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Original Research Article

Correlates of metabolic syndrome and prevalence among urban population of Agra, Uttar Pradesh, India

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ABSTRACT

Background: Chronic non-communicable diseases (NCD) are increasing among the adult population in both developed and developing countries, resulting diabetes, cardiovascular diseases with high morbidity and mortality. Due to increase in life expectancy and change in life style and behavior of people and clustering of metabolic abnormalities in individuals leads to development of metabolic syndrome. To estimate the prevalence of metabolic syndrome and their associated risks factors belonging the age group of 18 years and above of urban Agra population.
Methods: Cross sectional study was carried out among 18 years and above age group of urban population of Agra, Uttar Pradesh, India. A multi stage simple random sampling technique is used to reach the subjects.
Results: Prevalence of metabolic syndrome was found 37.1% in study subjects, more common in females (65.9%). The metabolic syndrome was also found higher in the educated group between class 8 to class 12 and among socio economic status III. Higher risk showed by serum triglyceride component of metabolic syndrome among study group.
Conclusions: The prevalence of metabolic syndrome in female study population is higher as compared to the male study population in every selected bio social characteristics.

Keywords: Metabolic syndrome, Prevalence, Triglyceride

INTRODUCTION

Chronic non-communicable diseases (NCD) are increasing among the adult population in both developed and developing countries, resulting diabetes, cardiovascular diseases with high morbidity and mortality. The upward trend of prevalence is due to increase in life expectancy and change in life style and behavior of people.[1] People with impaired glucose intolerance is having a multiple set of risk factors that commonly appears together, forming what is known as metabolic syndrome. The factors characteristic of metabolic syndrome includes abdominal obesity, atherogenic dyslipidemia, raised blood pressure, insulin resistance, and prothrmbotic and proinflammatary states. The clustering of metabolic abnormalities in individual put heads together for development of cardiovascular disease. Different guideline for the Metabolic Syndrome has been proposed by WHO, National Cholesterol Education Program-Adult Treatment Panel III (NCEP-ATP-III) and International Diabetes Federation IDF and AACE.[2-6]

About 20-30% of adult population worldwide is suffering from metabolic syndrome. They have a fivefold greater risk of developing type-2 diabetes and two to three fold risk for heart attack or stroke.[7] One third of the urban Indian population has Metabolic Syndrome.[8] Because of change in diet, sedentary life style, urbanization and mechanization there is an increment in prevalence of

metabolic syndrome in India.[9-12] This study was designed to assess the prevalence of Metabolic Syndrome and its risk factors in 18 years and above age group of urban Agra population.

METHODS

Present cross sectional study was carried out among 18 years and above age group of urban population of Agra, Uttar Pradesh, India. Informed written consent was taken from the participant with the clearance from college ethical committee (S. N. Medical College, Agra) to conduct the study. The study was completed in one and a half year (April 2014 to September 2015).

The sample consisted of 18 years and above age group males and females belonging to urban Agra. The sampling frame consisted of urban wards of Agra city. All men and women aged 18 years and above in selected localities were be included in the sampling frame for the study.

Mangat et al was reported the prevalence of metabolic syndrome for Chandigarh city was 38.5% under ATP-III criteria.[13] The National Cholesterol Education Program (NCEP) Adult Treatment Panel III (ATP-III) devised a definition for the metabolic syndrome and it is one of the most widely used criteria for metabolic syndrome. It uses measurements and laboratory results that are readily available to physicians, facilitating its clinical and epidemiological application. Based on NCEP ATP-III definition, Metabolic Syndrome is present, if three or more of the following five criteria are met: waist circumference over 102 cm. (men) or 88 cm (women), blood pressure over 130/85 mmHg, fasting triglyceride (TG) level over 150 mg/dl, fasting high-density lipoprotein (HDL) cholesterol level less than 40 mg/dl (men) or 50 mg/dl (women) and fasting blood sugar over 100 mg/dl.

For drawing a statistically valid sample size, the prevalence of Metabolic Syndrome was assumed to be 38.5%, in urban population of India under ATP-III guidelines. However, the various studies in India have reported the prevalence of Metabolic Syndrome to be range from 10-50%.[9,14-20]

The sample size was calculated at 95% confidence at 80% of power under two-sided test criterion. The resultant sample size is 137. Hence, a total of 137 males and females of 18 years or above age group were initially registered, however final analysis was done only on 127 cases with 10 incomplete interviews.

A multi stage simple random sampling technique is applied here for the survey. Present population-based study conducted in urban wards of Agra district including individuals aged ≥18 years. Based on sampling plan, from 90 corporation wards (in Agra city), one ward (Khataina) was randomly selected by the help of a random number table. In the selected ward, based on random number table, one mohalla "Jattu Bazar" was further selected. One lane (row), from the selected mohalla is chosen as next stage. Then all consecutive household in that lane was selected. Any one individual was selected randomly in the visited house out of all those members who gave consent to participate in the study until achieve the desired sample size, last stage of our sampling technique.

After establishing a good rapport and obtaining consent from participating subjects in every visited household, the information was recorded in the predesigned and pretested schedule. The data on socio-economic and demographical status were noted. Waist circumference was measured at the midpoint between the lower castle cartilage and the highest points of iliac crest during complete its exhaling. The Blood pressure was measured in the left arm, after 10 minutes of resting position. The sphygmomanometer was calibrated and average of two different measurements with five-minute interval was taken.

The participants were enlisted and provided with a unique ID number and instructed to keep fasting until blood sample was collected on the next morning. Next day, early in the morning, fasting intravenous blood sample (5 ml) was collected in a plain vial after 8 hours of overnight fasting of all those individuals only who were provided ID No. a day before in evening, for the estimation of triglycerides, HDL and Fasting Plasma Glucose. The sample was taken to the laboratory of S. N. Medical College for biochemical investigations. The HDL cholesterol was estimated by Diazyme HDL cholesterol assay. The assay is based on a modified polyvinyl sulfonic acid (PVS) and polyethylene-glycol-methyl ether (PEGME) coupled classic precipitation method with the improvements in using optimized quantities of PVS/PEGME and selected detergents.

Enzymatic –colorimetric method was used for the estimation of Serum Triglycerides and Fasting Plasma Glucose. Interviewed person, who had forgotten to remain fasting, was again explained about importance of fasting and sample collection of such person was done on another day. Those subjects found diabetic or having abnormal blood glucose levels or abnormal lipid levels during the survey were referred to S.N. Medical College for further evaluation and management.

The information collected on the study schedules was transferred on the predesigned classified tables, formed according to our aims and objectives. The Chi-square test statics was applied here for measuring the association between metabolic syndrome and bio-social factors. The logistic regression is to correctly predict the category of outcome for individual cases using the most parsimonious model. Logistic regression calculates the probability or success over the probability of failure, the results of the analysis are in the form of an odds ratio,

and Wald test is one of the best choices over likelihood ratio (LR) test for statistical significance of each coefficient based on odds.

Statistical analysis

Data analysis was done to draw the valid inferences by the help of IBM SPSS Statistics 20.0.

RESULTS

It is observed from the Table 1 that, the 37.01% study population meets the criteria of Metabolic Syndrome, in which 65.9% were female. The prevalence of metabolic syndrome among 35-54 age group was found higher as compared to other age-groups and is statistically significant (p=0.008) among study groups.

Table 1: Metabolic syndrome and age of study group.

Metabolic syndrome								
	Present			**Absent**			**Total**	
	47 (37.01)			80 (62.99)			127 (100)	
Age intervals (years)	Male N (%)	Female N (%)	Total	Male N (%)	Female N (%)	Total	Chi-Square	p-value
Under 24	1 (2.13)	0 (0)	1 (2.13)	9 (11.2)	9 (11.2)	18 (22.5)		
25-34	3 (6.38)	6 (12.7)	9 (19.1)	4 (5.0)	17(21.3)	21(26.3)		
35-44	5 (10.6)	9 (19.2)	14(29.7)	4 (5.0)	10 (12.5)	14 (17.5)		
45-54	4 (8.51)	7 (14.8)	11 (23.4)	4 (5.0)	6 (7.5)	10 (12.5)	15.78	0.008
55-64	1 (2.13)	6 (12.7)	7 (14.8)	2 (2.5)	3 (3.75)	5 (6.25)		
65 & above	2 (4.26)	3 (6.38)	5 (10.6)	6 (7.5)	6 (7.5)	12 (15)		
Total	16 (34.0)	31(65.9)	47 (100)	29 (36.2)	51 (63.8)	80 (100)		

Table 2: Metabolic syndrome and selected social factors.

Metabolic Syndrome								
Social Factors	Present			Absent			Total	
	47 (37.01)			80 (62.99)			127 (100)	
	Male N (%)	**Female N (%)**	**Total**	**Male N (%)**	**Female N (%)**	**Total**	**Chi-Square**	**p-value**
Educational status								
Illiterate	0 (0)	2 (4.26)	2 (4.26)	1 (1.25)	1 (1.25)	2 (2.5)		
Up To 8th	2 (4.26)	4 (8.51)	6 (12.8)	6 (7.5)	15 (18.8)	21(26.3)		
Up To 12th	8 (17.0)	15(31.9)	23(48.9)	14 (17.5)	27(33.8)	41(51.3)	5.17	0.159
Graduate & above	6 (12.8)	10(21.3)	16(34.0)	8 (10)	8 (10)	16 (20)		
Total	16	31	47 (100)	29	51	80 (100)		
Occupational status								
Student	1 (2.13)	4 (8.51)	5 (10.64)	4 (5)	1 (1.25)	5 (6.25)		
Retired	2 (4.26)	4 (8.51)	6 (12.8)	8 (10)	14 (17.5)	22 (27.5)		
Household Work (Housewife)	1 (2.13)	1 (2.13)	2 (4.26)	3 (3.75)	6 (7.5)	9 (11.3)		
Government Job	10 (21.3)	11 (23.4)	21 (44.7)	6 (7.5)	11 (13.8)	17 (21.3)	3.76	0.584
Private Job	2 (4.26)	5 (10.7)	7 (14.9)	7 (8.75)	11 (13.8)	18 (22.5)		
Shopkeeper	0 (0)	6 (12.8)	6 (12.8)	1 (1.25)	8 (10)	9 (11.3)		
Total	16	31	47 (100)	29	51	80 (100)		
Socio-economic status								
I	2 (4.26)	2 (4.26)	4 (8.51)	1 (1.25)	1 (1.25)	2 (2.5)		
II	3 (6.38)	7 (14.9)	10 (21.3)	3 (3.75)	7 (8.75)	10 (12.5)		
III	10 (21.3)	17 (36.2)	27 (57.5)	15 (18.8)	26 (32.5)	41 (51.3)	8.94	0.03
IV	1 (2.13)	5 (10.6)	6 (12.8)	10 (12.5)	17 (21.3)	27 (33.8)		
Total	16	31	47 (100)	29	51	80 (100)		

The highly educated group of study population shows the lower prevalence (34.0%) of metabolic syndrome when they compared with others. It is also observed from the table that, the prevalence of Metabolic Syndrome is quite higher in the educated between classes 8 to class 12. This is statistically insignificant (p=0.159) due to chance only. It is also observed from the table that the higher prevalence (44.7%) was found in Government jobholder then followed by Private jobholder and students. Based on Socio economic status, the higher prevalence (57.5%) of metabolic syndrome was found in Group III, (Modified Kuppu Swami's social economic status scale 2014) whereas the least prevalence (8.51%) was found in Group I.[21] The noting fact is that the prevalence of metabolic syndrome in female study population is higher as compared to the male study population in every selected biosocial characteristics. All the results discussed above are statistically significant based on study population.

Based on binary logistic regression analysis on components of metabolic syndrome (Table 3) on might say that the higher risk showed by the component serum triglyceride (STG) (Wald test score = 15.67, p =0.00). The second most affecting component of metabolic syndrome is fasting plasma glucose (FPG). Similarly, others effecting factors are high density lipoprotein (HDL) cholesterol, waist circumference (WC), and systolic blood pressure (SBP). It is also remarkable that the diastolic blood pressure (DBP) is not playing a significant roll (Wald test score = 0.538, p =0.463).

Table 3: Binary logistic regression analysis on components of metabolic syndrome.

Components	Metabolic syndrome		Wald test Statistic Value	p-Value
	Present N (%)	Absent N (%)		
Systolic blood pressure (mmhg)				
<130	12 (25.53)	57 (71.25)	4.568	0.033
≥130	35 (74.47)	23 (28.75)		
Total	47 (100)	80 (100)		
Diastolic blood pressure (mmhg)				
<85	14 (29.79)	51 (63.75)	.538	0.463
≥85	33 (70.21)	29 (36.25)		
Total	47 (100)	80 (100)		
Serum triglyceride (mg/dl)				
≥150	5 (10.64)	17 (21.25)	15.676	0.000
<150	42 (89.36)	63 (78.75)		
Total	47 (100)	80 (100)		
Fasting plasma glucose (mg/dl)				
<100	34 (72.34)	78 (97.5)	10.660	0.001
≥100	13 (27.66)	2 (2.5)		
Total	47 (100)	80 (100)		
Waist circumference (cm)				
>102 for Male and >88 for Female	22 (46.81)	63 (78.75)	2.849	0.091
≤102 for Male and ≤88 for Female	25 (53.19)	17 (21.25)		
Total	47 (100)	80 (100)		
High density lipoprotein cholesterol (mg/dl)				
<40 for Male & <50 for Female	36 (76.6)	39 (48.75)	8.040	0.005
≥40 for Male & ≥50 for Female	11 (23.4)	41 (51.25)		
Total	47 (100)	80 (100)		

DISCUSSION

In the present study (using modified ATP III criteria), 37.0% of subjects were found to have Metabolic Syndrome. Number of female subjects suffering from metabolic syndrome was higher (65.96%) than the male subjects (34.04%) and the difference is statistically significant (p=0.008). The maximum prevalence of metabolic syndrome among study subjects was observed in the age-group 35-54 followed by upper age group. A salient point also noted that, the latest life style might be the factor for metabolic syndrome (19.15%) in younger age group.

Mangat et al, also reported similar prevalence (38.5%) in Chandigarh under similar criteria.[13] Ramachandran et al

reported slightly higher prevalence (41.1%) in Chennai city due to difference in age group of study population (≥20 years).[22] Higher prevalence (51.4%) was observed by Kaur et al using the same criteria as in the present study.[23] This dissimilarity may have occurred because their study population comprised of male industrial workers exclusively. High levels of stress in industrial workers could have played an important role. Singh et al and Ramachandran et al have found prevalence of metabolic syndrome increases with age increases.[22,24] However, in present study the maximum prevalence of Metabolic Syndrome among study subjects was observed in the age-group 35-54. Apurva et al did not find any association between metabolic Syndrome and age in their study.[25]

Selvaraj et al, and Chakraborty et al have found rise in prevalence of metabolic syndrome with increase in literacy status.[26,27] The present study also shows the lower prevalence in higher educated group.

The present study shows that the prevalence of metabolic syndrome was very high among those belonging to class III (57.45%) followed by class II (21.28%), and class IV (12.77%). Similar findings of rising prevalence of Metabolic Syndrome with increasing socioeconomic status have also been observed by Mangat et al, Chakraborty et al, Pathania et al in their study.[20,27,28]

The distribution of five components of Metabolic Syndrome shows that the most common component was HDL (76.6%) followed by FPG (72.34%) and then waist circumference (46.81%).

The present study shows that of those having Waist Circumference above the cut off level, 46.81% respondents had metabolic syndrome while waist circumference below the cut off level 53.19% had metabolic syndrome. Among those with systolic and /or diastolic blood pressure above cut off level, more than half (74.47% & 70.21% respectively) had Metabolic Syndrome. All the differences are statistically significant. Prasad et al find that the Asian Indians are metabolically obese but physically non-obese.[30] In their study even with modified BMI cut-off values for South Asians/Asians, 33% of subjects did not have general obesity, but still had metabolic syndrome.

Most respondents having fasting plasma glucose or triglyceride levels below cut off values had Metabolic Syndrome (89.36 and 72.34% respectively) whereas only 10.64% and 27.66% respectively of those having fasting plasma glucose or triglyceride levels above cut off value had metabolic syndrome. Present difference is also statistically significant with both fasting plasma glucose and serum triglyceride levels. Sharad et al shows that, triglyceride level (48.9%) plays an important role in development of metabolic syndrome and is identified as "obesity epidemic" for contributing to the rising prevalence of metabolic syndrome in Indians.

Low HDL is very common among Asian Indians and is corroborated by various studies. From the table, it is also observed that 76.6% of those having HDL level below cut off value were suffering from Metabolic Syndrome while 23.4% subjects having HDL level above cut off value had metabolic syndrome. Prasad et al shows that, the high prevalence of low HDL amongst women can be attributed to a higher prevalence of central obesity as compared to men.[30]

CONCLUSION

The prevalence of metabolic syndrome was found more than one third among study population in which female population dominance with two third and approx. half of them belongs to 25 to 44-year age group. The prevalence of metabolic syndrome in female study population is higher when it compared to male study population based on selected biosocial characteristics. However, the highly educated study population shows minimum risk of metabolic syndrome. The serum triglyceride (STG) is the most affecting component found for Metabolic Syndrome in the present study.

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