Prevalence of metabolic syndrome among Nepalese type 2 diabetic patients

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ABSTRACT

This study was carried out to establish the prevalence of metabolic syndrome among the type 2 diabetic patients in Nepal. Two hundred twenty one participants aged 26-90 (mean age 53.41± 13.30) years with established type 2 diabetes visiting Kathmandu Model Hospital, Kathmandu, Nepal from August 2011 to November 2011 were included in the study. National Cholesterol Education Adult Treatment Panel III (NCEP ATPIII) definition of the metabolic syndrome with ethnic threshold on abdominal obesity was used. 170 (76.9%) participants were found to have metabolic syndrome. Thirty two (14.5%) participants fulfilled all 5 criteria for metabolic syndrome, 63 (28.5%) participants had four criteria while three criteria were fulfilled by 75 (33.9%) of the participants. Among the patients having metabolic syndrome, hypertension was seen in 89 (52.35%) participants, raised serum triglyceride levels were found in 144(84.70%) subjects, decreased serum HDL cholesterol levels were found in 119 (70%) participants while in 108 (63.35%) participants increased waist circumference was found. There was a higher frequency of metabolic syndrome in obese (81.58%) and in overweight (79.49%) subjects. This study indicates significant prevalence of metabolic syndrome among type 2 diabetic patients with strong association of obesity.

Keywords: Metabolic syndrome, national cholesterol education program, abdominal obesity, body mass index.

INTRODUCTION

Metabolic syndrome (MetS), a group of metabolic abnormalities, includes abdominal obesity, low level of high density lipoprotein cholesterol (HDL-C), high triglycerides level, hypertension and hyperglycemia.[1] According to National Cholesterol Education Program Adult Treatment Panel III (NCEP ATP III)[2] individuals with MetS are at risk of developing cardiovascular disease (CVD) and insulin resistance, which confers risk for type 2 Diabetes. They are also susceptible to conditions such as polycystic ovary syndrome, fatty liver, cholesterol gallstones, asthma, sleep disturbances and some forms of cancer.[3] Type 2 diabetes mellitus (T2DM), one of the components of metabolic syndrome which can lead to development of cardiovascular disease, is a group of metabolic disorders of multiple etiologies characterized by chronic hyperglycemia with disturbances of carbohydrate, fat and protein metabolism. Contributing factors for hyperglycemia can be defects in insulin secretion, action or both.[4] Incidence of diabetes in developing countries is increasing and is one of the leading causes of death and disability.[8]

Reaven[5] observed that several risk factors (such as dyslipidemia, hypertension, and hyperglycemia) commonly cluster together. He called it syndrome X. World Health Organization (WHO)[6] gave the first global definition of MetS, however the requirement of using euglycaemic clamp to measure insulin sensitivity made the WHO definition impossible to be employed in either clinical or epidemiological practices. National Cholesterol Education Program (NCEP) of USA introduced new definition of MetS.[2] Diagnostic criteria of NCEP for MetS became popular because of its simplicity and feasibility since its components can be determined routinely and in research settings. International Diabetes federation (IDF) presented new definition[7] which emphasizes abdominal obesity as an important component of MetS.

Reports suggest that 20% of global DM burden lies in South East Asia Region (SEAR) and is likely to triple by 2025 from present estimates of about 30 million to 80 million.[8] The Framingham study has showed that a clinical history of diabetes was independently associated with risk of developing Heart failure.[9] According to the study there is 2-fold increased risk in men and a 5-fold increased risk in female. Study shows that obesity is associated with increased cardiovascular mortality, independent of dyslipidemia, diabetes and hypertension.[10] Obesity has increased in south Asian countries including Nepal and Bangladesh, between 1996 and 2006 (from 1.6% to 10% and from 2.7% to 8.9%, respectively).[11] Abdominal obesity in particular,

is responsible for several metabolic and cardiovascular problems. High risk of developing both diabetes and cardiovascular disease associated with obesity in Asians may be due to a predisposition to abdominal obesity leading to metabolic syndrome.[12] There have been many studies done on the prevalence of risk factors for developing metabolic syndrome in Nepal.[13-15]

This study aimed to assess incidence of metabolic syndrome in patients with T2DM who visited Kathmandu Model Hospital in 2011. We used the national cholesterol education program adult treatment panel III (NCEP ATP III) definition of the MetS with ethnic threshold on abdominal obesity to observe the frequency of metabolic syndrome in type 2 diabetic patients in our study.

MATERIALS AND METHODS

A total number of two hundred and twenty one subjects with established type 2 diabetes visiting Kathmandu Model Hospital, Kathmandu, Nepal from August 2011 to November 2011 were included in the study. The target group was outpatients with a history of Type 2 diabetes visiting pathology department for the regular measurement for blood sugar or lipid profile. The population included in the study had diabetes for a year or more, some under medication and some under diet control. The exclusion criteria was coexistence of any other serious illness. Patients were asked for clinical history of myocardial infarction, aneurysms, chronic stable angina pectoris, arrhythmias, renal dysfunction and other chronic diseases. Each subject was asked for the demographic details (age, sex), duration of diabetes, any medication, hypertension, consuming alcohol and smoking habits. They were also enquired about their profession.

After the patient's consent, the blood pressure (BP) was measured in sitting position using the auscultatory method and a standard cuff (12X34cm) for the patients appearing directly in the department of pathology. The patients were let to rest for about 3-5 minutes on the arm chair before BP measurement was taken. For those attending the OPD for consultation, the BP was taken from their record book. Individuals having systolic blood pressure ≥ 130mmHg or diastolic blood pressure ≥ 85mmHg and/or concomitant use of antihypertensive medications were categorized as having high blood pressure according to the definition of NCEP ATP III definition.[16]

The Height and weight of each candidate was taken in a upright standing position without shoes. BMI was calculated as weight in Kilogram (Kg) divided by height squared (m^2). According to the WHO guidelines for Asians the individuals, both for men and women, having BMI < 18.5 (kg/m^2) termed as underweight, 18.5-22.9 (Kg/m^2) as normal, 23-24.9 (Kg/m^2) as overweight and ≥ 25 (kg/m^2) as obese.[17]

The waist circumference was measured over a light garment at a level midway between lower rib margin and iliac crest using the WHO guideline for waist circumference measurement.[18] The abdominal obesity was defined according to the International Diabetes Federation (IDF) guideline for Asians ≥ 90 cm for male and ≥ 80 cm for female.[19]

All the subjects were on overnight fast (about 12 hours) for checking fasting blood sugar level or lipid profile. The blood glucose level was measured using Glucose Oxidase Peroxidase method (Systemic reagent for Humastar 600, Human, Germany). The lipid profile was done using CHOD-PAP method (Systemic Reagent for Humastar 600, Human, Germany). The Low Density Lipoprotein (LDL) was calculated using the Friedewald Formula.[20] All the biochemical tests were run in the fully autoanalyzer (Humastar 600, Human, Germany). The serodos and serodos plus were used as the quality control samples and autocal as the standard to calibrate the tests. Both the internal and external quality assurance tools are employed routinely to ensure the quality of test results.

Definition of metabolic syndrome: In our current study we used the NCEP ATP III definition of metabolic syndrome to observe the frequency of metabolic syndrome. According to which the participants are said to be suffering from metabolic syndrome when they meet three or more of the following:

Abdominal obesity (waist circumference >120 cm in men and >88 cm in women)*

Triglycerides (TGs) >=1.7 mmol/L

HDL cholesterol <1.03 mmol/L in men and <1.29 mmol/L in women

Systolic BP >=130 mmHg and/or Diastolic BP >= 85 mmHg

Fasting Plasma Glucose >=6.1 mmol/L

* We used the IDF criteria for waist circumference for the south Asians. According to IDF, abdominal obesity for south Asians is defined as the waist circumference >=90 cm in men & >= 80 cm in women.

So in our study we used the modified NCEP ATP III definition for metabolic syndrome with respect to waist circumference.

All the statistical analysis were done using IBM SPSS Statistics (version 19) software. All tests of statistical significance were two sided with 95% confidence intervals (CI).

RESULTS

Among the 221 type 2 diabetic subjects enrolled for this study, 119(54%) were males and 102(46%) were females. The mean age of the study population was 53.41± 13.30 years (mean age of males = 52.67±13.21 and females=54.27±13.42 years). Table-1 shows the age distribution of participants. Out of 221 participants, 170 (76.9%) were found to have metabolic syndrome by applying the NCEP ATP III definition of the metabolic syndrome (Table-2). Table-3 shows distribution of metabolic syndrome in different age groups.

Table-1: Age distribution of Participants

Age groups (in Years)	Male	Female	Total
<=40	21	18	39
41-50	34	22	56
51-60	30	30	60
61-70	26	19	45
>70	8	13	21
Total	119	102	221

Table-2: Frequency of metabolic syndrome

Status	Frequency (%)		Total (%)
	Male	Female	
Without Metabolic syndrome	36 (30)	15(14.7)	51(23.1)
With Metabolic syndrome	83(70)	87(85.3)	170(76.9)
Total	119	102	221

Table-3: Distribution of metabolic syndrome in different age groups

Gender	Age Group (in Years)				
	<=40	41-50	51-60	61-70	>70
Male	18	27	21	10	7
Female	16	19	25	16	11
Total (%)	34 (20.00)	46 (27.06)	46 (27.06)	26 (15.30)	18 (10.58)

Thirty-two (14.5%) participants fulfilled all 5 criteria for metabolic syndrome. Sixty-three (28.5%) participants had four criteria of metabolic syndrome while three criteria were fulfilled by 75 (33.9%) of the participants (Table-4).

Table-4: Number of participants fulfilling different criteria of metabolic syndrome

NCEP ATP III Definition	Male		Female		Total
	No.	%	No.	%	
3 Criteria	47	62.67	28	37.33	75
4 Criteria	28	44.44	35	55.56	63
5 Criteria	8	25.00	24	75.00	32
Total	83		87		221

Among the patients having metabolic syndrome, the facts and figures were as follows: All the patients were known type 2 diabetic. Hypertension was seen in 89 (52.35%) participants. Raised Triglyceride levels were found in 144(84.70%) subjects. Decreased serum HDL cholesterol levels were found in 119 (70%) participants. In 108 (63.35%) of participant, increased waist circumference was found. Table-5 shows the frequency of the components of the metabolic syndrome in patients diagnosed to have metabolic syndrome within the gender.

Table-5: Frequency of the components of the metabolic syndrome in patients diagnosed to have metabolic syndrome

NCEP ATP III Definition	Total		Male (n=83)		Female (n=87)	
	No.	%	No.	%	No.	%
Type 2 Diabetes	170	100.00	83	48.82	87	51.18
Hypertension	89	52.35	40	44.94	49	55.06
Raised Triglyceride	144	84.70	75	52.08	69	47.92
Decreased HDL Cholesterol	119	70.00	63	52.94	56	47.06
Increased Waist Circumference	108	63.35	27	25.00	81	75.00

Statistically highly significant differences were observed between Serum Triglyceride Levels, Serum HDL Cholesterol Levels, Serum VLDL Cholesterol Levels, Serum Total Cholesterol minus HDL Cholesterol, Waist Circumference, Systolic Blood Pressure, Diastolic Blood Pressure and BMI between participants having metabolic syndrome and without metabolic syndrome with mean differences of 92.46 mg/dl, 8.23 mg/dl, 18.49 mg/dl, 19.22 mg/dl, 5.15 cm, 10.63 mmHg, 8.07 mmHg and 2.75 respectively (Table-6). Table-7 shows the distribution of participants on the basis of BMI.

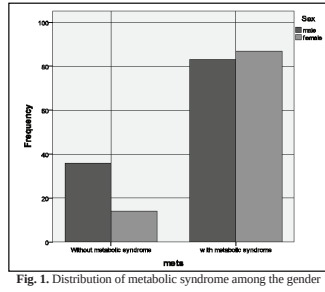

Fig. 1. Distribution of metabolic syndrome among the gender

Table6: Comparison of participants having metabolic syndrome (n=170) with those without metabolic syndrome (n=51)

	Subjects	Mean	SD	t- test P value
Fasting Blood Glucose (in mg/dl)	Without Metabolic Syndrome	156.03	75.63	0.859
	Having Metabolic Syndrome	158.14	69.63	
Serum Total Cholesterol (mg/dl)	Without Metabolic Syndrome	214.54	64.58	0.286
	Having Metabolic Syndrome	225.54	64.37	
Serum Triglyceride (mg/dl)	Without Metabolic Syndrome	150.63	81.61	0.000**
	Having Metabolic Syndrome	243.10	187.96	
Serum HDL Cholesterol (mg/dl)	Without Metabolic Syndrome	52.51	12.39	0.000**
	Having Metabolic Syndrome	44.27	13.82	
Serum LDL Cholesterol (mg/dl)	Without Metabolic Syndrome	131.91	55.09	0.936
	Having Metabolic Syndrome	132.64	62.38	
Serum VLDL Cholesterol (mg/dl)	Without Metabolic Syndrome	30.12	16.32	0.000**
	Having Metabolic Syndrome	48.62	37.59	
Serum Total Cholesterol-HDL (mg/dl)	Without Metabolic Syndrome	162.03	61.10	0.049*
	Having Metabolic Syndrome	181.26	60.90	
Waist Circumference (in cm)	Without Metabolic Syndrome	84.63	7.73	0.000**
	Having Metabolic Syndrome	89.79	9.42	
Systolic Blood Pressure (mmHg)	Without Metabolic Syndrome	120.51	11.00	0.000**
	Having Metabolic Syndrome	131.15	16.18	
Diastolic Blood Pressure (mmHg)	Without Metabolic Syndrome	79.69	8.27	0.000**
	Having Metabolic Syndrome	87.76	13.42	
BMI (kg/m^2)	Without Metabolic Syndrome	23.13	4.04	0.000**
	Having Metabolic Syndrome	25.89	3.73	

*statistically significant **statistically highly significant

DISCUSSION

The prevalence of diabetes is increasing in Nepal.[21] The cross-sectional study on prevalence of metabolic syndrome has been carried by Sharma *et al*.[22] But we could not find study on the prevalence of metabolic syndrome in type 2 diabetic patients in Nepal. Our study aimed to study the frequency of type 2 diabetic patients suffering from metabolic syndrome who in future can be the victims of cardiovascular and peripheral artery diseases. Patients having metabolic syndrome are at increased risk of developing cardiovascular diseases.[23]

Our study has shown that 76.9% of the total participants met the criteria for metabolic syndrome according to the NCEP ATP III definition of the metabolic syndrome. Study done by Sharma *et al*[22] showed that 58.6% of the participants with metabolic syndrome were diabetic. Different studies carried out around the globe have estimated a prevalence of 70-80% among Caucasian type-2 diabetic subjects[24] and 75.6% among Chinese population with T2DM.[25]

Present study showed that the age group of 40-60 years had a higher prevalence of metabolic syndrome which is in accordance with other study done in south Asians.[26]

In our study the frequency of abdominal obesity is more in female (75%) than in the male (63.35%) participants. The main cause for the increase in abdominal obesity in female may be due to sedentary life style. After menopause decrease in androgen hormone leading to increase in visceral obesity with overall obesity can be the reason for the insulin insensitivity and metabolic syndrome. There is established link between abdominal obesity and hyperinsulinism, insulin resistance, elevated plasma free fatty acid (FFA) levels, hypertension, predisposition to thrombosis, hypertriglyceridemia, small, dense LDL particles, and reduced HDL.[27] There is inverse relationship between abdominal obesity and HDL-C.[28]

Table-7: Distribution of participants on the basis of BMI

Status	Subjects			
	Without Mets	(%)	With Mets	(%)
Obese	21	18.42	93	81.58
Normal	18	29.03	44	70.97
Overweight	8	20.51	31	79.49
Underweight	4	66.66	2	33.34
Total	51		170	

The possible reason for hypertension in obesity can be due to rennin-angiotensin system and associated mechanisms. The visceral fat is second most important organ after Liver for secretion of angiotensin. Accordingly the current study has indicated that the incidence of hypertension is higher in female participants.

Our study indicated that there is higher frequency of metabolic syndrome in obese (81.58%) and in overweight (79.49%). This may be due to the adipocyte dysfunction during increased body fat. It has been well documented that the adipose tissue is an active endocrine and paracrine organ that releases a large number of cytokines and bioactive mediators which are responsible for inflammation, coagulation, fibrinolysis, insulin resistance, diabetes, atherosclerosis, and some forms of cancer.[29] Though obesity is a major cause of morbidity and mortality, associated with an increased risk of cardiovascular diseases and metabolic syndrome the body fat distribution rather than adiposity per se is an important risk factor for obesity related disorders.[30] The infiltration rate of monocytes into visceral adipose tissue is higher than into subcutaneous adipose tissue[31] which helps in the secretion of pro-inflammatoy and atherogenic factors. Intra-abdominal fat is an important determinant of the risk of Coronary Heart Disease (CHD) in patients with metabolic syndrome.[32] In our study 108 (63.35%) participants with metabolic syndrome have been found to have increased waist circumference which can be due to ectopic deposition of adipose tissue in visceral organ leading to increased intra-abdominal as well as overall abdominal obesity.

Our study has indicated that there is significant prevalence of metabolic syndrome in type 2 diabetic patients and the strong association of obesity with metabolic syndrome. Individual suffering from type 2 diabetes must reduce the harmful adipose tissue that is the visceral adiposity to minimize the other complications due to disturbed adipocyte metabolism. Only the treatment to increase glucose utilization may not be sufficient to curb the increasing prevalence of metabolic syndrome. One must be aware of the food quality, lifestyle and increase in ectopic adipose tissue.

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