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Prevalence and Correlates of Metabolic Syndrome in Young Population: A Cross Sectional Study

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Abstract

Background: The Metabolic Syndrome (MS) is emerging as one of the major public health problem all over the world including India. It confers increased risk of Cardiovascular Disease (CVD) and Diabetes Mellitus (DM), both of which pose a huge burden over the society and economics. This study was conducted to assess the prevalence and correlates of MS in young population.

Settings and design: A cross-sectional study was performed in Department of Medicine of a rural teaching tertiary care hospital in central India.

Materials and methods: In all consecutive study subjects, a National Cholesterol Education Programme Adult Treatment Panel (NCEP ATP – III) criteria was applied to assess the magnitude of MS.

Statistical analysis: Prevalence of MS was expressed in percentage. For determining the association of risk factors with MS, we used Student's *t*-test to test for continuous variables Chi square for categorical variables and Fisher exact test in the case of small cell sizes (expected value<5). Association was considered statistical significant when P value was ≤ 0.05.

Results: The magnitude of MS was 11.2%.

Conclusion: Metabolic syndrome exists in significant number of young student population. The early identification of MS and associated risk factors can help to prevent or delay MS, diabetes and CVD by modifying their lifestyle.

Keywords: Cardiovascular disease; Diabetes mellitus; Metabolic syndrome

Introduction

The Metabolic Syndrome (MS) consists of a constellation of metabolic abnormalities like central obesity, hypertriglyceridemia, low high-density lipoprotein cholesterol (HDL-C), hyperglycemia and hypertension (HTN) [1]. It confers increased risk of cardiovascular disease (CVD), diabetes mellitus (DM), ischaemic stroke and peripheral vascular disease. Metabolic syndrome poses a huge financial and psychological burden for the patients. In the Framingham Offspring Study, the population-attributable risk for patients with the MS to develop CVD was 34% and 16%; for developing Type 2 DM was 62% and 47% in men and women respectively [2].

Metabolic syndrome is emerging as one of the major public health problem all over the world including India. The prevalence of MS in urban Indian population has been reported as 22.9% in men and 39.9% in women and the age-adjusted prevalence was 24.9%, 18.4% in men and 30.9% in women [3]. Ford et al. reported that the prevalence of MS as 6.7% in participants aged 20 - 29 years, 43.5% participants aged 60-69 years and 42% for participants aged 70 years and above [4].

The rapid increase in the clustering of risk factors (obesity, sedentary life style, aging, lipodystrophy, coronary artery diseases (CAD), DM and HTN) is due to increasing affluence of middle class, urbanization, mechanization, marked changes in diet and sedentary habits [5]. Metabolic syndrome in young population have gained greater attention because of the adverse effects it has and its early identification results in better health. So far, data regarding MS among the young is scarce. Hence, this study was aimed to determine the prevalence of MS among medical students of central India.

Materials and Methods

Ethics

The study was approved by the ethics committee (IRB00003623) of Mahatma Gandhi Institute of Medical Sciences (MGIMS). We obtained a written informed consent from all study subjects before enrolling them in the study.

Study setting

The study was conducted in the Department of Medicine, MGIMS, Sevagram which is a 650-bedded teaching tertiary care hospital located in a town in central India. Between September 1, 2010 and August 31, 2012, a cross-sectional study was conducted to determine the prevalence of MS among study subjects.

Study subjects

This study was carried out amongst medical students (undergraduates, interns and postgraduates) of aged 17 years or above. All medical students in the institute including undergraduates, interns

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and postgraduates were screened during the study period. Students were excluded if they did not provide consent to participate in the study. During the study period, a total of 686 students were expected to be in the institute campus. We aimed at 95% coverage.

Data collection tools

All the study subjects were asked to fill in a pilot tested self-answered questionnaire. This included demographic data [age and sex; socioeconomic status, personal habits like current smoking and alcohol consumption; history of HTN and DM. For social class assessment, Wealth index scale (WIS) was used according to which assigned study subjects into two social classes like "lower" and "upper" based on material possessions. Wealth index scale assess material possessions as follows: one essential (E) item like electricity, 5 useful (U) items like radio, bicycle, scooter, television, land and two non - essential (NE) items i.e. car and refrigerator. Study subjects were considered in "lower " social class if they did not have E item, ≤ 2 U and no NE item, but "upper" if they had E item, ≥ 3U item and two non - essential (NE) item [6].

Current smokers were defined as who reported smoking for at least 3 months in their life and who currently smoke at least on some days of a week. Alcohol consumption was considered for persons who reported alcohol consumption in last 3 months. Questionnaire also covered family (parents and siblings) history of HTN, DM, ischaemic heart disease (IHD) and stroke.

All study subjects included in the study underwent physical examination. Their body mass index was calculated using standard formula. Waist and hip circumference were obtained to get waist/hip ratio. BMI reference value according to World health organization was considered as normal between 18.5 – 24.9 kg/m^2, underweight<18.5 kg/m^2, overweight 25–29.9 Kg/m^2 and obese ≥ 30 kg/m^2. For analysis study subjects were categorized in three groups, normal, underweight and overweight and obese. Blood pressure was measured with the auscultatory method using appropriate cuff, after 20 minutes of rest.

Biochemical analysis and definitions

Baseline blood samples were obtained in fasting state in order to measure plasma glucose and lipid levels. All the study subjects were informed previously to remain fasting at-least 10 hours before the blood samples were withdrawn. Biochemical analyses were performed using auto analyser (XL-300), calibrated with standard calibrators, and followed by quality control before the test. Plasma glucose was measured by Glucose Oxidase Peroxidase method [7]. Cholesterol, triglycerides, HDL-C, VLDL and LDL cholesterol were also calculated in all study subjects [8-10].

In our study MS was defined as per National Cholesterol Education Programme Adult Treatment Panel (NCEP ATP – III) criteria [11-14]. According to this criterion, MS is diagnosed as presence of 3 or more of following 5 parameters: 1. Waist circumference>102 cm in men and >88 cm in women, 2. Hypertriglyceridemia: Triglycerides> 150 mg/dL or on specific medication, 3. Low HDL-C: <40 mg/dL and <50 mg/dL, for men and women respectively, or specific medication, 4. Hypertension: BP ≥ 130 mm systolic or ≥ 85 mm diastolic or specific medication, 5. Fasting plasma glucose ≥ 100 mg/dL or specific medication or previously diagnosed Type 2 DM.

Statistical analysis

We used statistical software STATA (version 16, Stata Corporation, Texas, USA). Magnitude of MS was expressed in percentage and 95% confidence interval (CIs). We used Chi-square test to study associations. Unadjusted odds ratio (ORs) were computed to assess the strength of association between independent variables (age, sex, socioeconomic status, smoking and alcohol and family history of HTN, DM, IHD and stroke and dependent variables (MS) along with their 95% CIs. Multiple logistic regression analysis was performed using backward likelihood ratio (LR) method to derive final model. Variables which had P ≤ 0.2 on univariate analysis were pushed in multiple logistic regression. $P \leq 0.05$ was considered as significant.

Results

Out of 686 students enrolled in our medical college during the study period, 668 students were included in this study. Of the total 668 study subjects, 401 (60%) were males and 267 (40%) were females. The study subject's age at the time of presentation varies from 17 years to 35 years with a mean of 24.9 years. (SD=3.85). The baseline characteristics of the study subjects with respect to risk factor profile, clinical profile and biochemical profile are summarized in Table 1. Almost 60% of the study subjects belonged to upper class of WIS and 40% in lower class of WIS. Number of smokers was estimated to be 12.4% and alcohol consumers was 11.2% of study subjects. Majority (69.5%) of study subjects had normal BMI. Positive family history of HTN was present in 29.5%, DM in 14.8%, IHD in 3.7% and stroke in 2.7%. In majority 94.8% and 96.1% of the study subjects LDL cholesterol and Total cholesterol levels were normal respectively.

Magnitude of metabolic syndrome

On the basis of NCEP ATP – III criteria, MS was found in 11.2% (95% CI: 8.98-13.93) of the study subjects. Among features of MS as per NCEP ATP – III criteria low HDL cholesterol levels were found in 51.1%, hypertriglyceridemia in 18.6%, DM in 18.1%, HTN in 15.1 and increased waist circumference in 6% of study subjects (Table 2).

Correlates of metabolic syndrome

On univariate analysis, odds of MS were 1.45 (95% CI: 0.89-2.34) times higher in females as compared to males but increase in odds was not statistically significant (P=0.132). However odds of MS were 2.17 (95% CI: 1.31-3.67) in study subjects with age group of more than 25 years as compared to study subjects with age group of less than 25 years, and increase in odds was statistically significant (P=0.002). Odds of smoking and alcohol were not found to be significant on univariate analysis. Final model derived by multivariate logistic regression suggested that the only significant correlate of MS was age of the study subjects (OR: 2.11 (95% CI: 1.25-3.55) P=0.005). Significant correlates of MS as derived by univariate and multivariate logistic regression by final model are shown in Table 3.

Discussion

Magnitude of MS was 11.2% among study subjects as per NCEP ATP – III in this cross sectional study. In previous studies, the reported prevalence of MS varies from 24% to over 45% (Table 4). Significant differences in magnitude of MS existed in the present study subjects and the other studies. These differences in magnitude can be significantly attributed to the difference in the age group of the study subjects which is less, as we included younger study subjects in our study. This variation in magnitude of MS is mainly because of the methods used to define MS, ethnic variation and different study settings. The subjects of our study population were medical students which were supposed to be more health conscious and hence may be the reason for the difference between the magnitude of MS between our study and other studies.

Characteristic	Number (N=668)	Percentage
Age (completed years)		
<25	324	48.5
≥25	344	51.5
Sex		
Males	401	60
Females	267	40
Socioeconomic status (Wealth index scale)		
Upper	261	30.1
Lower	407	60.9
History of Smoking		
Present	83	12.4
Absent	585	87.6
History of Alcohol consumption		
Present	75	11.2
Absent	593	88.8
Positive Family history		
Hypertension	197	29.5
Diabetes mellitus	99	14.8
Ischemic heart disease	25	3.7
Stroke	18	2.7
Waist circumference (cms)		
Abnormal	40	6
Normal	628	94
Body Mass Index		
Under-weight	98	14.7
Normal	464	69.5
Over-weight and Obese	106	15.8
Hypertension		
Present	101	15.1
Absent	567	84.9
Diabetes mellitus		
Present	121	18.1
Absent	547	81.9
Triglycerides (mg/dl)		
Abnormal	124	18.6
Normal	544	81.4
HDL cholesterol (mg/dl)		
Abnormal	341	51.1
Normal	327	48.9
LDL cholesterol (mg/dl)		
Abnormal	35	5.2
Normal	633	94.8
Total cholesterol (mg/dl)		
Abnormal	26	3.9
Normal	642	96.1

Table 1: Baseline characteristics of the study subjects.

The current study demonstrates statistically significant association between magnitude of MS and increasing age. The magnitude (14.8%) was significantly (P=0.002) higher in those aged more than 25 years in comparison to those less than 25 years of age (7.4%). Similar results were observed by Ford et al. in U.S. population, based on NHANES III, revealed prevalence of MS increased from 6.7% in participants aged 20 years through 29 years and 43.5% for participants aged through 60-69 years [4]. In another study using IDF definition of MS, magnitude increased from 11.0% in 20-29 years of age group to 47.2% in the 80-89 years in men and 9.2% to 64.4% for women in the corresponding age group [15].

In our study we found that the females had higher magnitude of MS (13.5%) compared to males (9.7%), however this difference was not statistically significant (p=0.132). Our observation is in agreement with the finding of previous studies [16-18]. According to a study conducted in Europe, magnitude of the MS as per WHO, NCEP, NCEP revised and the IDF definitions was 27.0%, 25.9%, 32.2% and 35.9% respectively in men and 19.7%, 23.4%, 28.5% and 34.1% respectively in women [19,20]. However Ramchandran et al., have also reported in a study in urban area of Chennai using modified ATP-3 criteria that magnitude of MS was higher in women than man (46.5% versus 36.4%) [21]. The age-standardized magnitude of MS in a Chinese population has been found to be 9.8% (95% CI 9.0-10.6) in men and 17.8% (16.6-19.0) in women [22].

In our study we found that MS is significantly (p<0.00) higher among those who have are obese (65.2%) compared to those with normal (6.7%) and overweight (25.5%) as per the BMI cut off. These results were comparable to other studies which found that MS was present in 4.6%, 22.4%, and 59.6% of normal-weight, overweight, and obese men, respectively, and a similar distribution was observed in women [23]. Studies have shown that all of these measures have significant association with obesity but BMI represents the lean as well as the fat content of the body and is dependent upon height of the person and hence age also. So it may not represent true central obesity in all the settings. Non-the-less several studies have proven that as the BMI increases MS as well as its associated diseases increase [24].

In a study, Deepa et al. reported magnitude of increased triglycerides in 25.2% and low HDL-C 63.5% [25-29]. The differences between our observation and other studies can be attributed to differences in dietary pattern and age group differences. Kamble et al., has reported in their study that 30.2% of the population had hypertriglyceridemia, 50% of the males had low HDL-C while 70.2% of the females had low HDL-C [17].

The present study is unique in certain ways and first of its kind in India as it studied magnitude of MS in young population as data from India are still scarce in the context of young population. We

Sr. No.	Features of Metabolic Syndrome as per NCEP ATP – III criteria	Number (percentage)
1	Waist circumference (>102 cm in men and >88 cm in women)	40 (6)
2	Hypertriglyceridemia (Triglycerides > 150 mg/dL)	124 (18.6)
3	Low HDL-C (<40 mg/dL for men and <50 mg/dL for women)	341 (51.1)
4	Hypertension (BP ≥ 130 mm systolic or ≥ 85 mm diastolic)	101 (15.1)
5	Fasting plasma glucose (≥ 100 mg/dL) or previously diagnosed diabetes	121 (18.1)

Table 2: Features of Metabolic Syndrome in study subjects.

Correlates of MHE	Univariate analysis		Multivariate analysis	
	OR (95% CI)	P value	OR (95% CI)	P value
Age in years				
≥25	2.17 (1.31-3.67)	0.002	2.11 (1.25-3.55)	0.005
<25	1			
Sex				
Females	1.45 (0.89-2.34)	0.132	1.59 (0.97-2.62)	0.065
Males	1			
Socioeconomic status (Wealth index scale)				
Upper	1		1.70(1.05-2.76)	0.030
Lower				
History of Smoking				
Present	1.74 (0.93-3.28)	0.082	0.58 (0.29-1.16)	0.120
Absent	1			
History of Alcohol consumption				
Present	1.25 (0.61-2.55)	0.540	1.08 (0.49-2.37)	0.849
Absent	1			

Table 3: Correlates of Metabolic syndrome.

Sr. No.	Author	Country	Year	Sample size	Age group (Years)	Criteria used to define MS	Prevalence/ Magnitude of MS (%)
1.	Present study	India	2014	668	17-35	NCEP	11.2
2.	Kamble (17)	India	2010	300	>18	NCEP with waist standards for asians	30.2
3.	Gupta (27)	India	2004	468	>20	NCEP	24.1
4.	Gupta (3)	India	2004	1091	>20	NCEP	30.9
5.	Ramchandra (21)	India	2003	475	20-75	NCEP	45.6
6.	Azimi (28)	Bangladesh	2012	1386	>20	NCEP	43.6
7.	Al-lawati (18)	Oman	2003	1419	>20	NCEP	35
8.	Ford (4)	U.S.	2002	8814	>20-70	NCEP	30
9.	Meigs (29)	U.S.	2003	5961	20-79	NCEP	37.3

Table 4: Magnitude of Metabolic Syndrome reported in different studies.

studied all the students of the medical college with a good coverage more than 97% of the population, this limits the selection bias. This single centre study had some inherent methodology which provides credibility to the study. We used standard definitions (NCEP ATP III) for diagnosis of MS. Our study has certain limitations also. Firstly, our study has selection bias as most of study subjects belonged to higher socioeconomic status that could have led to lower prevalence of MS. Secondly, the medical students were from all parts of country, and known to the investigator hence there may be inappropriateness in the responses related to assessment regarding risk factors of MS i.e smoking and alcohol. Finally being a cross-sectional study it had its indigenous limitations, as temporal associations could not be studied.

Conclusions

We concluded from this study that that metabolic syndrome exist in significant number of young student population. The early identification of MS and associated risk factors can help to prevent or delay MS, diabetes and CVD. The adolescent with risk factors like obesity, hypertension and diabetes need to modify their lifestyle.

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