (MetS) concept gathers in a single entity a set of metabolic abnormalities that have in common a close relationship with ectopic deposit of lipids, insulin resistance, and chronic low-grade inflammation. In many cases, a chronic exposure to a positive caloric balance is the driving force for the appearance and progression of this condition. The main traits included in Metabolic Syndrome diagnosis are arterial hypertension, central adiposity, hyperglycemia, and atherogenic dyslipidemia [1]. Several other conditions are related to similar metabolic derangements (that is, liver steatosis, polycystic ovary syndrome, and hyperuricemia) but are not part of the Metabolic Syndrome diagnostic criteria. The main long-term complications of Metabolic Syndrome are type 2 diabetes [2], atherogenesis [3], and cognitive impairment [4].

The risk of Type 2 DM has been shown to rise markedly with increase in degree of obesity. However, traditional tools of measuring obesity like BMI do not take into account the distribution of body fat. Of late, it has been shown that central obesity (visceral fat) has positive correlation with insulin resistance and is a strong risk factor for CVD and a strong predictor of future DM. Objectives of this present study was to estimate the incidence of metabolic syndrome in diabetic and non-diabetic subjects.

METHODOLOGY

The 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, Katihar Medical College, Katihar.

Method:

The study included 100 subjects, of whom 50 were non-diabetic (controls) and 50 were diabetic subjects (cases) attended to Katihar Medical College, Katihar, during December 2018 to march2020.

Inclusion Criteria: Type-2 diabetes mellitus patients with duration more than 6 months and matched non-diabetics.

Exclusion Criteria: Patients who are on insulin therapy and gestational diabetes patients.

Procedure:

A detail history, clinical examinations and relevant investigations, like as history of duration of diabetes, hypertension, dyslipidemia, coronary artery disease, treatment history of diabetes, hypertension, dyslipidemia, coronary artery disease, history of smoking and alcohol intake were performed to all subjects.

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 were recorded as per proforma. Clinical examination was done for the evidence of complications of diabetes, hypertension & dyslipidemia.

Investigations were performed like as Fasting plasma glucose, Post prandial plasma glucose, Blood urea, Serum Creatinine, Fasting Lipid profile, Glycosylated haemoglobin (HbA1c %), Fasting Serum Insulin, Urine Routine and ECG.

Body mass index (BMI): BMI was calculated from the formula BMI = weight in kg / height in m^2.

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) IR:

Fasting glucose (mg/dL) X Fasting serum insulin (uIU/mL) /405. A value greater than 2.5 indicates insulin resistance.

STATISTICALANALYSIS

Data was analysed by using IBM SPSS software. Mean and standard deviations were observed. Z-test, student test and chi square test were used. P-value was taken equal to or less than 0.05 ($p \leq 0.05$) for significant differences.

RESULTS

A Cases-Control clinical study on 50 Non-diabetic subjects (Control Group) and 50 Type 2 Diabetic patients (Cases group) was undertaken to study the incidence of metabolic syndrome, to identify and quantify

the risk factors associated with the metabolic syndrome. 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.

Age was matched in both the groups (controls & cases). Samples were age matched with P=0.905. Maximum number 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 was52.44 (Standard Deviation, SD: 9.19) and in cases was 52.66 (SD: 9.1).

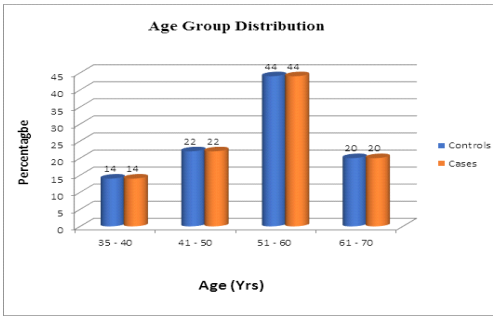

Fig.1. Age wise distributions of subjects.

(52%) males and 24(48%) females were included in both the groups (case & control). And p value was found to be p=1.000. Maximum percentage of subjects (56%) were found to be diabetic of ≤ 5 years duration. Mean duration of diabetes was 5.58 years (SD: 3.22). Hypertension was higher in cases group (70%) than control group (26%). Majorities of percentage of subjects were found to be hypertensive of ≤ 5 years duration in cases group, whereas in controls group, majorities of 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*. Incidence of Metabolic Syndrome was significantly higher in cases than controls (6.64 times more).

Table.1. Levels of risk factors in absence and presence of metabolic syndrome.

Risk factors	*Metabolic Syndrome*	*Controls*	*Cases*	*P value*
Age in years	Absent	50.72±9.29	45.73±8.85	0.0815
	Present	57.23±7.12	55.62±7.28	0.4969
BMI (kg/m^2)	Absent	27.15±6.72	27.47±6.76	0.876
	Present	27.61±6.26	27.37±.47	0.910
Waist (cm)	Absent	85.65±8.13	94.07±10.06	0.003**
	Present	102.69±6.66	97.83±14.62	0.256
SBP (mm Hg)	Absent	118.16±6.28	119.73±6.76	0.427
	Present	147.23±8.06	148.69±9.53	0.628
DBP (mm Hg)	Absent	81.11±3.32	80.40±3.48	0.479
	Present	95.38±4.19	92.29±5.32	0.065+
FBS (mg/dl)	Absent	87.89±7.08	179.00±8.24	<0.0001*
	Present	90.92±6.97	177.97±11.97	<0.0001*
PPBS (mg/dl)	Absent	130.83±9.89	229.66±31.05	<0.0001*
	Present	131.15±7.57	236.02±31.09	<0.0001
Blood urea (mg/dl)	Absent	31.40±5.08	44.26±7.29	0.0001*
	Present	31.84±7.63	36.37±6.07	0.0376
S.Creatinine (mg/dl)	Absent	0.94±0.26	0.9±0.21	0.5095
	Present	1.08±0.38	1.07±0.27	0.9194
Triglycerides (mg/dl)	Absent	137.64±23.34	133.6±3.00	0.5095
	Present	186.53±21.14	200.42±18.53	0.312
HDL (mg/dl)	Absent	48.89±5.38	46.86±4.81	0.2104
	Present	40.69±6.32	42.65±6.12	0.3334
LDL (mg/dl)	Absent	87.48±7.20	88.53±2.93	0.5887
	Present	118.15±25.26	120.45±20.05	0.7437
FSI	Absent	6.88±2.33	4.56±0.74	0.0004*
	Present	16.04±4.34	12.35±2.98	0.0016
HOMA	Absent	1.78±0.38	2.06±0.26	0.0119
	Present	3.66±0.91	5.41±1.22	0.0001

Incidence of metabolic syndrome is significantly positively associated with the subjects having dyslipidemia, CAD, increased waist circumference, elevated Tgl, Lower HDL levels, elevated LDL levels, BP>130/85 mm Hg and HOMA >2.5. Incidence of metabolic syndrome is not statistically associated with BMI and gender. However, the age is positively associated with the occurrence of metabolic syndrome but not statistically significant with P=0.138.

The higher incidence of metabolic syndrome was observed to be in patients having dyslipidemia, diabetes (>5 years), Triglycerides ≥150 mg/dl, raised LDL levels, patients with BP ≥130/85 and HOMA >2.5. Raised waist circumference was significantly associated with the incidence of MS in controls, but statistically not associated with cases. Similarly, the low HDL was not statistically associated with MS in cases while it is significantly associated with the MS in Control. Waist circumference was the better predictor of metabolic syndrome in both cases and controls.

Majorities of percentage (40.9%) of metabolic syndrome was found in the subjects within the age group of 51-60 years, predominantly in males (26.9%) than in females (25%) and more subjects (38.9%) were found to had metabolic syndrome with the BMI of 25-30.

Table.2. Evaluation of BMI and Waist Circumference for predicting the Metabolic syndrome by using the Regression analysis.

Factors	B-co-efficient	SE	Beta weight	P value
Controls				
BMI (kg/m2)	-0.052	0.007	-0.077	0.469
Waist circumference (cm)	0.029	0.004	0.711	<0.001**
Cases				
BMI (kg/m2)	-0.021	0.017	-0.300	0.207
Waist circumference (cm)	0.014	0.008	0.368	0.123

Incidence of Metabolic syndrome was positively associated with increasing age, while it was not associated with the increase in BMI. Most of the percentage of metabolic syndrome (76.9%) was found in males than in females (62.5%).

DISCUSSIONS

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.

In this present study, age was matched in both the groups (controls & cases). Maximum number of subjects was in the age group of 51-60 years, and minimum were in the age group of 35-40 years. Mean age in non-diabetic subjects was 57.23 (Standard Deviation, SD: 7.12) and in diabetic subjects was 55.62 (SD: 7.28). In this study, there were 52% males and 48% females in both the groups.

Statistical analysis in this study shows that the Incidence of metabolic syndrome in diabetic subjects was 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 was not found in the non-diabetic subjects. The study done by Earl S. Ford et al [4] and Louis Guize et al also shows the increasing

prevalence of metabolic syndrome with the age and the same study also shows that the prevalence was found more in males than in females.

Diabetes:
In the present study among the subjects with metabolic syndrome, the mean FBS (fasting blood sugar) in diabetic & non-diabetic subjects were 90.92±6.97 & 177.97±11.97 respectively and mean PPBS (post prandial blood sugar) were 131.15±7.57 & 236.02±31.09. respectively. Statistically significant rise in 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 results i.e, 64% were shown in the Indian study done by Vijay Achari et al in Patna [5].

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 [6] also shows less prevalence of metabolic syndrome i.e, only 18.7% in general population, which correlates with this study.

In this study it had been observed that the incidence of metabolic syndrome in diabetic subjects also increased among the subjects with worsening glucose tolerance reflected by high HbA1c levels i.e, 55.5%, 76%, 83.3% & 100% prevalence of metabolic syndrome with HbA1c levels of 7-8, 8-9, 9-10 &10-11 respectively. The study done by Isomaa B et al also shows that the prevalence of metabolic syndrome increased in a step wise fashion with worsening glucose tolerance. NHANES III data also shows the similar results.

Hypertension:
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 [7].

More percentage i.e, 36% diabetic subjects with metabolic syndrome were found to be hypertensive of ≤ 5 years duration, whereas only 8% of non-diabetic subjects with metabolic syndrome were found to be hypertensive of ≤ 5years duration. It implies that more number of diabetic subjects with metabolic syndrome are predisposed to be hypertensive than non-diabetic subjects with metabolic syndrome.

Dyslipidemia:
History of dyslipidemia was found to be 82.9% in diabetic subjects with metabolic syndrome, and in non-diabetic subjects with metabolic syndrome it was found to be in all i.e, 100%.

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 byLouisGuizeetalinFrenchpeopleduring1999-2002 Low HDL Cholesterol levels in diabetic subjects with metabolic syndrome were found to be 66.7%, whereas in non-diabetic subjects with metabolic syndrome the low HDL Cholesterol levels were found to be100%.

Raised LDL Cholesterol levels in diabetic subjects with metabolic syndrome & in non-diabetic subjects with metabolic syndrome were found to be 100%. It denotes that all the metabolic syndrome subjects were prone to have higher LDL Cholesterol levels irrespective of the diabetes.

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.
Among non-diabetic subjects, the evidence of atherosclerosis and peripheral vascular diseases were 4% & 2% respectively, where as in diabetic subjects, more percentages i.e 8% & 4% respectively have been observed which is significant.

Anthropometric parameters BMI & Waist Circumference:
The BMI of ≥25 kg/m2 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.

In our study, raised waist circumference in diabetic subjects with metabolic syndrome was found to be 70%, whereas in non-diabetic subjects with metabolic syndrome the waist circumference was found to be higher i.e, 86.7%.

The study done by Manisha Chandalia et al at the University of Texas, USA also found that Indians are more insulin resistant with only mild obesity. The International Diabetic Federation (IDF) also recommended that ethnic group specific cut-off point should be used for people of the same ethnic group wherever they are found, and the recommended waist circumference cut-offs for South Asians by IDF are ≥ 90cms for males & ≥ 80cms for females. These levels are lower than those suggested by the US National Cholesterol Education Program (ATP III criteria) which we have followed in this study.

Prediction of metabolic syndrome using ethnic specific values as advised by IDF provides better identification of people even with low waist circumference who might be at risk to have metabolic syndrome. The new ATP III Guidelines in the year 2005 recommended relatively high cut-off values for waist circumference, but at the same time accepted that certain ethnic groups and insulin resistant individuals may require lowering of waist circumference criteria.

Insulin Resistance:
In this study insulin resistance in all the subjects was assessed using HOMA (Homeostasis Model Assessment of Insulin Resistance) method which correlates well with other methods like QUICKI (Quantitative Insulin Sensitivity Check Index), and Euglycemic, hyperinsulinemic clamp method etc. HOMA >2.5 in adults is considered to be indicative of insulin resistance [8].

HOMA levels >2.5 in diabetic subjects with metabolic syndrome & in non- diabetic subjects with metabolic syndrome were found in all 100% subjects. It indicates that all the metabolic syndrome subjects were prone to have insulin resistance irrespective of the diabetes.

Incidence of metabolic syndrome is significantly positively associated with the subjects having dyslipidemia, CAD, increased waist circumference, raised triglycerides, Low HDL levels, raised LDL levels , BP >130/85 mm Hg and HOMA>2.5 (Homeostasis Model Assessment of Insulin Resistance).

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.

CONCLUSIONS

This present study concluded that incidence of metabolic syndrome increases as the duration of diabetes increases and with the worsening glucose tolerance, as reflected by high HbA1c levels. Hypertension was the higher prevalent in diabetic subjects with metabolic syndrome. Raised triglyceride levels in diabetic subjects with metabolic syndrome were statistically significant and positively associated with the incidence of metabolic syndrome. Evaluation of BMI & waist circumference 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 & non-diabetic subjects. HOMA levels indicated that all the metabolic syndrome

subjects were having insulin resistance irrespective of the presence of diabetes.

Hence, different criteria are available to diagnose metabolic syndrome at the peripheral level with the use of simple parameters. Our population is at high risk for metabolic syndrome. However, neither the waist circumference nor the BMI criteria were present in all the subjects with metabolic syndrome. So that, we should advise to the patients for intensive life style modifications along with therapies for different risk factors to prevent the progression to diabetes and atherosclerotic cardiovascular disease.

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