ORIGINAL ARTICLE
FREQUENCY OF METABOLIC SYNDROME IN TYPE-2 DIABETES MELLITUS

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Background: Metabolic syndrome (MetS) is a cluster of coronary risk factors such as diabetes and pre-diabetes, abdominal obesity, high triglyceride (TG), low high density lipoprotein cholesterol (HDL-c) levels and high blood pressure (BP). It is estimated that around a quarter of the world's adult population have MetS and they are twice as likely to die from it and three times as likely to have a coronary event or stroke compared with people without the syndrome. **Methods:** This observational descriptive study was conducted at the Department of General Medicine, Federal Government Polyclinic Islamabad. All type-2 diabetics presenting in the outpatient and inpatient department during 11 months between the ages of 30–80 were enrolled. They were interviewed; blood pressure, waist circumference, fasting blood glucose, and lipid profiles were checked. **Results:** Of the 300 patients 165 (55%) were females and 135 (45%) were males with mean age 52.47±11.24 years. The mean duration of Diabetes Mellitus was 7.38±3.85 years. Metabolic Syndrome was present in 83% of the study population, 129 (43%) were male and 171 (57%) were female. The *p*-value was statistically significant on comparing the presence of the Metabolic Syndrome with waist circumference, serum triglyceride levels, and blood pressure as it was <0.05. The most commonly occurring finding was a decreased HDL-cholesterol in both genders. **Conclusions:** The MetS was present in 83% of the diabetic population, mostly in females with decreased HDL-cholesterol being the most common in both genders.
Keywords: Diabetes Mellitus, Metabolic Syndrome, Insulin Resistance

INTRODUCTION

The metabolic syndrome (MetS) is the new epidemic in both developed and developing countries. It has now come to be recognized as the constellation of signs and symptoms most likely to predict the occurrence of diabetes mellitus (DM) and coronary vascular disease (CVD). It is a cluster of coronary risk factors such as diabetes and pre-diabetes, abdominal obesity, high triglyceride (TG), low high density lipoprotein cholesterol (HDL-c) levels and high blood pressure (BP). MetS is estimated to be present in quarter of the world's population and are three times more likely to have an acute coronary attack and twice as likely to die from it as compared to people without metabolic syndrome.[1] In addition, people with MetS have a fivefold greater risk of developing Type-2 DM.[2] In most people with glucose intolerance or Type-2 DM there is a multiple set of risk factors that commonly appear together, forming what is now known as the Met S, previously as the deadly quartet[3] and more recently, the Insulin Resistance Syndrome(IRS)[4].

The estimated incidence of Met S in Pakistan is 46% in Type-2 DM.[5] The study shows an alarming situation regarding MetS. Very few studies exist in Pakistan to actually evaluate the incidence of MetS in type-2 DM. It was with this scenario in mind that it was decided to carry out this study.

MATERIAL AND METHOD

This descriptive study was conducted at Federal Government Polyclinic Hospital. Non-Probability convenient sampling technique was applied in the study. All male and female type-2 diabetics presenting in the outpatient and inpatient department during 11 months of study period, aged between 30-80 years of age were included in the study. Patients were excluded if they had iatrogenic DM, i.e., Patients using corticosteroids, thyroid hormonal replacement therapy, thiazide diuretics, or B-blockers, endocrinopathies causing raised blood sugars, gestational diabetes, type-1 diabetes or refused to give consent. Informed consent was taken from study subject and basis of the study was also explained. A detailed history including age, gender, duration of DM and compliance with medication was taken. Fasting Plasma Glucose (FPG) was taken using a portable hand held gluco-meter. If for any reason the FPG could not be checked at that time a blood sample was sent to the laboratory and subject advised to follow-up with the report. Weight in kilograms and height in meters was measured and Body Mass Index (BMI) calculated. The BMI was noted to be increased or decreased according to

gender. Waist circumference was checked using a standard measuring tape, with reference point 10 cm above the anterior superior iliac spine in the upright position. The waist circumference was noted to be increased or decreased according to gender in accordance to the IDF guidelines (defined as waist circumference ≥90 cm for Asian men and ≥80 cm for Asian women). BP was checked in the sitting position with a mercury sphygmomanometer. Serum Triglyceride and Serum HDL-c levels were noted to be increased or normal in accordance to the IDF guidelines (Raised TG level: ≥150 mg/dL and reduced HDL-c: <40 mg/dL in males and <50 mg/dL in females. All the information collected by history, examination, and investigations was entered into the prescribed *pro forma*.

Data was entered in SPSS-12 for analysis. Descriptive statistics was used to calculate mean and standard deviation (SD) for quantitative variables like age and gender. Frequencies and percentages for qualitative variables like gender and treatment. Chi-square test was used to find difference in proportions between waist circumference (normal or increased) and blood pressure both systolic and diastolic (normal or increased), fasting blood sugar, triglyceride level (normal or increased) and HDL (normal or increased) levels at 5% level of significance. A *p*-value <0.05 was considered significant.

RESULTS

A total of 300 patients were enrolled in this study. 165 (55%) were females and 135 (45%) were males. The mean age of the patients was 52.47±11.24 years. The mean duration of DM was 7.38±3.85 years with minimum duration of DM being 1 year and maximum 20 years. The treatment taken by the patients was either oral hypoglycaemic agents (OHGA'S), Insulin or both. Of the male population OHGA'S was being taken by 124 (86%) male and 138 (83.6%) of the female participants, Insulin was taken by 0 (0%) males and 6 (3.6%) females and both OHGA'S and insulin was taken by 21 (14%) males and 21 (12.7%) females. One hundred and seventy-seven (59%) were compliant and 123 (41%) were non-compliant with their medications. The mean fasting plasma glucose (FPG) was 204±82 mg/dl with a minimum of 100mg/dl and maximum of 561 mg/dl. A Serum TG cut-off value was taken to be 150 mg/dl in both genders. The Serum TG level was increased in 210 (70%) of the participants, the mean being 223±132 mg/dl. The value of HDL-c was taken to be 40 mg/dl and 50 mg/dl in males and females respectively. In the male patients the HDL-c was decreased in 77.8% and normal in 22.2%. In females the HDL-c was decreased in 96.4% and normal in 3.6%. The mean value of HDL-c was 33.8±11.2 mg/dl with minimum 8 mg/dl and maximum of 87 mg/dl. The waist

circumference cut-off point was also different for men and women, in the females a waist circumference of more than 80 cm. was taken as the cut-off point and in males it was taken to be 90 cm. In the male participants 93 (64.1%) had increased waist circumference and 52 (35.9%) had a circumference below the cut-off value and mean waist circumference was 107.4±15.80 cm. Of the female patients 132 (80%) had increased waist circumference and 33 (20%) had a waist circumference below the cut-off value and mean waist circumference was 103.7±20.47 cm. The blood pressure was increased in 204 (68%) and normal in 96 (32%) of the patients. The BMI was also calculated and increased in 225 (75%) of the participants. Of the 75% patients with increased BMI 31% were males and 44% were females. Met S was present in 249 (83%) of the study population. Of the 249 patients with Met S 107 (42.9% were male and 142 (57.1%) were female. The most commonly occurring abnormality in the males was a high blood pressure and in the females was a decreased HDL-c level.

The data of the 249 (83%) patients who fulfilled the criteria for the Met S was also analysed. The characteristics of the study population in depicted in the table-2. One hundred and seven (42.9%) were male and 142 (57.1%) female. Sixty (56%) and 86 (60.5%) of the men and women were compliant with their treatment respectively. In the male category 93 (86.9%), 14 (13.08%) were using OHGA'S and OHGA'S and Insulin respectively. In the female category 114 (80.28%), 10 (7.04%) and 18 (12.67%) were using OHGA'S, Insulin and OHGA'S, and Insulin respectively. The waist circumference was increased in 92 (85.98%) and 133 (93.66%) of the male and female participants with MetS respectively. Blood pressure was increased in 93 (86.91%) and 105 (73.94%) of the males and females respectively. The TG were increased in 85 (79.43%) and 116 (81.69%) and HDL-c was decreased in 95 (90.65%) and 137 (96.47%) of the male and female patients respectively. The BMI was also calculated and found to be increased in 82 (76.63%) and 120 (84.50%) men and women respectively. The most commonly occurring abnormality was a decreased S.HDL in both genders. The *p*-value was highly significant (*p*-value <0.05) when co-relating TG, waist circumference and BP with MetS.

Table-1: characteristics of study population

Haracteristics		Male	Female
Total no. of patients (n=300)		135 (45%)	165 (55%)
Mean age in years (Mean±S.D)		55.2±12.1	50.1±9.9
PLACE	Ward	60 (44.4%)	80 (48.4%)
	OPD	75 (55.5%)	85 (51.5%)
Duration of diabetes in years (Mean±S.D)		7.6±3.4	7.1±4.1
Treatment taken	OHGA'S	124 (86%)	138 (83.6%)
	Insulin	0 (0%)	6 (3.6%)
	Both	21 (14%)	21 (12.7%)
Compliance	Yes	177 (59%)	
	No	123 (41%)	

Table-2: Characteristics of patients with metabolic syndrome

Characteristics		Male	Female	*p*-value
Total no. (249)		107 (42.9%)	142 (57.1%)	---
Compliance to treatment	Yes	60 (56.1%)	86 (60.5%)	---
	No	47 (43.9%)	56 (39.5%)	---
Treatment	OHGA'S	93 (86.9%)	114 (80.28%)	---
	Insulin	0 (0%)	18 (12.67%)	---
	Both	14 (13.08%)	10 (7.04%)	---
Waist circumference	Increased	92 (85.98%)	133 (93.66%)	0.000
	Normal	15 (14.01%)	9 (.33%)	---
Blood pressure	Increased	93 (86.91%)	105 (73.94%)	0.000
	Normal	14 (13.08%)	37 (26.05%)	---
S. Triglyceride levels	Increased	85 (79.43%)	116 (81.69%)	0.000
	Normal	22 (20.56%)	26 (18.30%)	---
S. HDL levels	Decreased	95 (90.65%)	137 (96.47%)	---
	Normal	12 (11.21%)	5 (3.52%)	---
BMI	Increased	82 (76.63%)	120 (84.50%)	---
	Normal	25 (23.36%)	22 (15.49%)	---

DISCUSSION

Type-2 Diabetes Mellitus is fast becoming a chronic and lethal disease in our community and is likely to increase even more rapidly in the near future.[6] Met S is used as a clinical tool to identify individuals at risk of cardiovascular disease but, its clinical value in the management of type-2 Diabetes Mellitus remains uncertain. Our study was conducted at a tertiary care hospital on consenting type-2 diabetics presenting in the out-patient and in-patient departments.

Studies have proven that people of Asian origin are more predisposed to the development of other ethnicities.[7] It also holds true for our study in which 83% of the participants had Met S. Comparable results have been reported in studies worldwide. A study done in India showed the prevalence of metabolic syndrome to be between 35.8% and 45.3%[8] and 30.5% to 31.5% in China[9]. A study conducted in Iran at the Isfahan University of Medical Sciences and Health Services demonstrated the frequency of MetS to be 65.0%.[10]

Current studies found that metabolic syndrome is more common among female participants. In a study conducted by Imam *et al*[11], Met S was present in 68.1% of the diabetic patients and most commonly in females as compared to males (43.7% women and 24.4%. men). Similarly, in our study Met S was also more common in females (57.1% women and 42.9% men). A study conducted by Song SH and Hardisty CA in the United Kingdom demonstrated 91.7% males and 94.8% females of the study population had Met S.[12] Many factors that are unique to females are thought to impact the characteristics and prevalence to metabolic syndrome such as gestational diabetes mellitus, preeclampsia, pregnancy, lactation, hormonal contraceptives, polycystic ovary syndrome and menpause.[13] Other factors that may contribute towards the development to metabolic syndrome are different socioeconomic In addition, higher prevalence of metabolic syndrome among women may be due to different socioeconomic standing, working environment and cultural perception on body image.[14] Santos and *et al*[15] demonstrated in their study that the odds favouring the development of metabolic syndrome greatly decreased in respect to the education level and social class.

On comparing the different components used to define Met S, a study carried out by Khan SH *et al*[16] demonstrated that the diastolic blood pressure was significantly increased in patients with Met S as compared to patients without Met S. The mean diastolic blood pressure was 86.79 mmHg which is comparable to our results which showed a diastolic blood pressure of 86.50 mmHg. In the study conducted by Khan there was no significant difference of systolic blood pressure between patients with Met S or without, but in our study the systolic blood pressure was also raised with a mean systolic blood pressure of 145.54 mmHg.

The waist circumference is an important parameter for the diagnosis of the MetS as evident by its ability to predict the occurrence of mortality in the future. In a study conducted at Laboratory of Epidemiology, Demography, and Biometry, National Institute on Aging, USA[17], the authors examined the association between waist circumference and mortality among 154,776 men and 90,757 women aged 51–72 years. After adjustment for BMI and other covariates, a large waist circumference was associated with an approximately 25% increased mortality risk. In our study the waist circumference was increased in 93.66% and 85.98% of the females and males diagnosed as having MetS respectively. Even though our study did not examine the mortality risk of the patients but it has serious implications as a significant number of our patients had an increased waist circumference.

The mean serum triglyceride level was 210 mg/dl and HDL-c was 52 mg/dl in the study by Ashraf S *et al*.[5] In our study the mean serum TG level was 223 mg/dl and HDL-c was 33.8 mg/dl. It was noted in our study that a significant number of both males and females had a low HDL-c. The HDL-c was noted to be decreased in 95 (90.65%) and 137 (96.47%) of the males and females with Met S, and in fact it was the most common occurring abnormality in our study. Similarly the S. Triglyceride levels was increased in 85 (79.43%) and 116 (81.69%) of the males and females respectively. In a study conducted at Istanbul, Turkey it was demonstrated that the Turkish population also has a low HDL-c and in patients with a low HDL-c the frequency of Met S was 70.8%.[18] In a study conducted at Al-Shifa Metabolic Centre, Faisalabad, a total of 8300 type-2 diabetics were enrolled and 49% had fasting serum triglyceride level above 150 mg/dl.[19]

CONCLUSION

Met S was present in 83% of the diabetic population, which is an alarming figure. The Met S was most common in the female patients. The most commonly occurring finding was a decreased HDL-c and increased BP in the diabetic females and males respectively. The most finding in both males and females who fulfilled the criteria of the MetS was a decreased HDL-c. Thus emphasis now more than ever should be on prevention of all the modifiable factors that make up the Met S so as to prevent CVD and DM.

AUTHOR's CONTRIBUTION

All the authors contributed equally.

REFERENCES

1. Isomaa B, Almgren P, Tuomi T, Forsén B, Lahti K, Nissén M, et al. Cardiovascular morbidity and mortality associated with the metabolic syndrome. Diabetes Care 2001;24(4):683–9.
2. Stern MP, Williams K, Gonzalez-Villalpando C, Hunt KJ, Haffner SM. Does the metabolic syndrome improve identification of individuals at risk of type 2 diabetes and/or cardiovascular disease? Diabetes Care 2004;27(11):2676–81.
3. Kaplan NM. The deadly quartet. Upper-body obesity, glucose intolerance, hypertriglyceridemia and hypertension. Arch Intern Med 1989;149(7):1514–20.
4. Alexander CM, Landsman PB, Teutsch SM, Haffner SM. NCEP-defined metabolic syndrome, diabetes, and prevalence of coronary heart disease among NHANES III participants age 50 years and older. Diabetes 2003;52(5):1210–4.
5. Ashraf S, Ziauddin F, Jahangeer U. Metabolic syndrome in Type2 diabetes mellitus. Pak J Med Sci 2006;22:295–9.
6. Saad MF, Lillioja S, Nyomba BL, Castillo C, Ferraro R, De Gregorio M, et al. Racial differences in the relation between blood pressure and insulin resistance. N Engl J Med 1991;324(11):733–9.
7. Yusuf S, Reddy S, Ounpuu S, Anand S. Global burden of cardiovascular diseases: Part II: variations in cardiovascular disease by specific ethnic groups and geographic regions and prevention strategies. Circulation 2001;104(23):2855–64.
8. Ravikiran M, Bhansali A, Ravikumar P, Bhansali S, Dutta P, Thakur JS, et al. Prevalence and risk factors of metabolic syndrome among Asian Indians: a community survey. Diabetes Res Clin Pract 2010;89(2):181–8.
9. Zuo H, Shi Z, Hu X, Wu M, Guo Z, Hussain A. Prevalence of metabolic syndrome and factors associated with its components in Chinese adults. Metabolism 2009;58(8):1102–8.
10. Janghorbani M, Amini M. Metabolic syndrome in type 2 diabetes mellitus in Isfahan, Iran: prevalence and risk factors. Metab Syndr Relat Disord 2007;5(3):243–54.
11. Imam SK, Shahid SK, Hassan A, Alvi Z. Frequency of the metabolic syndrome in type 2 diabetic subjects attending the diabetes clinic of a tertiary care hospital. J Pak Med Assoc 2007;57(5):239–41.
12. Song SH, Hardisty CA. Diagnosing metabolic syndrome in type 2 diabetes: does it matter? QJM 2008;101(6):487–91.
13. Bentley-Lewis R, Koruda K, Seely EW. The metabolic syndrome in women. Nat Clin Pract Endocrinol Metab 2007;3(10):696–704.
14. Cornier MA, Dabelea D, Hernandez TL, Lindstrom RC, Steig AJ, Stob NR, et al. The metabolic syndrome. Endocr Rev 2008;29(7):777–822.
15. Santos AC, Ebrahim S, Barros H. Gender, socio-economic status and metabolic syndrome in middle-aged and old adults. BMC Public Health 2008;8:62.
16. Khan SH, Khan FA, Ijaz A, Sattar A, Dilawar M, Hashim R. Hypertension and metabolic syndrome: Impact of clustering of hypertension in subjects with metabolic syndrome. Pak J Med Sci 2007;23(6):903–8.
17. Koster A, Leitzmann MF, Schatzkin A, Mouw T, Adams KF, van Eijk JT, et al. Waist circumference and mortality. Am J Epidemiol 2008;167:1465–75.
18. Uzunlulu M, Oguz A, Tinazli M, Takir M, Eker P. Relationship between low levels of high-density lipoprotein cholesterol and metabolic syndrome in Turkish patients. Acta Cardiol 2005;60(5):532–6.
19. Rana MM, Akhtar MS, Bashir MB, Rehman A. Type 2 Diabetics; components of the metabolic syndrome. Professional Med J 2006;13(3):453–9.

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