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A COMPREHENSIVE STUDY ON METABOLIC SYNDROME (NCEPATP III) AND FRAMINGHAM RISK SCORE IMPLIED CVD RISK ASSESSMENT AND MANAGEMENT OF CARDIOMETABOLIC RISK FACTORS

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ABSTRACT

Objectives: The objectives of the study were to screen the patients for MetSusing NCEPATP-III criteria, to predict the prevalence of CVD risk using FRS and to find out various risk factors associated with CVD. Methodology: Across sectional study was conducted for a period of 6 months. The ethical clearance was obtained from the institutional ethical committee of Bapuji Pharmacy College, Davangere. The estimated sample size was 278. Patients were screened for MetS andCVD risk assessment was done using non – laboratory - based FRS. Categorical data were analyzed using Chi-square test. Quantitative variables were analyzed using unpaired t-test and one way ANOVA. Results: Out of 278 participants, 71.9% had MetSand 28.05% did not have MetS. The participants with three MetScomponents had the highest prevalence of high CVD risk. Using multiple logistic regression, the significant predictors of CVD risk by FRS were male gender (OR=1.00), age 51–70 years (OR=1.13), BMI between 25–29.9 kg/m2 (OR=1.083 for high and OR=1.086 for moderate CVD risk), SBP between140–150 mm Hg (OR=1.028), and FBS 126mg/dl (OR=1.00). Conclusion: Participants with three MetS risk factors had the highest prevalence of high CVD risk Therefore, awareness about the risk factors associated with MetS and the necessity for managing proper dietary pattern and its associated cardiovascular risk.

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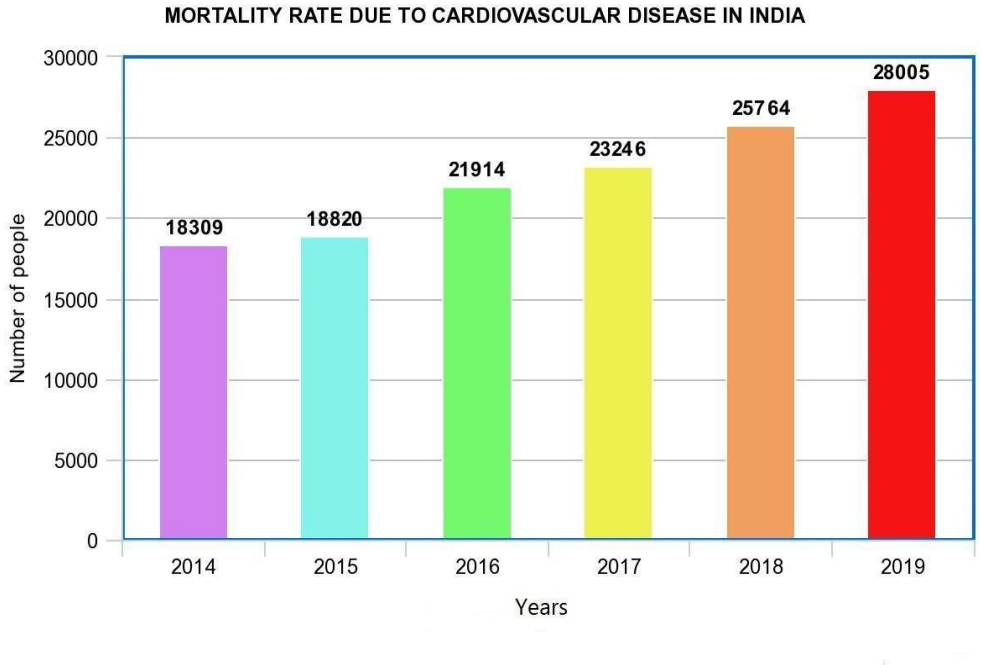
INTRODUCTION

Around the globe, it is observed that there is structural change of disease patterns in the last three decades with a sudden increase in the burden of non-communicable disease (NCD) and a decreasing trend of communicable disease. Lifestyle, environmental and genetic factors are the leadings trends of NCDs.[1] Key elements contributing to the development of these NCDs have been identified and are studied together under the heading of Metabolic Syndrome (MetS).[2] According to World Health Organization (WHO), MetS can be defined as the cluster of cardiometabolic dysfunction which is characterized by the increase in fasting blood glucose (FBG), waist circumference (WC), blood pressure (BP), triglycerides (TG) and reduction in high density lipoprotein cholesterol (HDL-C).[3]. As per NCEP ATP III criteria MetS can be diagnosed if any of the three or more criteria is satisfying i.e. Fasting plasma glucose level at least 110mg/dl (6.1mmol/l), at least 150mg/dl(1.7 mmol/l) of serum triglycerides, serum high density lipoprotein cholesterol level less than 40mg/dl(1.04mmol/l), BP of at least 130/85mmHg or controlled with any antihypertensive treatment and or waist circumference of more than 102cm.[4] There are multiple risk factors that are leading to the syndrome X but inmostcasesobesityactsasakeyfactorforthedevelopmentofothercomponents.The fat accumulation not only relates to development of cardiovascular risks butalsothecardiovasculardiseases.[5]

The Asian Indian ethnicity are predisposed to (CVD) at an earlier age, with a unique feature of "atherogenic dyslipidemia profile" and "South AsianPhenotype" with high propensity of Metabolic syndrome. As per the Global Burdenof Disease, age-standardized CVD death rate of 272 per 100,000 population in Indiaexceeded the global average. Around 59% of the premature mortality is due to CVDin India over two decades highlighting the continuing threat to the population.[6] CVDs are one of the major causes of disability and premature death worldwide andcontributesubstantially to the escalating cost of healthcare.[7]



CVD risk prediction models play a crucial role in early prevention. There existseveral models which include Framingham Risk score (FRS), QRISK2 model. TheAmerican Heart Association (AHA) and the American College of cardiology (ACC)developed Atherosclerotic Cardiovascular Disease (ASCVD) risk score which areused in high-risk population.[8] Among these, FRS is the most simple, common andmost applicable method for predicting the person's chance of developing CVD over10years. Considering the local applicability and modifiability of risk model inIndian population, who CVD develop at a very young age and also have a higher frequency of emerging risk factors the best option to adopt is Non–Laboratory based Framingham Risk Score.[9] The non-laboratory-based Framingham Risk Score is based on age, gender, SBP and treatment status, current smoking, diabetes and BMI. Henceforth, it is important to detect and treat the underlying risk factors that are the starters for most of the CVDs.[10]

There exist a wide range of modifiable and non-modifiable risk factors that are associated with MetS. Controlling or taking care of the modifiable risks likebeing overweight, social habit. Although the risks are significant, there is good news that MetS can be treated by maintaining a normal blood pressure, keeping the blood sugar in check, controlling the cholesterol, reaching and maintaining a healthy weight, getting enough physical activity and following the advice of health care team.[11] As the number of cases with MetS is increasing at a rapid rate and is considered as a major problem in both developed and developing countries and its prevalence increases with urbanization.[12] Similarly the prevalence of CVD among patients with MetS are increasing all over the world. Therefore, our study focuses on screening for metabolic syndrome (MetS) using NCEPATP-III criteria, predicting the prevalence of CVD risk using non-laboratory-basedFRS in MetSpatients and analyzing various riskfactorsthat areassociated withMetS.

MATERIALS AND METHODS:

A prospective cross-sectional study was conducted in the in and out patients at S.S.I.M.S and RC, Davangere for a period of 6 months. Institutional Ethical Committee (IEC) clearance was acquired from the Bapuji Pharmacy College Ethical Committee. Data was collected from the study participants and all records were kept private. Participants were selected for the study based on the inclusion criteria, such as bothmaleandfemale in the age group of 30 – 80 years of age, with social habits like smoking and alcohol consumption and other comorbidities like hypertension, type 2 diabetes mellitus, thyroid disorders, dyslipidemia, asthma, COPD. Patientswith TypeIDM, with a history of CVD or newly diagnosed CVD's, whoarenotwilling togiveinformedconsent, criticallyill patients whoareatriskofCVDorstroke and mental disabilities as well as pregnantandlactating women were excluded from the study. Awell-designedinformed consentformandpatientdatacollectionform was developed whichwasused to collect the details the of patients like name, age, gender, date of admission, date ofdischarge, comorbidities, drug history, diagnosis, laboratory values, height, weight,waist,hipcircumference,waist/hipratioand status of physical activity. The questionnaire was rectified and validated by an Endocrinologist. The data collected during the survey was entered in MicrosoftExceland was analyzed using SPSS18forwindows. The collected data was summarized as frequency and percentage forcategorical variables. The categorical variables were compared using the chi-square test or Fisher's exact test (when more than 20% of the cells with expectedcount of <5 was observed). Multiple logistic regression analysis wasused to examine the association between risk factors of MetS. Risk factors were considered as independent variables, CVD risk as per FRS was considered as dependent variables. Pvaluelessthan0.05, 0.001were consideredstatistically significant.

RESULTS

The study participants were divided into patients with MetS and without MetS and the meanage±standarddeviationofstudyparticipantsinMets andnon-MetSgroupswere58.83±10.76 years and 55±10.95 years respectively. The majority of the participantsbelonged to male gender in the MetS category. In our study, the overall prevalence ofMets was 71.9%.[13] The overall prevalence of CVD risk in low risk, intermediate riskandhigh-risk groups were17.98%, 23.74%and 58.27%respectively.

TABLE 1. DISTRIBUTION OF STUDY PARTICIPANTS BASED ON DEMOGRAPHIC DETAILS.

DEMOGRAPHIC DETAILS	WITH METS (N%)	WITHOUT METS(N%)
GENDER		
Male	114 (57)	46(58.97)
Female	86(43)	32(41.02)
AGE		
30-40	17(8.5)	9(11.53)
41-50	39(19.5)	20(25.64)
51-60	59(29.5)	24(30.76)
61-70	59(29.5)	19(24.35)
71-80	26(13)	6(7.69)
EDUCATION		
Noformal education	34(17)	19(24.35)
Primaryschool	52(26)	16(20.51)
Highschool	46(23)	13(16.66)
Diploma/Masters	68(34)	30(38.46)
INCOME		
Lowincome	26(13)	27(34.61)
Middleincome	141(70.5)	36(46.15)
Highincome	33(16.5)	15(19.23)
MEDICAL HISTORY		
HTN	7(3.5)	15(19.23)
T2DM	46(23)	12(15.38)
HTNandT2DM	89(44.5)	2(2.56)
Hypothyroidism	11(5.5)	1(1.28)
Others	47(23.5)	48(61.5)
SOCIAL HABITS		
Smoker	58(29)	18(23.07)
Alcoholic	9(4.5)	5(6.41)
Both	7 (3.5)	5(6.41)

None	126(63)	50(64.10)
PHYSICAL ACTIVITY		
Sedentary	01(0.5)	01(1.28)
Lessactive	79(39.5)	11(14.10)
Moderatelyactive	111(55.5)	57(73.07)
Highlyactive	09(4.5)	09(11.53)

As shown in the table 1, the study involved male participants in more number as compared to the females in the age group of 51-70 years. Majority of the participants were having primary education with a middle income. Participants with medical history of both HTN and DM with moderately active lifestyle are prone to have MetS.

TABLE 2: DISTRIBUTION OF STUDY PARTICIPANTS BASED ON ANTHROPOMETRIC PARAMETERS AND RISK FACTOR.

ANTHROPOMETRIC PARAMETERS	**WITH METS N(%)**	**WITHOUT METS N(%)**
BMI (kg/m^2)		
<18.5	1(0.5)	1(1.28)
18.5-24.9	10(5)	40(51.28)
25-29.9	148(74)	34(43.58)
≥ 30	41(20.5)	3(3.84)
WAIST CIRCUMFERENCE MALE (cm)		
≤94.9	0 (0)	1(1.28)
95-100	0 (0)	16(34.78)
100-120	107(93.8)	28(35.89)
>120	7(3.5)	1(1.28)
WAIST CIRCUMFERENCE FEMALE (cm)		
<70	0 (0)	0 (0)
70-89	4(4.65)	15(46.87)
90-109	69(80.23)	14(43.75)
>110	13(15.11)	3(9.37)
HIP CIRCUMFERENCE MALES (cm)		
91-100	34(29.82)	21(45.65)
101-110	44(38.59)	18(39.13)
111-120	28(24.56)	7(15.21)
121-131	8 (7.01)	0 (0)
HIP CIRCUMFERENCE FEMALES (cm)		
61-70	1(1.16)	0(0)
71-80	1(1.16)	6(18.75)
81-90	4(4.65)	4(12.5)
91-100	46(53.48)	13(40.625)
101-110	46(53.48)	6(18.75)
111-120	8(9.30)	3(9.37)
121-130	3 (3 . 4 8)	0 (0)
WAIST HIP RATIO (MALE)		
<0.85	0 (0)	0 (0)
0.85-0.89	0 (0)	0 (0)
0.90-0.95	13(11.403)	7(15.21)
≥0.95	101(88.59)	39(84.78)

WAIST HIP RATIO (FEMALE)		
<0.75	0 (0)	0 (0)
0.75-0.79	0 (0)	0 (0)
0.80-0.86	1(1.162)	0 (0)
≥0.86	85(98.83)	32 (100)
RISK FACTORS		
SYSTOLIC BLOOD PRESSURE (mmHg)		
<120	0	17(21.79)
120-139	40(20)	30(38.46)
140-150	99(49.5)	18(23.07)
≥160	36(18)	11(14.10)
≥180	25(12.5)	2(2.56)
DIASTOLIC BLOOD PRESSURE (mmHg)		
<80	0	18(23.07)
80-89	49(24.5)	34(43.58)
90-99	117(58.5)	13(16.66)
≥100	31(15.5)	10(12.82)
TREATMENT FOR HTN		
Yes	134(67)	33(42.30)
No	66(33)	45(57.69)
FASTINGBLOODSUGAR (mg/dl)		
70-100mg/dl	02(1)	43(55.1)
101-125mg/dl	09(4.5)	06(7.69)
>126mg/dl	189(94.5)	29(37.17)

From table 2,it can be interpreted that participants with a BMI of 25-29.9 and male participants with a waist circumference of 100-120 cm and female participants with a waist circumference 90-109 cm as well as participants who were tang treatment for HTN and with high systolic and diastolic BP and FBS were having MetS.

TABLE.3 COMPARISON IN PATIENTS WITH OR WITHOUT METABOLIC SYNDROME.

Parameters	**WithMetS N=200**	**WithoutMetS N=78**	**χ^2 value**	**P value**
GENDER				
Male	114(5)	46(58.97)	0.089	0.764
Female	86(43)	32(41.02)		
AGE(YEARS)				
30-40	17(8.5)	9(11.53)		
41-50	39(19.5)	20(25.4)		
51-60	59(29.5)	24(30.76)	3.483	0.480
61-70	59(29.5)	19(24.35)		
71-80	26(13)	6(7.69)		
EDUCATION				
No formal education	34(17)	19(24.35)	3.662	3.003
Primaryschool	52(26)	16(20.51)		
Highschool	46(23)	13(16.66)		
Diploma	68(34)	30(38.46)		
INCOME				
Lowincome	26(13)	27(34.61)		

Middleincome	141(70.5)	36(46.15)	19.218	<0.0001**
Highincome	33(16.5)	15(19.28)		
MEDICALHISTORY				
HTN				
T2DM	7(3.5)	15(19.23)	75.327	<0.0001**
HTN&T2DM	46(23)	12(15.38)		
Hypothyroidism	89(44.5)	2(2.56)		
Others	11(5.5)	1(1.28)		
	47(23.5)	48(61.5)		
SOCIALHISTORY				
Smoker	58(29)	18(23.07)	2.238	0.524
Alcoholic	9 (4.5)	5(6.41)		
Both	7 (3.5)	5(6.41)		
None	126(63)	50(64.10)		
PHYSICAL ACTIVITY				
Sedentary	1(0.5)	1(1.28)	18.819	<0.0001**
Lessactive	79(39.5)	11(14.10)		
Moderately active	111(55.5)	57(73.07)		
Highlyactive	9(4.5)	9(11.53)		
BMI(kg/m2)				
<18.5	1(0.5)	1(1.28)		
18.5-24.9	10(5)	40(51.28)	85.068	<0.0001**
25-29.9	148(74)	34(43.58)		
≥30	41(20.5)	3(3.84)		
WAIST CIRCUMFERENCE CM(MALE)				
≤94.9	0 (0)	1(1.28)		
95-100	0 (0)	16(34.78)	47.389	<0.0001**
100-120	107(93.8)	28(35.89)		
>120	7(3.5)	1(1.28)		
WAIST CIRCUMFERENCE CM(FEMALE)				
<70	0 (0)	1(1.28)	31.039	<0.0001**
70-89	(4.65)	14(43.75)		
90-109	69(80.23)	14(43.75)		
>110	13(15.11)	3(9.37)		
SYSTOLICBP (mmHg)				
<120	0 (0)	17(21.79)	66.705	0.00*
120-139	40(20)	30(38.46)		
140-150	99(49.5)	18(23.07)		
≥160	36(18)	11(14.10)		
≥180	25(12.5)	2(2.56)		
DIASTOLIC BP (mmHg)				
<80	0 (0)	18(23.07)		
80-89	49(24.5)	34(43.58)	75.707	0.00*
90-99	117(58.5)	13(16.66)		
≥100	31(15.5)	10(12.82)		
≥110	3(1.5)	3(3.84)		

RxHTN				
Yes	134(67)	33(42.30)	14.264	<0.0001**
No	66(33)	45(57.69)		
FASTING BLOOD SUGAR (mg/dl)				
70-100	02(1)	43(55.1)		
101-125	09(4.5)	06(7.69)	126.140	<0.0001**
>126	189(94.5)	29(37.17)		

As shown in table 3, there exists a statistically significant association between MetS and income, physical activity, BMI, blood pressure , treatment for HTN and high FBS levels.

TABLE .4 DISTRIBUTION OF STUDY PARTICIPANTS BASED ON FRSRISK CATEGORIES AND NUMBER OF METABOLIC SYNDROME COMPONENTS.

NCEP ATP-III COMPONENTS	CVD RISK BASED ON FRS CRITERIA		
	Low Risk N (%)	Intermediate Risk N (%)	High Risk N (%)
1 Component	20(25.64)	7(8.97)	5(6.41)
2 Components	16(20.51)	26(33.33)	4(5.12)
3 Components	14(7)	33(16.5)	153(76.5)

As shown in table 4, participants with one component were at low risk and participants with two components and three components were at intermediate and high risk.

TABLE 5. COMPARISON OF 10-YEAR RISK FOR CVD ACCORDING TO FRS SCORING BETWEEN GENDER SUBGROUPS OF WITH AND WITHOUT METABOLIC SYNDROME:

Characteristics	WithMetS	WithoutMetS	χ^2 value	P value
MEN	**N=114**	**N=46**		
Low-risk	04(3.5)	07(15.21)	15.21	<0.0001**
Intermediate-risk	10(8.77)	11(23.91)		
High-risk	100(87.71)	28(60.86)		
WOMEN	**N=86**	**N=32**		
Low-risk	10(11.62)	15(46.87)	24.62	<0.0001**
Intermediate risk	23(26.74)	12(37.5)		
High-risk	53(61.62)	5(15.62)		

As shown in table 5, male and female participants were at high risk with a p- value< 0.0001(highly significant)

TABLE .6 COMPARISONOFMETABOLICSYNDROME PATIENTS WITH 10 YEAR CVD RISK PREDICTION AS PERFRSSCORING.

Variables	Category	CVDriskprediction (FRS)			χ^2value	P value
		low-risk N=14(%)	Intermediate-risk N=33(%)	High-risk N=153(%)		
AGE	30-40	**10(71.4)**	04(12.12)	03(1.96)		
	41-50	03(21.4)	**19(57.57)**	17(11.11)	127.83	0.00*
	51-60	0(0)	08(24.24)	51(33.33)		
	61-70	01(7.14)	02(6.06)	**56(36.60)**		
	71-80	0(0)	0(0)	26(16.99)		
GENDER	Men	04(3.50)	10(8.77)	**100(87.7)**	16.31	<0.0001**
	Women	**10(11.62)**	**23(26.74)**	53(61.62)		
INCOME	Low income	0 (0)	03(9.09)	23(15.03)		
	Middleincome	**11(78.57)**	**25(75.75)**	**105(68.6)**	3.27	0.513
	Highincome	03(21.42)	05(15.15)	25(16.33)		
MEDICAL HISTORY	HTN	0 (0)	02(6.06)	05(3.26)	34.03	<0.0001**
	T2DM	**06(42.85)**	**10(30.30)**	20(13.07)		
	HTN&T2DM	0 (0)	03(9.09)	**86(56.20)**		
	Hypothyroidism	01(7.14)	02(6.06)	08(5.22)		
	Others	04(28.57)	08(24.24)	35(22.87)		
PHYSICAL ACTIVITY	Lessactive	02(14.28)	10(30.30)	67(43.79)	10.68	0.098
	Moderately active	10(71.42)	20(60.60)	81(52.94)		
	Highly Active	02(14.28)	03(9.09)	04(2.61)		
BMI	<18.5	0 (0)	0(0)	01(0.65)	61.64	<0.0001**
	18.5-24.9	0(0)	05(15.15)	04(2.61)		
	25-29.9	**11(78.57)**	**23(69.69)**	**115(75.16)**		
	≥30	03(21.42)	05(15.15)	33(21.56)		
WAIST CIRCUMFERENCE (male)	100-120	04(28.57)	08(24.24)	95(62.09)	0.877	0.644
	>120	0(0)	0(0)	07(4.57)		
WAIST CIRCUMFERENCE (female)	70-89	0(0)	02(6.06)	02(1.30)	2.845	0.584
	90-109	09(64.28)	19(57.57)	41(26.79)		
	>110	01(7.14)	02(6.06)	10(6.53)		
SYSTOLICBP (mmHg)	120-139	**06(42.85)**	08(24.24)	26(16.99)	14.80	0.021*
	140-150	07(50)	**21(6.63)**	**71(46.40)**		
	≧160	0(0)	03(9.09)	33(21.56)		
	≧180	01(7.14)	01(3.03)	23(15.03)		
DIASTOLIC BP (mmHg)	80-89	03(21.42)	09(27.27)	37(24.18)	2.149	0.905
	90-99	09(64.28)	18(54.54)	90(58.82)		
	≧100	02(14.28)	03(9.09)	26(16.99)		
	≧110	0(0)	01(3.03)	02(1.30)		
Rx HTN	Yes	04(28.57)	15(45.45)	**115(75.16)**	20.89	<0.001*
	No	**10(71.42)**	**18(54.54)**	38(24.83)		
FASTING BLOOD SUGAR (mg/dl)	70-100	0(0)	0(0)	02(1)	2.99	0.558
	101-125	0(0)	03(1.5)	06(3)		
	>126	14(7)	30(15)	145(72.5)		

As shown in table 6, men in the age group of 61-70 years with a middle income having a medical history of both HTN and DM with a BMI of 25-29.9 and with SBP of 140-150 mmHg and taking treatment for HTN are having high statistically significant association with MetS and 10- year CVD risk (p value < 0.0001)

TABLE.7 ASSOCIATION BETWEEN VARIOUS RISK FACTORS AND CVD RISK BY FRS IN METS STUDY PARTICIPANTS:

Riskfactors	LowRisk	IntermediateRisk	HighRisk
AGE (51-70YEARS)			
OR	Reference	0.819	1.138
CI (Lower toUpper)	1	0.698 to 0.959	0.999 to 1.296
pvalue	-	0.058	0.013*
GENDER (MALE)			
OR	Reference	0.995	1.00
CI (Lower to Upper)	1	0.9763 to 1.0158	0.9869 to 1.0212
p value	-	0.680	0.042*
MEDICALHISTORY (HTN&TYPEII DM)			
OR	Reference	0.992	1.003
CI (Lower to Upper)	1	0.9744 to 1.0103	0.9874 to 1.0193
pvalue	-	0.395	0.037*
BMI(25-29.9kg/m2)			
OR	Reference	1.086	1.083
CI (Lower to Upper)	1	0.7806 to 1.5126	0.8107 to 1.4473
pvalue	-	0.022*	0.048*
SBP(140-150mmHg)			
OR	Reference	0.988	1.028
CI (Lower to Upper)	1	0.8420to 1.160	0.8802 to1.2012
pvalue	-	0.395	<0.001**
TREATMENT FORHYPERTENSION (YES)			
OR	Reference	0.996	1.00
CI (Lower to Upper)	1	0.9831 to 1.0109	0.9888to 1.0139
pvalue	-	0.6634	0.840
FASTINGBLOODSUGAR (> 126 mg/dl)			
OR	Reference	1.0034	0.994
CI (Lower to Upper)	1	0.9925 to 1.0144	0.9852 to 1.0046
pvalue	-	<0.001**	0.302

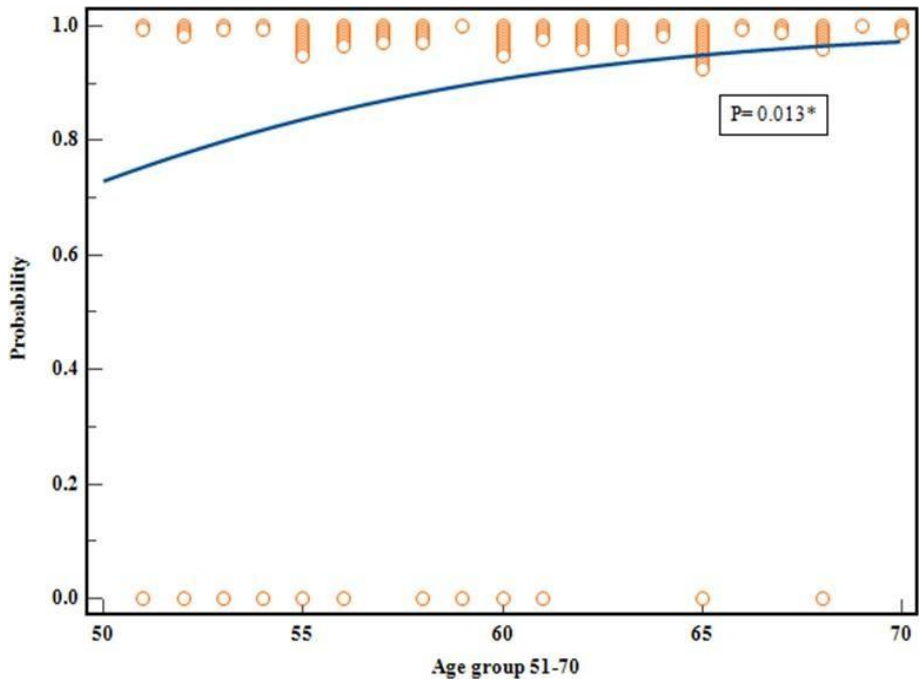


Figure 2: Regression analysis of High CVD risk in agegroupof51-70 years.

As shown in table 7 and figure 2 the oddsratio in theage group of 51-70yearswas1.13 (p=0.013) which suggests that the participants in this age group were 1.13 timesmorelikely to beunder thehigh CVDrisk category compared toother agegroups.

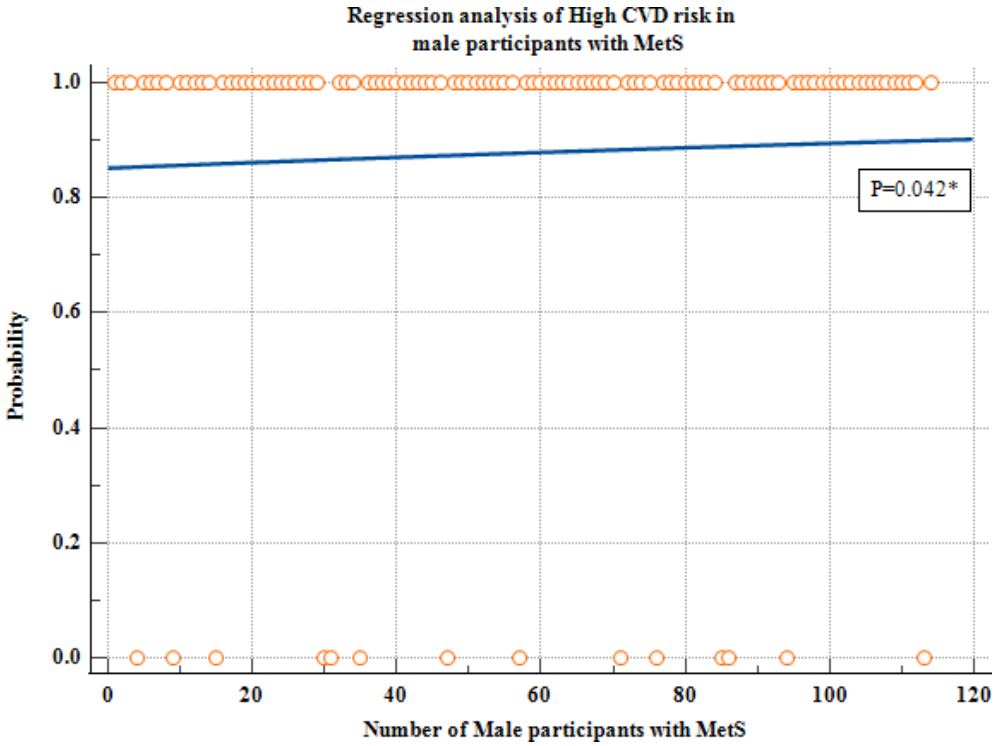


Figure 3: Regression analysis of High CVD risk in male participants with Mets.

As shown in the table 7 and figure 3, males had an odds ratio of 1.00 (p= 0.042), indicating that they were1.00 times more likely to have high CVD risk than females.

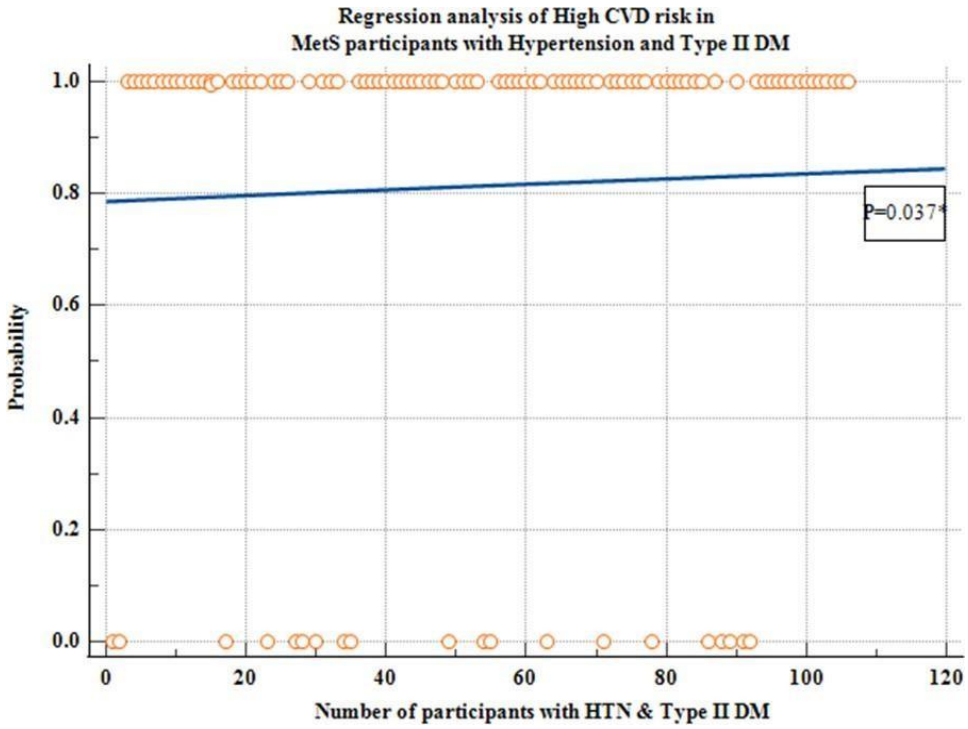


Figure 4: Regression analysis of high CVD risk in MetS participants with T2DM and HTN.

As shown in table 7 and figure 4, participantswithHTNandT2DMhadanoddsratioof 1.00 (p=0.037), indicating that they were 1.00 times more likely to have high CVDrisk.

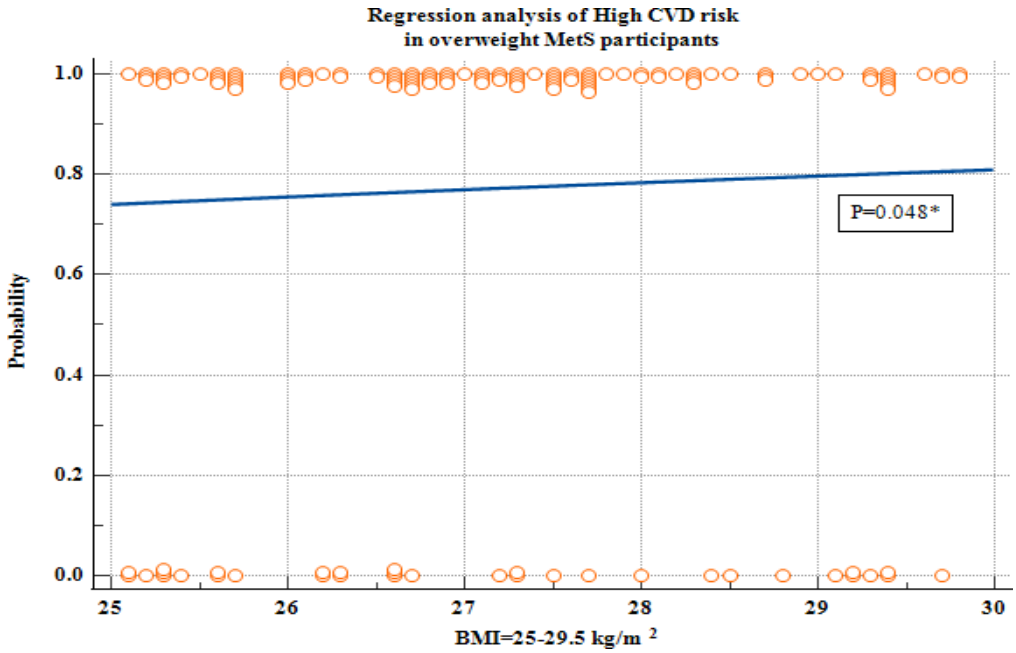


Figure 5: Regression analysisofhighCVDriskin overweightMetS participants.

As shown in table 7 and figure 5,the odds ratio in participants with a BMI of25-29.9 kg/m2 was 1.086 (p=0.022) and 1.083 (p=0.048), indicating that participantswithaBMIof25-29.9kg/m2were1.086and1.083timesmorelikelytohaveintermediateand high CVDrisk, respectively

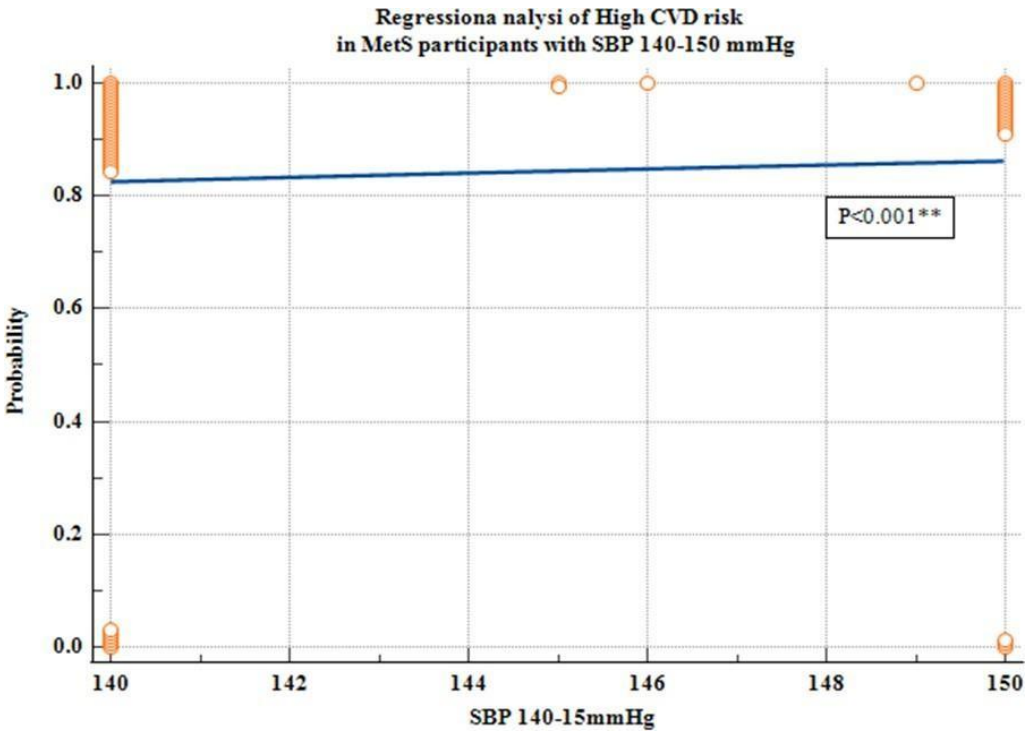


Figure 6: Regression analysis of high CVD risk in MetS participants with SBP140-150 mmHg.

As shown in table 7 and figure 6, SBP ranged between 140-150mm Hg, the odds ratio was 1.028 (p=<0.001), concluding that the participants with SBP ranged between140-150mmHg were at higher risk of CVD by 1.02 times.

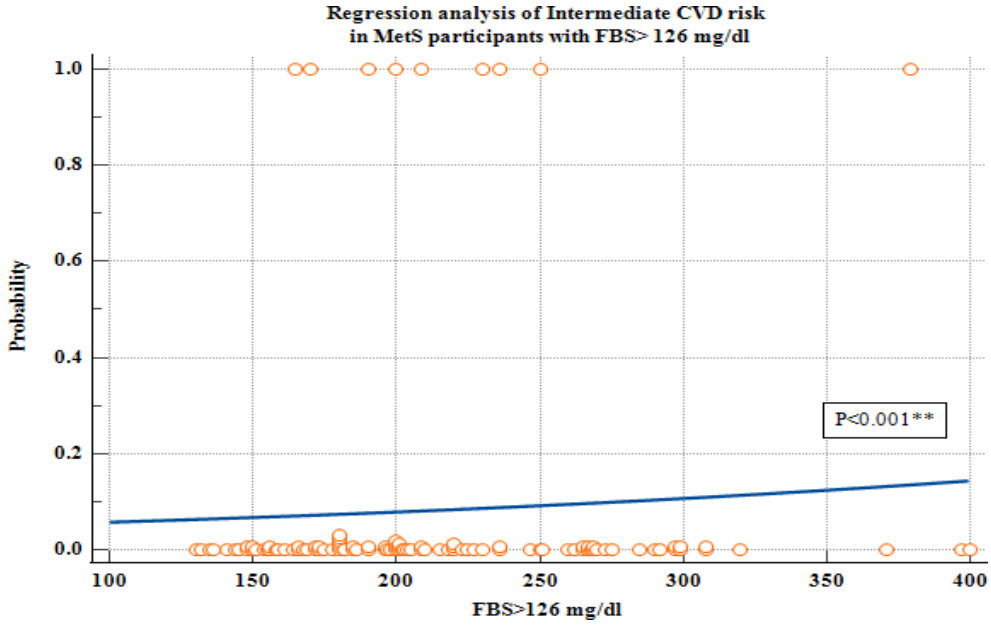


Figure 7: Regression analysis of intermediate CVD risk in Mets participants with FBS>126 mg.

As shown in table 7 and figure 7, the odds ratio for FBS levels ranged above 126mg/dl was 1.00 (p=<0.001) suggesting that the participants with FBS levels above 126mg/dlwereat intermediate risk of CVDby 1.00 time.

DISCUSSION

The present study was aimed and distinctly designed to determine prevalence of metabolic syndrome (MetS) and CVD risk and the factors associated with CVD among the Indian population. During the study period, a total of 278 patients were screened. Out of 278 patients in our study, 200 patients were screened with MetS and 78 patients without MetS. The mean age ± standard deviation of study participants in Mets and non-MetS groups were 58.83±10.76 years and 55±10.95 years respectively. This finding was similar with another study conducted by Jholamrezayousefzadehetal[14]where the mean age of the entire cohort was 44.34± 16.32 years. Among MetS participants, the majority were males (57%) compared to females (43%) and participants between the age group 51-70 years were at more risk of MetS. Our results were found to be consistent with the previously conducted study in India by Apurva Sawantetal [15] where the prevalence of metabolic syndrome was double in males as compared to females and more prevalent in 41-60years of age. In our study, prevalence of MetS was directly proportional to age, the prevalence of Mets was 71%. According to a meta-analysis report, the prevalence of MetS among adult population in India was 30% and there was as steady increase in the burden across age groups from 13% (18-29 years) to 50% (50-59years).[16]

Socio economic status has long been known to predict higher rates of many chronic diseases, but according to our results MetS was more prevalent in participants with highest level of education and participants in middle income group (p<0.0001) which was contradictory to the result of a study by Natalie D. Riediger [17] where theprevalence of MetS was higher among participants with lower level of education andlowerincome adequacy.

Among the MetS participants, medical history with HTN and T2DM and MetS was found to be significant (p <0.0001), 89 patients (44.5%) had both HTN and T2DM, 46 patients (23%) had only T2DM and 7 patients (3.5%) had HTN. In a study by Muleet al [18] stated that there is a marked tendency for hypertensive and Type II DMpatients with MetS to develop early signs of end-organ damage may account for a considerable portion of the elevated risk of cardiovascular morbidity.

Among the MetS participants 0.5%, 39.5%, 55.5%, 4.5% had sedentary, less, moderate and vigorous physical activity levels respectively (p<0.0001), which was contradictory to the result of a study by K. Hajian - Tilaki [19]et al where the prevalence rate of MetS were 49.0%, 42.5%, and 22.6% in low, moderate, and vigorous physical activity levels respectively (p=0.001). Also, among the MetS patients, the majority of participants didn't have any social history (63%), smoking (29%), alcoholic (4.5%) and both smokers and alcoholics (3.5%). There was no MetS prevalence related to smoking or alcohol consumption according to our results which was similar to the results of a study by K. Hajian-Tilaki.[19]

Comparison of anthropometric details in patients with or without MetS, the association between MetS and BMI of 25-29.9kg/m² and waist circumference of 100-120 cm in males and 90-109 cm in females (p<0.0001) were found statistically significant. This was similar to studies by Swant Aetal and Scuteri A et al [20,21] where BMI of more than 23 kg/m² is considered a prime determinant of MetS along withwaistcircumferenceof 102cm in men and 88cminwomen.

Of the 200 MetS individuals, 49.5% had SBP between 140 -150 mmHg and 58.5% had DBP between 90-99mmHg. There was significant association between MetS and systolic blood pressure of 140-150 mmHg, diastolic blood pressure of 90-99 mmHg (p < 0.001). These findings were in accordance with the previous study by Leila Jahangiry et al [22] where SBP131.78±11.03mmHg and DBP 88.33±6.45mmHg were found to be prevalent in MetS.

The participants who were under treatment for hypertension were found to have statistically significant association with MetS (p < 0.001). Out of 200 MetS patients, 67% were receiving treatment for HTN, whereas 33% were not on treatment. In a study by ButkowskiL et al [23] antihypertensive medication significantly increased the number of MetS factors. Several studies suggest that some anti hypertensive drugs, like thiazide diuretic, are linked to metabolic disturbances that lead to increased glucose in tolerance. Smoking or alcohol consumption according to our results which was similar to the results of a study by K. Hajian-Tilaki.[19]

The participants who were under treatment for hypertension were found to have statistically significant association with MetS (p < 0.001). Out of 200 MetS patients, 67% were receiving treatment for HTN, whereas 33% were not on treatment.

The fasting blood sugar levels of>125mg/dl was found to be significantly associated with MetS (p<0.001). The majority of the study participants 94.5% had FBS ranging >125 mg/dl, 1% had FBS ranging between 70-100 mg/dl and only 4.5% were having levels ranging between 101-125 mg/dl. According to a study by Leila Jahangiry et al [22] high FBS levels (>110 mg/dl) were more susceptible to higher CVD risk in patients with MetS.

10-year increased risk for CVD according to FRS risk categories were significantly associated with the number of MetS definitional components that 10-year low risk of cardio vascular disorders was predicted in 25.64% of patients with one MetS component, 20.51% in two components group and 7% in three MetS components group and the 10-year high risk of cardiovascular disorders was predicted in 6.41% of patients with one MetS component, 5.12% in two components group and 76.5% in three MetS components group. This finding was similar with another study conducted by Jholamrezayousezadeh et al. [14] A positive correlation was observed in CVD risk score and number of MetS components, that is the greater the number of MetS components the higher the risk of developing CVD.

According to FRS, 154 of the 200 MetS participants were at high risk of CVD. Prevalence of MetS components like high SBP (p=0.0051), high WC (p=0.0239) and high FBS (p=0.0398) were found statistically significant. This was similar to a study by Leila Jahangiry et al [22] where there was a significant relationship between FRS and components of MetS including high SBP, high WC and high FBS.

The prevalence of high 10-year CVD risk in males (87.71%) were more compared with those in females (61.62%) with p<0.0001. These results were in accordance with another study by Mahdeih Farhangi et al [24] where male showed the highest prevalence of CVD risk in all categories compared to females.

Prevalence of 10-year CVD risk and demographic details was obtained. High risk was more prevalent in the age group 61-70 years and low risk in the age group of 30-40years (p=0.00). According to multiple logistic regression analysis participants in

the age group 51-70 years were 1.13 times more likely to be under the high CVD risk category. Yazdanyar A et al [25] in a study discussed that age related increase in CVD risk continues into the oldest age group, with 2-3-fold increase in persons > 80 years of age compared to those age 65-69. Based on our results males having both HTN & T2DM ($p<0.0001$) was found to be significant. Similar trends were seen with demographic details and prevalence of MetS which indicates that MetS is an important predictor for cardiovascular risk. Based on results of regression analysis males were 1.00 times more likely to have high CVD risk than females. In a study by Mahdeih Farhangi et al[24] the gender specific relationship between FRS, cardio-metabolic risk factors discovered that males were more prevalent than females to develop low, intermediate and high FRS risk scores. According to a study by Regassa LD et al [26] likelihood of acquiring CVD among hypertensive patients is more than two times in T2DM patients.

Between anthropometric details and CVD risk, the participants with a BMI of 25-29. 9 kg/m² were 1.086 and 1.083 times more likely to have intermediate and high CVD risk, respectively. There was a significant association between the BMI of 25-29.9 kg/m² and 10 year-CVD risk, a similar association was found in a study by Cheongmin Sohn et al [27] 26.7±2.8kg/m² was found significant in high – risk group. It was observed that severely obese group had a 3.3-fold higher risk of CVD and 2.7-fold higher risk of all – cause mortality compared with overweight individual in a study by IyenB et al. [28]

The risk factors like SBP ($p=0.021$) and treatment for HTN ($p<0.00$) and 10- year CVD risk were also found to be highly significant with 10-year CVD risk. In a study by Takashaki et al [29] their results showed a positive correlation between age and SBP where CVD risk score increased with age and was related to MetS diagnostic factors like SBP. According to our research, those with SBP between 140 and 150 mmHghada 1.02-times increased chance of developing CVD. The risk of CVD increased steadily with higher levels of SBP and DBP of 115 and 75 mmHg, respectively. For a 20mmHg increase in SBP and 10 mmHg increase in DBP there was 2 -fold increase in CVD risk according to a study by Fush FD et al [30].

Our study involved multiple logistic regression analysis between different risk variables and 10-year CVD risk and it was found that participants with FBS levels above126mg/dl were at intermediate risk of CVD by 1.00 times. Similarly in a study by Leila Jahangiry et al [22] where there was a significant relationship between FRS risk score and components of MetS, by logistic regression analysis patients with high FBS were3-5 times more likely to develop moderate to high cardio vascular risk.

CONCLUSION

Metabolic syndrome is the key element contributing to the development of non-communicable disease. A universal deficiency of awareness, ineffectual screening programs and inadequate interest given to the associated risk factors, all together influence alarmingly high MetS rates. It is noted that the prevalence of CVD among the MetS patients is increasing on a rapid scale.

The present study focuses on evaluation on MetS using the most appropriate guideline (NCEPATP-III) and predicting the 10-year risk of CVD. The SBP, WC and FBS were the three major components of MetS considered in our study. Male participants had a higher chance of developing MetS than the female counterparts. The subjects in the age group of 51-70 years were more at risk of MetS. Participants with Middle income, who had completed Diploma/ masters, who were moderately active and with both HTN and T2DM higher probability to develop MetS. All the anthropometric parameters like BMI, WC and HC showed a positive association with Mets. The prevalence of High risk for 10-year risk of CVD in males were more compared to females. Participants with three MetS risk factors had the highest prevalence of High CVD risk than the participants with one and two risk factors. Hence, these results suggest that there is a need for more effective awareness programs about MetS and the risk of developing CVD associated with it. Therefore, promotion of free regular check-ups as well as educating and encouraging the people to adopt a healthier lifestyle will increase the awareness and there by decrease the disease burden. Recommended future studies can be done using FRS in patients who are at CVD risk and by using different diagnostic tests various types of CVDs among MetS participants can be evaluated, comparative studies can be done using different CVD risk prediction tools and analyse which tool has shown more relevant results in Indian population and the prediction of MetS can be done using NCEP ATP III criteria in both pregnant and lactating women.

COMPETING INTEREST:

The authors declare no conflict of interest

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ABBREVIATION:

NCEP ATP III: National Cholesterol Educational Programme Adult Treatment Panel III
MetS : Metabolic Syndrome
CVD : cardiovascular disease
FRS : Framingham Risk Score
NCD : Non-communicable disease
FBS : Fasting Blood Glucose
HTN : Hypertension
T2DM : Type 2 Diabetes Mellitus
WC : Waist Circumference
BP : Blood Pressure
TC : Triglyceride
AHA : American Heart Association
ACC : American College of cardiology
ASCVD : Atherosclerotic Cardiovascular Disease
COPD : Chronic Obstructive Pulmonary Disease
BMI : Body Mass Index
N : Numbers
χ^2 : Chi-square
% : Percentage
OR : Odds Ratio
CI : Cumulative Interval
Cm : Centimeters
mmHg : millimeters of mercury
kg/m^2 : kilogram-meters square

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