ORIGINAL ARTICLE

Metabolic syndrome and cardiovascular risk among adults

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Abstract

Background: Mortality and morbidity due cardiovascular diseases in India is on the rise. Metabolic Syndrome which is a collection of risk factors of metabolic origin, can greatly contribute to its rising burden. **Aims & Objectives:** The present study was conducted with the objective of estimating the prevalence of metabolic syndrome and 10-year cardiovascular risk among adults. **Material & Methods:** This hospital-based study included 260 adults aged 20-60 years. Metabolic Syndrome was defined using National Cholesterol Education Program – Adult Treatment Panel -3 criteria. The 10 year cardiovascular risk was estimated using Framingham risk scoring. **Results:** The overall prevalence of metabolic syndrome among the study participants was 38.8%. Age (41-60yrs), male gender and daily consumption of high salt items were positively associated with metabolic syndrome whereas consumption of occasional high sugar items showed an inverse association with metabolic syndrome. According to Framingham Risk Scoring, 14.3% of the participants belonged to intermediate/high risk category. **Conclusion:** With a high prevalence of metabolic syndrome and a considerable proportion of individuals with intermediate to high 10 yr CVD risk, there is a need to design strategies to prevent future cardiovascular events.

Keywords

Metabolic syndrome; Adults; Cardiovascular risk

Introduction

Non communicable diseases are estimated to account for 60% of total deaths and at least a quarter of them were attributed to cardiovascular diseases (CVDs) in India in the year 2014 (1). According to the estimates from the Global Burden of Disease study, age-standardized death rate due to CVDs in India is higher than the global average (272 Vs 235 per 100000) (2). This problem is compounded by the fact that India is also considered as the world capital for diabetes which is an important and independent risk factor for CVD. The metabolic syndrome (MS) is a constellation of interrelated risk factors of metabolic origin that increase the development of atherosclerotic cardiovascular disease (ASCVD) (3).

Individuals with MS show a twofold risk of developing CVD and a fivefold risk of Type 2 Diabetes Mellitus (T2DM) (4). Considering the high burden of CVDs in India, one of the way to reduce the burden of CVD is by modification of life style and managing the composite risk factors of MS. Hence, the current study was aimed to estimate the prevalence of MS and the risk of development of CVD among the patients attending a tertiary care hospital.

Aims & Objectives

- To estimate the prevalence of metabolic syndrome in adults aged 20-60 years attending a tertiary care hospital.
- To assess the 10-year cardiovascular risk using Framingham Risk Score among adults.

Material & Methods

A cross sectional study was conducted among adults attending outpatient facility of department of Medicine of a tertiary care teaching hospital in southern India. The study included 260 adult males and nonpregnant females aged between 20-60 yrs who had their fasting lipid profile and fasting blood sugar done in the past one year. Anticipating the prevalence of MS of 20.7 % (5) with relative precision of 25% and a non-response rate of 10% the sample size was calculated to be 260.

A clearance was obtained from Institutional Ethics Committee. A written informed consent was obtained from the participants. Data including socio demographic characteristics, behavioral factors such as diet (high fat/sugar/salt items, fish and fruit/vegetable consumption), tobacco and alcohol consumption were collected using a semi structured questionnaire. Current use of tobacco or alcohol was defined as daily or occasional consumption during the current year and past user was defined as one who has quit for more than a year. Physical activity was assessed using International Physical Activity Questionnaire (IPAQ) and the subjects were classified as inactive, minimally active and Health Enhancing Physical Activity (HEPA) (6). The 10-year cardiovascular risk was estimated among individuals without known CVD by Framingham risk scoring (FRS) (7). Weight (kg), height (cm) and waist circumference (cm) were measured. Body mass index (BMI) was computed and classified based on Indian classification (8). Two blood pressure readings were taken through mercury sphygmomanometer, in sitting position in the right arm, 10 minutes apart and an average of two readings was considered. MS was defined as per assessment based on National Cholesterol Education Program – Adult Treatment Panel (NCEP-ATP3) 2005 revision criteria (9) which were as follows: Abdominal obesity (waist circumference ≥90cm for Asian men or ≥80cm for Asian women), Fasting Triglycerides (TG) ≥150 mg/dl or drug treatment for elevated triglycerides, HDL cholesterol (HDL-C) ≤40 mg/dl for men or ≤50 mg/dl for women or on drug treatment for reduced HDL-C, Systolic/Diastolic Blood Pressure(SBP/DBP) ≥130/85 mmHg or receiving drug treatment, and Fasting plasma glucose (FPG) ≥100 mg/dl or drug treatment for elevated glucose. Asian cut offs for Abdominal obesity were taken (10,11). If any three or more of the above criteria were present, then the person was labelled to as having MS.

Statistical analysis: The data was entered and analyzed using Statistical Package for Social Sciences (SPSS) version 15. Mean (SD) or Median (IQR) have been reported for continuous variables and categorical variables have been expressed as percentages. Univariate and multivariate logistic regressions were done to identify the factors associated with MS and unadjusted and adjusted odd's ratio (OR) respectively with 95% Confidence Intervals (CI) have been reported. A p value of <0.05 was considered to be statistically significant.

Results

The median (IQR) age of the participants was 47(32.0, 56.0) years. Table 1 shows the gender wise distribution of the background characteristics of study participants. The study included a total of 70(26.9%) patients with type 2 diabetes, 62(23.8%) patients with hypertension and 15(5.8%) with diagnosed CVD.

Figure 1. depicts the distribution of various criteria used to assess the presence of MS among the participants. Males had a higher percentage of all the abnormal parameters compared to females except the abdominal obesity. Among the participants, 18.5% of males and 19.3% of females had at least one abnormal component of MS.

As shown in table 2, on univariate analysis: age (41-60 yrs.), male gender, being married/widowed/divorced, having an educational status >10th standard, daily consumption of salt and BMI≥23 kg/m^2 were significantly associated with MS. However, after multivariate analysis, age (41-60yrs) [OR=3.80, 95%CI=1.74-8.28, p=0.001], male gender [OR=3.36,95%CI=1.04-10.87, p=0.043] and daily

consumption of high salt items [OR=2.77, 95%CI=1.007-7.67, p=0.048] were positively associated with MS whereas consumption of occasional high sugar items [OR=0.47, 95%CI=0.22-0.97, p=0.044] showed an inverse association with MS. This inverse association with occasional sugar consumption could be due to the fact that the participants with MS are people with diabetes or other health problems and hence, might have reduced their consumption.

Framingham Risk Score:

After exclusion of participants with diagnosed CVD, following was the distribution of risk categories of FRS among the study participants: Low (85.7%), intermediate (9%) and high (5.3%). Overall, 75.8% of participants with MS had low risk, 14.3% had intermediate risk and 9.9% had high risk according to FRS. Among those who did not have MS, 91.6% had low risk, 5.8% had intermediate and 2.6% had high risk and this difference in CVD risk among those with MS and without MS was statistically significant (p=0.003).

Discussion

The prevalence of MS reported in the present study was comparable to those reported in hospital based studies and studies done in urban India. However, the prevalence of MS observed in the present study was found to be higher compared to community based studies in rural India. This variation may be due to type of population selected, the criteria followed for determination of MS amidst other contributing factors.

Prevalence of MS from hospital based studies in India ranged from 20% to 47.5% (12,13,14).

The prevalence of MS in studies done in rural areas ranged from 9.3% to 17% (15,16) while studies done in urban areas observed a higher prevalence of MS ranging from 32.7% to 40.7% (17,18,19,20). The Chennai Urban Rural Epidemiology Study, one of the largest epidemiological studies on diabetes in India reported a prevalence of 18.3% as per ATP 3 criteria (21).

The type of predominant abnormal component reported in various studies varied to a great extent. Abdominal obesity was the predominant abnormal component among the adults in the study by Saini A *et al* (93.8%) (20), Madan JG *et al* (70.3%) (19), while in the present study FPG>100 mg/dl was found to be the most common. However, studies by Prasad DS *et al* (18) reported that elevated blood pressure (63.1%) and Deshmukh PR *et al* (16) reported that low HDL (50.2% of men and 69.7% of women) to be the most common abnormalities.

While many studies reported MS to be common among females, fewer studies reported male predominance including the present study. The male predominance in the present study may be due to the fact that it included population younger than 60 years. Sawanth A *et al* (25.16% Vs 12.6%) (5) and Chakraborty SN *et al* (17) found that MS prevalence was higher in males as compared to females. However, study by Prasad DS *et al* (18) observed that prevalence of MS to be higher among females as compared to males (42.3% Vs 24.9%).

A study by Manjunath D *et al* among 18-25 year old adults reported a prevalence of 3.6% while the present study observed a prevalence of 8.1% among 20-25 years (22). Older age has been consistently reported as a factor associated with MS in many studies. The studies by Mahato K *et al* (12) and Rothangpui *et al* (13) observed that MS was associated with older age. However, the study by Sawanth A *et al* found the prevalence of MS to be same in 20-40 and 41-60 yrs (20.61% and 20.76%) which is in contrast to the present study findings (5).

Dietary factors did not show any association with MS in the current study except for daily consumption of high salt items. Study by Mahanta TG *et al* showed that consumption of meat, fast food, pickled vegetable rich in salt and sweet snacks to be significantly associated with MS (23).

Obesity in general was reported to be a risk factor in many studies unlike the present study. Rothangpui *et al* (13) and Prasad DS *et al* (18) found that MS was associated with higher BMI.

While studies by Mahato K *et al* (12) and Chakraborty SN *et al* (17) reported that MS to be associated with sedentary lifestyle as compared to those who were active, the present study did not observe any significant association. However, participants with MS were 1.5 times more likely to be inactive or minimally active as compared to the physically active participants.

While many studies which report CVD risk among individuals with specific morbidities are available, studies done among hospital attendees are sparse. Bansal M *et al* found the CVD risk among those with MS to be low among 76.8% of the participants which is coherent to present study observations (14). However, the proportion of participants with high CVD risk was higher in the present study (Bansal M

et al: 2.7%) (14). A Nigerian study by Oguoma VM *et al* found that CVD risk among adults aged 18 years and older to be low among 86.3% of the participants similar to the present study (24).

Conclusion

The study was conducted among 20-60 yrs old adults, an age group in which people generally neglect the prospects of following the healthy lifestyle and become prone to develop chronic diseases. The study showed age, male gender and high salt item consumption was associated with MS. Although not statistically significant, the study showed that a BMI>23 kg/m^2 to be associated with MS. A considerable proportion of the study participants had intermediate to high 10yr CVD risk. Lifestyle modification in terms of change in behavioral, dietary factors and tackling obesity could reduce the future mortality amongst this population.

Recommendation

A cohort study to estimate the prevalence of MS and development of CVD in the community is desirable. With a high prevalence of MS, and a sizeable proportion of participants having intermediate to high CVD risk, it is important to modify the determinants of MS to reduce future risk of cardiovascular disease and diabetes in this age group.

Limitation of the study (If any)

As the present study was hospital based and conducted in a single center, the prevalence of MS may have been overestimated and cannot be generalized to local community. The information on dietary intake of atherogenic items was limited as detailed dietary survey was not undertaken. Information on behavioral factors such as consumption of tobacco and alcohol was limited and may have been affected by recall bias.

Relevance of the study

The study reports a higher prevalence of MS compared to most of the other hospital based studies done in India. This calls for action with specific interventions and investigate the factors associated with this issue of concern through a more detailed study

Authors Contribution

SDM & KS: conceived and designed the study; RH: collected the data. SKRT, KS, HMH& SKN: analyzing and interpretation of data. All authors participated in drafting the manuscript, reviewing and revising and approved the final version.

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Tables

TABLE 1 BACKGROUND CHARACTERISTICS OF THE STUDY PARTICIPANTS BY GENDER (N=260)

Variables	Category	Males (n=146)	Females (n=114)	Total (n=260)
Median Age in years		47.0(32.75,55.25)	45.0(32.0,56.0)	47(32.0,56.0)
Marital status	Single	38(26.1)	18(15.8)	56(21.5)
	Married	104(71.2)	92(80.7)	196(75.4)
	Widowed/ Divorced	4(2.7)	4(3.5)	8(3.1)
Education	Illiterate	13(8.9)	24(21.1)	37(14.2)
	1st -10th std	72(49.3)	54(47.4)	126(48.5)
	>10th std	61(41.8)	36(31.6)	97(37.3)
Occupation	Employed	110(75.3)	20(17.5)	130(50.0)
	Unemployed	36(24.7)	10(8.8)	46(17.7)
	Homemaker	0(0)	84(73.7)	84(32.3)
Tobacco consumption	Present	32(21.9)	0(0)	32(12.3)
	Absent	114(78.1)	114(100)	228(87.7)
Alcohol consumption	Present	39(26.7)	0(0)	39(15.0)
	Absent	107(73.3)	114(100)	221(85.0)
Physical activity	Inactive	81(55.5)	75(65.8)	156(60.0)
	Minimal active	23(15.7)	10(8.8)	33(12.7)
	HEPA	42(28.8)	29(25.4)	71(27.3)
High fat item consumption	No/rarely	66(45.2)	59(51.8)	125(48.1)
	Daily	10(6.8)	9(7.9)	19(7.3)
	2-3 times/wk or once a week	70(47.9)	46(40.4)	116(44.6)

High salt item consumption	No/rarely	65(44.5)	45(39.5)	110(42.3)
	Daily	33(22.6)	23(20.2)	56(21.5)
	2-3 times/wk or once a week	48(32.9)	46(40.4)	94(36.2)
High sugar item consumption	No/rarely	70(47.9)	49(43.0)	119(45.8)
	Daily	15(10.3)	14(12.3)	29(11.2)
	2-3 times/wk or once a week	61(41.8)	51(44.7)	112(43.1)
Fish consumption	No/rarely	58(39.7)	46(40.4)	104(40.0)
	Daily	32(21.9)	28(24.6)	60(23.1)
	2-3 times/wk or once a week	56(38.4)	40(35.1)	96(36.9)
Fruits/vegetable consumption	Daily	99(67.8)	72(63.2)	171(65.8)
	2-3 times/wk or once a week	47(32.2)	42(36.8)	89(34.2)
BMI in kg/m^2	≤22.9	66(45.2)	49(43.0)	115(44.2)
	>23	80(54.8)	65(57.0)	145(55.8)

TABLE 2 FACTORS ASSOCIATED WITH MS (N=260)

Variable	Category	MS present N=101	MS absent N=159	OR with 95% CI	p value
Age	20-40	18(17.8)	84(52.8)	1	
	41-60	83(82.2)	75(47.2)	5.16(2.84-9.38)	<0.001*
Gender	Male	61(60.4)	85(53.5)	1.32(0.80-2.20)	0.27
	Female	40(39.6)	74(46.5)	1	
Marital status	Single	8(7.9)	48(30.2)	1	
	Married	87(86.1)	109(68.6)	4.78(2.15-10.65)	<0.001*
	Widowed/divorced	5(5.9)	2(1.3)	18.0(3.07-105.32)	0.001*
Education	Illiterate	20(19.8)	17(10.7)	1	
	1st -10th standard	53(52.5)	73(45.9)	0.61(0.29-1.29)	0.19
	>10th standard	28(27.7)	69(43.4)	0.34(0.15-0.75)	0.008*
Occupation	Employed	50(49.5)	80(50.3)	1	
	Unemployed	16(15.8)	30(18.9)	0.85(0.42-1.72)	0.65
	Homemaker	35(34.7)	49(30.8)	1.14(0.65-2.00)	0.64
Tobacco consumption	Present	17(16.8)	15(9.4)	1.94(0.92-4.09)	0.08
	Absent	84(83.2)	144(90.4)	1	
Alcohol consumption	Present	17(16.8)	22(13.8)	1.26(0.63-2.50)	0.51
	Absent	84(83.2)	137(86.2)	1	
Physical activity	Inactive	64(63.4)	92(57.9)	1.45(0.80-2.62)	0.21
	Minimal active	14(13.9)	19(11.9)	1.52(0.65-3.60)	0.32
	HEPA	23(22.8)	48(30.2)	1	
High fat item consumption	No/rarely	47(46.5)	78(49.1)	1	
	Daily	10(9.9)	9(5.7)	1.84(0.69-4.86)	0.21
	2-3 times/week or once a week	44(43.6)	72(45.3)	1.01(0.60-1.70)	0.95
High salt item consumption	No/rarely	41(40.6)	69(43.4)	1	
	Daily	27(26.7)	29(18.2)	1.56(0.81-3.00)	0.17
	2-3 times/week or once a week	33(32.7)	61(38.4)	0.91(0.51-1.61)	0.74

High sugar item consumption	No/rarely	51(50.5)	68(42.8)	1	
	Daily	13(12.9)	16(10.1)	1.08(0.47-2.45)	0.84
	2-3 times/week or once a week	37(36.6)	75(47.2)	0.65(0.38-1.12)	0.12
Fish consumption	No/rarely	40(39.6)	64(40.3)	0.99(0.56-1.76)	0.99
	Daily	24(23.8)	36(22.6)	1.06(0.54-2.05)	0.85
	2-3 times/week or once a week	37(36.6)	39(37.1)	1	
Fruits/ vegetable consumption	Daily	67(66.3)	104(65.4)	1	
	2-3 times/week or once a week	34(33.7)	55(34.6)	0.96(0.56-1.62)	0.87
BMI	≤22.9	34(33.7)	81(50.9)	1	
	>23	67(66.3)	78(49.1)	2.04(1.22-3.43)	0.007*

** Statistically significant, p<0.05*

Figures

FIGURE 1 PRESENCE OF VARIOUS CRITERIA FOR METABOLIC SYNDROME AMONG THE PARTICIPANTS (N=260)