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METABOLIC SYNDROME AMONG URBAN INDIAN ADULTS

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ABSTRACT

The prevalence of metabolic syndrome has dramatically increased over the last few decades and has become a major health challenge worldwide, increasing the risk of cardiovascular disease. The present study was done to assess which of the diagnostic components as given by NCEP (ATPIII) criteria contribute more to the prevalence metabolic syndrome in urban adults. Anthropometric measurements were taken and blood pressure was measured. Blood lipid profile and blood glucose levels were assessed. Phenotypic markers of metabolic syndrome were also assessed. By NCEP (ATPIII) criteria, 750 subjects (44.9% males and 55.1% females) were identified with metabolic syndrome (MS). The major components of MS were low HDL levels and high blood glucose in both the genders. Abdominal obesity was seen more in females (82.5%). The prevalence of metabolic syndrome increased with age. The mean values of waist circumference, blood glucose, blood triglycerides and blood pressure showed an increase with increase in the number of metabolic syndrome diagnostic components. More than 50% of subjects had buffalo hump and double chin as phenotypic markers that help in early identification of metabolic syndrome. The severity of each problem associated with occurrence of metabolic syndrome is compounded by the concomitant presence of other problems.

KEY WORDS:
Metabolic syndrome, diabetes, obesity, hypertension and dyslipidemia

INTRODUCTION

A global transition in the disease pattern has been observed, where the relative impact of communicable diseases are decreasing while on the other hand, non-communicable diseases like cardiovascular disease (CVD), diabetes and hypertension are increasing at a faster rate (Johnsen, 2007). The clustering of lifestyle diseases

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viz hypertension, dyslipidemia and obesity are characterized as metabolic syndrome (MS). Individuals with MS have a 30%–40% probability of developing diabetes and/or CVD within 20 years, depending on the number of components present (Enas et al, 2007). These components are elevated fasting blood glucose, elevated triglycerides, reduced HDL cholesterol, elevated waist circumference and elevated blood pressure (Grundy, 2005).

The predominant underlying risk factors for the syndrome appear to be abdominal obesity (Carr et al, 2004; Lemieux et al, 2001) and insulin resistance (Reaven, 1988); other associated conditions can be physical inactivity (Park et al, 2003), aging (Ford et al, 2002) and hormonal imbalance (Apridonidze et al, 2004).

Numerous studies have shown that separate components of metabolic syndrome are associated with higher risk of coronary heart disease and stroke, cardiovascular disease events followed by myocardial infarction. Thus preventing the development of each component of metabolic syndrome using diagnostic criteria should be utmost priority (Katano et al, 2010).

The present study was, therefore, planned to assess which of the diagnostic components as given by NCEP (ATPIII) criteria contribute more to the prevalence metabolic syndrome in urban adults.

MATERIALS AND METHODS

A hospital based study was conducted with 1500 subjects. The subjects comprised of middle aged men and women visiting the OPDs of 7 Delhi hospitals for medical problems related to the components of metabolic syndrome and/or for preventive health checkups. According to third report of National Cholesterol Education Program (NCEP) expert report (ATPIII) (2008), metabolic syndrome is defined as having three or more of the following abnormalities.

Waist circumference >40 inches for men, >35 inches for women
Blood Triglycerides >150mg/dl
HDL Cholesterol <40 mg/dl in men, <50mg/dl in women
Fasting blood glucose >100 mg/dl
Blood pressure >130/85 mmHg (Grundy, 2005).

NCEP (ATP III) criteria (Grundy, 2005) was used to select freshly diagnosed cases of metabolic syndrome. The project was approved by the ethics committee of Delhi University, India and all participants signed an informed consent form.

The study consisted of collection of ground data and relevant literature for a statistical selection of probabilistic sample size of individuals with MS, aged 35 to 55 years (n = 750) calculated at the 95% confidence interval with a 5% margin of error. An equal number of non metabolic syndrome (NMS) subjects matched for age and gender were selected.

Suitable questionnaires were formulated to collect demographic & baseline information, smoking and alcohol consumption, family history of the components of metabolic syndrome; information on routine daily physical activity and exercise pattern,

occupational and leisure time physical activity, physical activity during the last 3-4 years including occupation, recreation and exercise patterns.

Anthropometric measurements like height, weight and waist circumference were taken using standardized techniques and the subjects were examined for blood pressure. Data regarding biochemical parameters viz blood glucose and lipid profile was obtained from the hospital authorities. Phenotypic markers were also assessed as early detectors of metabolic syndrome (Mishra et al, 2008).

The data was statistically analyzed. Means and standard deviations (SD) were calculated for parametric data. Chi-square and t tests were used for comparison between the MS and NMS groups. The significance level used was $\alpha = 0.01$ for a two-tailed test. All statistical analyses were carried out using the SPSS 19 version statistical program.

RESULTS

By NCEP (ATPIII) criteria, 750 subjects (44.9% males and 55.1% females) were identified with metabolic syndrome. An equal number of age and gender matched non metabolic syndrome subjects (NMS) were taken.

DISTRIBUTION OF METABOLIC SYNDROME SUBJECTS BY AGE AND GENDER

Distribution of MS subjects by age and gender (Table 1) showed that metabolic syndrome was more prevalent in the age group of 50-55 years in both males and females. The prevalence of metabolic syndrome thus showed an increase with age.

PERCENTAGE PREVALENCE OF MS DIAGNOSTIC COMPONENTS

Table 2 illustrates the percentage prevalence of individual diagnostic components of metabolic syndrome in the MS subjects. Low HDL levels were present in the majority of both MS females (89.3%) and males (85.7%). High blood glucose and high blood pressure were the next in order of prevalence in MS males while abdominal obesity (larger than desirable waist circumference) was the next most prevalent component in MS females (82.5%). High blood glucose and high blood pressure were found in 58.59% and 54.4% of MS females respectively. The data thus reflects that the major cause of metabolic syndrome in middle aged adults is a low HDL level combined with high blood glucose and high blood pressure. Abdominal obesity is a major cause in females.

The subjects taken as controls (NMS) (Table 3) were those who had less than three diagnostic components of MS as per NCEP (ATPIII) criteria. Even among the NMS subjects, a large number of both males and females had low HDL levels (53.41% and 64.64% respectively). Abdominal obesity was another component seen in a large number of NMS subjects, especially females (31.1%).

DISTRIBUTION OF SUBJECTS ON THE BASIS OF NUMBER OF MS DIAGNOSTIC COMPONENTS

Distribution of subjects on the basis of prevalence of number of diagnostic components of metabolic syndrome (Table

4) shows that of the 750 MS subjects, 71.5% were diagnosed with 3 components and the rest 28.5% with more than 3 components. Amongst the NMS subjects, a substantial 20.8% were having 2 components and were thus at a risk of having metabolic syndrome with the addition of one more component.

MEAN VALUES OF MS DIAGNOSTIC COMPONENTS VS NUMBER OF DIAGNOSTIC COMPONENTS

Data analyzed for all the 1500 subjects as depicted in Table 5 shows that the mean values of waist circumference, blood glucose, blood triglycerides and blood pressure (both systolic and diastolic) showed an increase with increase in the number of metabolic syndrome diagnostic components. In a similar trend, HDL levels decreased with increase in the number of metabolic syndrome diagnostic components. The differences were statistically significant by one way analysis of variance ($p<0.01$). The data is thus indicative that the severity of any one component was compounded by the presence of other problems.

PHENOTYPIC MARKERS OF METABOLIC SYNDROME

Metabolic syndrome and type 2 diabetes mellitus are common in Asian Indians. Simple yet reliable phenotypic markers are needed for early detection of MS in Asian Indians. So the present study assessed 4 phenotypic markers in freshly diagnosed cases of metabolic syndrome. The results revealed that more than 50% of subjects had buffalo hump and double chin as a phenotypic marker of metabolic syndrome.

DISCUSSION

Asian Indians are at high risk with respect to diabetes and CVD, and the numbers are consistently increasing (Enas et al, 2007). The prevalence of MS in Asian Indians varies according to the region, the extent of urbanization, lifestyle patterns, and socioeconomic/cultural factors. The present study revealed that the major components contributing to metabolic syndrome in both the genders were low HDL combined with high blood glucose and high blood pressure. Abdominal obesity (larger waist circumference) was an additional major component in adult females.

A study conducted on prevalence and clinical characteristics of metabolic Syndrome in middle aged Korean adults (Kwon and Park, 2005) assessed the prevalence of various factors relating with metabolic syndrome. The prevalence of abdominal obesity and low HDL cholesterol in women was significantly higher than in men ($p<0.0001$), but the prevalence of hypertriglyceridemia and high blood pressure in men and women was not significantly different. Our study revealed similar results in that the prevalence of abdominal obesity in women was significantly higher than in men ($p<0.001$) but the prevalence of low HDL, high blood glucose and high BP was not significantly different.

In the study of Kwon and Park (2005), applying the NCEP-ATP III criteria, the order of factors with high prevalence in men was high blood pressure, hypertriglyceridemia, low HDL cholesterol, high fasting plasma glucose, and abdominal obesity. In women, the order was high blood pressure, low

HDL cholesterol, hypertryglyceridemia, abdominal obesity and high fasting plasma glucose. In our study, the order of factors with high prevalence in men was low HDL, high blood glucose, high blood pressure, high triglycerides and high waist circumference. In women, the order was low HDL Cholesterol, high waist circumference, high blood glucose, high blood pressure and high triglycerides.

The present study reflects that the means of waist circumference, blood glucose, blood triglycerides and blood pressure levels were higher while means of HDL levels were lower in subjects with a higher number (n=5) of metabolic syndrome diagnostic components. The finding were similar to a research conducted by Katano et al (2010) which stated that the mean values of SBP, DBP, BP, IGT and waist circumference were higher in group with a higher number of MS diagnostic components.

The present study showed that the prevalence of metabolic syndrome increased with age, from 21.4% among participants aged 30 through 35 years to 33.3% for participants aged 50 through 55 years in males and similarly from 25.2% to 29.5% in females. The findings were similar to a study conducted by Ford et al (2002) that the prevalence increased from 6.7% among participants aged 20 through 29 years to 43.5% for participants aged 60 through 69 years.

Buffalo hump and double chin as novel phenotypic markers for detection of MS for the first time were reported by a cross sectional study done on both MS and non MS subjects (Mishra et al, 2008). Our study also reflects presence of buffalo hump and double chin in almost 50% of the MS subjects.

The strength of our study was a fairly large sample size of freshly diagnosed cases of metabolic syndrome and assessment of phenotypic markers.

The current findings suggest creating awareness regarding lifestyle disorders and their effects. Early intervention, particularly with lifestyle changes, would delay the onset of advance forms of metabolic syndrome (Hamilton et al, 2007; Levine, 2004).

CONCLUSION

Low HDL levels, high blood pressure and high blood glucose are the main components of metabolic syndrome in most people. Abdominal obesity is another major component, especially making females prone to metabolic syndrome. Buffalo hump and double chin should be considered as early detectors of MS. The severity of each problem associated with occurrence of metabolic syndrome is compounded by the concomitant presence of other problems.

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Table 1: Distribution of metabolic syndrome subjects by age and gender

AGE (Years)	Metabolic Syndrome Subjects	
	Males (n=337) N (%)	Females (n=413) N (%)
35 – 39	72 (21.4)	104 (25.2)
40 – 44	69 (20.4)	83 (20.1)
45 – 49	84 (24.9)	104 (25.2)
50 – 55	112 (33.3)	122 (29.5)

Table 2: Percentage prevalence of metabolic syndrome diagnostic components in MS subjects

Components of Metabolic Syndrome	MS Males n=337 N (%)	NMS Females n=413 N (%)
Elevated BG	224 (66.46)	242 (58.59)
Elevated TG	181 (53.70)	184 (44.55)
Low HDL	289 (85.7)	369 (89.3)
Elevated BP	208 (61.43)	225 (54.4)
Elevated WC	173 (51.3)	341 (82.5)

LEGEND: BG: Blood Glucose; TG: Triglycerides; HDL: High Density Lipoprotein; BP: Blood Pressure; WC: Waist Circumference.

Table 3: Percentage prevalence of metabolic syndrome diagnostic components in NMS subjects

Components of Metabolic Syndrome	NMS MALES n=337 N (%)	NMS Females n=413 N (%)
Elevated BG	0 (0)	0 (0)
Elevated TG	5 (1.4)	4 (1.0)
Low HDL	180 (53.4)	267 (64.6)
Elevated BP	35 (10.2)	31 (7.4)
Elevated WC	65 (19.3)	129 (31.1)

LEGEND: BG: Blood Glucose; TG: Triglycerides; HDL: High Density Lipoprotein; BP: Blood Pressure; WC: Waist Circumference.

Table 4: Distribution of subjects on the basis of number of MS diagnostic components

MS/NMS	Number of Metabolic syndrome Components						Total (n=1500)
	0	1	2	3	4	5	
Metabolic Syndrome	0	0	0	536 (71.5)	184 (24.4)	30 (4.1)	750
Non- metabolic syndrome	248 (32.9)	346 (46.3)	156 (20.8)	0	0	0	750

LEGEND: The 5 diagnostic components of metabolic syndrome are defined as following: Elevated waist circumference: >40 inches in men, >35 inches in women; Elevated triglycerides: >150mg/dl; Low HDL Cholesterol: <40 mg/dl in men, <50mg/dl in women; Elevated fasting glucose: >100 mg/dl; Elevated blood pressure: >130/85 mmHg

Table 5: Mean values of MS diagnostic components in relation to number of diagnostic components

Components of MS	Number of Components					
	0 (M+SD)	1 (M+SD)	2 (M+SD)	3 (M+SD)	4 (M+SD)	5 (M+SD)
Waist Circumference	30.14+3.59	31.23+6.26	38.22+7.99	38.76+7.48	41.13+6.53	45.34+5.70
Fasting Glucose	82.11+12.9	85.14+15.2	94.94+34.7	116.5+42.4	126.4+36.1	159.2+48.5
Triglycerides	109.3+17.6	111.7+18.1	116.9+24.6	146.1+47.1	155.1+48.2	188.6+36.7
HDL	49.30+4.68	36.76+8.52	33.4+7.37	33.60+7.70	33.68+7.07	32.25+6.79
BP (systolic)	78.88+3.26	79.0+4.65	79.91+7.25	132.5+15.9	137.6+14.0	144.0+7.42
BP (diastolic)	78.88+3.26	79.0+4.65	79.9+7.25	86.2+8.95	89.0+7.99	92.46+5.92

LEGEND: The 5 diagnostic components of metabolic syndrome are defined as following: Elevated waist circumference: >40 inches in men, >35 inches in women; Elevated triglycerides: >150mg/dl; Low HDL Cholesterol: <40 mg/dl in men, <50mg/dl in women; Elevated fasting glucose: >100 mg/dl; Elevated blood pressure: >130/85 mmHg.

Table 6: Phenotypic markers of metabolic syndrome

Phenotypic Markers	Metabolic Syndrome (n=750) N (%)	Non Metabolic Syndrome (n=750) N (%)
Buffalo Hump	370 (49.3)	92 (12.2)
Double Chin	383 (51.1)	151 (20.1)
Skin Tag	78 (10.5)	35 (4.6)
Xanthelasma	40 (5.3)	24 (3.2)