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Original Article

Determinants of metabolic syndrome (MetS) amongst persons living in Dibrugarh District of Assam

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ABSTRACT

Problem considered: As India is considered as the diabetic capital of world, a huge burden of undiagnosed metabolic syndrome (MetS) is a possibility. Early intervention can be planned if MetS can be detected early to avert cardiovascular morbidities.

Aims: To assess determinants of MetS amongst population living in Dibrugarh District of Assam.

Methods: Community based cross-sectional study conducted in Dibrugarh District of Assam, with multistep sampling. Study area, i.e., four rural sub-centres and two urban electoral blocks, were selected randomly. From the list of population of selected area the consenting eligible were included. Sample size was 1700 population with MetS. Socio-demographic information, World Health Organization's Steps questionnaire for behavioural risk factors along with dietary history, anthropometric assessment and laboratory investigations were conducted in three stages. Statistical analysis used: rates, ratio, proportion, univariate and multivariate analysis.

Results: MetS was 47.6% (1606 of 3372 screened) and mean age 47.1 ± 10.9 years. Univariate analysis showed educational status, occupation, family history of hypertension and diabetes, tobacco and alcohol consumption, financial stress, depression, less physical activity, more consumption of meat, fish, egg, dairy products, and high-energy food significantly associated with MetS. Multiple logistic regression analysis showed age, education, occupation, computer owner (OR: 3.69, CI: 2.10–6.47, $p = 0.000$), family history of diabetes (OR: 3.18, CI: 2.10–6.47, $p = 0.000$), stress (OR: 1.85, CI: 1.45–2.35, $p = 0.000$), consuming dairy product ≥ 3 times/week (OR: 2.57, CI: 1.68–3.94, $p = 0.000$) and nuts and oilseed < 3 times/week (OR: 2.37, CI: 1.90–2.96, $p = 0.000$) have significant association.

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Conclusions: Risk factors of cardiovascular diseases were rampant amongst persons with MetS. Screening for risk factors amongst them can give opportunity for early intervention.

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1. Introduction

Type 2 diabetes mellitus (T2DM), is a heterogeneous disease with strong genetic component, characterized by insulin resistance and impaired beta-cell function. Combination of insulin resistance and compensatory hyper-insulinemia increases risk of hypertension and dyslipidaemia characterized by high plasma triglycerides (TG) and low high-density lipoprotein cholesterol (HDL-C) concentration. These changes increase risk of cardiovascular disease (CVD). This cluster of related abnormalities was previously designated as Syndrome X.¹ The increased risk for developing CVD and diabetes associated with a cluster of metabolic abnormalities, is referred to as metabolic syndrome (MetS). MetS includes hypertension, glucose intolerance, high TG, low HDL-C and abdominal obesity.² Strong association of abdominal obesity with metabolic abnormalities has prompted the National Institute of Health (NIH) of the United States of America and the World Health Organization (WHO) to issue guidelines for use of gender-specific waist circumference (WC) cut points to identify abdominal obesity.³

MetS was diagnosed based on modified ATP III guidelines if any three of the following abnormalities were present: abdominal obesity (defined as WC ≥ 90 cm for men and ≥ 80 cm for women, according to modified Asia Pacific World Health Organization guidelines), high blood pressure (systolic blood pressure [sBP] ≥ 130 mmHg, diastolic blood pressure [dBP] ≥ 85 mmHg, or who self-reported hypertension and on anti-hypertensives), hypertriglyceridemia or low HDL cholesterol. Obesity was defined as body mass index (BMI) ≥ 25 kg/m² according to modified Asia Pacific World Health Organization guidelines.^{4,5}

MetS was associated with increased risk for T2DM and CVDs. However, different diagnostic criteria have been recommended by different expert groups. Study shows high prevalence of hypertension amongst tea garden population of Dibrugarh.⁶ Therefore, we need to study MetS among these population. Individuals with MetS are associated with approximately five and two-fold increased risk for T2DM and CVD respectively and risk factor for all-cause mortality.^{7,8} MetS has been linked with obesity and sedentary lifestyle, both are modifiable.⁹ More effort to promote a healthy lifestyle with increased physical activity (PA) and reduced obesity was needed.^{10,11} Individuals with MetS should be identified early so that their cardiovascular risk factors can be reduced.¹² Definitions of MetS are changing (ATP-III/IDF etc.) based on perceived risk factors. India, considered as diabetic capital, sharing huge burden of undiagnosed MetS is a possibility and therefore present study is planned to estimate the determinant of MetS.

2. Methods

2.1. Setting

Dibrugarh District of Assam and is at the northern-most tip of the state, situated on the banks of River Brahmaputra, spread over 3000 km², and is populated by about 1.2 million individuals (0.9 million rural, 0.3 million urban). There are 1362 villages under 231 health sub-centres. In urban areas there were 96 electoral blocks.¹³

2.2. Ethics statement

Institutional ethics committee approval from Assam Medical College and necessary permissions was obtained from Joint Director of Health Services and the Assam Branch of the Indian Tea Association. Written informed consent, sought from all eligible, and those consenting, included. If a participant could not read or write, verbal information was provided, and consent was recorded as thumb impression in presence of two impartial witnesses. Surveys were preceded by meetings with community leaders.

2.3. Subject selection

For detecting MetS, after overnight fast (10–12 h), blood samples was obtained for determination of plasma glucose, plasma HDL-C and plasma TG levels. Modified ATP III guidelines was used for identification of persons with MetS.⁴ A screening log was prepared by house to house survey and all eligible individuals were enrolled. Laboratory investigation was done for all eligible and those fulfilling criteria of MetS were included till the required sample size was achieved.

The sample size was 1546, calculated by taking prevalence of MetS as 19.9 and 95% CI and relative precision 10%. Taking 10% non-response rate and rounding up, sample size inflated to 1700.

2.4. Sampling design

Cross-sectional study with multistep sampling to include representative population. Initially, sub-centres was enlisted from which four rural and two urban electoral block were selected using computerized random numbers. From the list of eligible population of selected sub centre area the required sample of population was enrolled (1700; 1400 rural, 300 urban). Then, household survey was done to enlist all eligible consenting individual aged 20–60 years. Socio-demographic, behavioural risk factors, medical history and family history of diabetes were assessed using WHO's Steps questionnaire.

Dietary history was taken using food frequency questionnaire and 24-hour recall. Anthropometric assessment and laboratory investigations were conducted. All consenting adults of selected areas having MetS were considered eligible for inclusion. Measurement of height, weight and WC was done. Height and weight was measured to nearest 0.5 cm and 0.1 kg, respectively. BMI was calculated as weight (kg) divided by height (m) squared. WC, determined at umbilical level (cm) to nearest 0.1 cm using a measuring tape positioned at midpoint between lowest rib and iliac crest. Similarly hip circumference was taken around widest portion of buttocks as recommended by WHO STEP wise Approach to Surveillance (STEPS).

2.5. Definition of metabolic syndrome

MetS was defined by modified NCEP ATP III and IDF groups.⁴ Presence of any three of five factors is required for diagnosis of MetS: abdominal obesity, hyper-triglyceridemia (TG ≥ 1.7 mmol/L); low HDL cholesterol (HDL cholesterol ≤ 1.03 mmol/L for men and ≤ 1.29 mmol/L for women); elevated blood pressure (sBP ≥ 130 mmHg and/or dBP ≥ 85 mmHg or current use of antihypertensive drugs); impaired fasting glucose (fasting plasma glucose ≥ 5.6 mmol/L). Modified NCEP ATP III criteria suggested cut-off points of WC should be ethnic specific where individuals of Asian origin should use cut-off of 90 cm in men and 80 cm in women.

2.6. Biochemical measurements

Measurement of plasma glucose was carried out by glucose oxidase method, using a commercial enzymatic reagent (Ozone biochemical Kit). Plasma TG and cholesterol concentrations were measured by enzymatic methods (Lifescan Kit).

2.7. Qualitative study

FGD and in-depth interview (IDI) of persons having MetS was done – one FGD and 5 IDI in each study area to understand, barriers affecting care seeking behaviour and compliance of treatment and to assess quality of care for CVD.

2.8. Statistical analysis

Most variables, collected as continuous measures and standard definitions, were used for categorical classifications. Information about each risk factor, described for, entire population. Student's t-test was used for continuous variables, and chi square test for dichotomous variables. Statistical analysis was done using SPSS software.

3. Results

Enrolment was 3372 to achieve required sample size. Mean age of study participants was 47.1 ± 10.9 years. Prevalence of MetS was 47.6%, which was more common amongst men than women (53.3% vs. 51.1%). MetS was higher amongst well-educated people. Prevalence of MetS was found to be higher amongst house makers (88.3%), business persons (71.1%), and government service holder (70.3%). Those staying in their own home, have less MetS compared to those staying in rented house (76.4% vs. 44.6%). Similarly, those having their own vehicle or motor cycle are having MetS more than those not having (73.6% vs. 45.8% and 67.2% vs. 38.5% subsequently). Those owning a computer were having higher prevalence of MetS than those not having (86.1% vs. 45.4%).

Overall prevalence of hypertension was 17%. Hypertension prevalence was 62.2% amongst person having MetS. Overall prevalence of diabetes was 5.7% and amongst MetS, it was 89.1%, indicating very high prevalence of diabetes amongst those having MetS. Other cardiovascular symptoms like angina was found in 3.6% of which 52.5% were having MetS. History of myocardial infarction was found in 0.3%, of which 60% were having MetS. Similarly stroke was found in 0.5%, of which 88.9% were having MetS (Table 1).

Behavioural risk factor distribution – current tobacco user was 40.6% (774), while 47.2% (102) were former user of tobacco. Amongst studied participants having MetS, 38.1% (619) consumes alcohol. Financial stress was moderate or severe in 44.4% (748) cases, while 50.9% (413) had stress for several period or permanent stress. Episodes of depression were present in last year in 60.9% (313) cases. Majority in work place (55.4%, 382) were mainly sedentary, while 47.2% (375) walks, and 37.7% (228) does heavy PA. During leisure time also 62.1% (425) were sedentary, while only 41.3% does moderate exercise (multiple response included) (Table 2).

Univariate analysis showing religion [Hindu (OR: 2.20, CI: 1.63–2.96, $p = 0.000$), Islam (OR: 2.13, CI: 1.36–3.33, $p = 0.001$)] compared to Christian, educational status [I–VIII standard (OR: 1.55, CI: 1.29–1.87, $p = 0.000$), IX–XII standard (OR: 3.34, CI: 2.81–3.98, $p = 0.000$), college/university (OR: 3.24, CI: 2.56–4.11, $p = 0.000$)] compared to illiterate, marital status [unmarried (OR: 2.25, CI: 1.59–3.17, $p = 0.000$), married (OR: 1.06, CI: 0.88–1.28, $p = 0.500$)], occupation [farmer (OR: 4.85, CI: 3.45–6.80, $p = 0.000$), house maker (OR: 14.92, CI: 11.43–19.46, $p = 0.000$), business (OR: 2.01, CI: 1.32–3.04, $p = 0.001$), government service (OR: 4.74, CI: 3.52–6.40, $p = 0.000$), self-employed (OR: 4.59, CI: 3.52–6.40, $p = 0.000$)], motorcycle owner [OR: 3.26, CI: 2.80–3.80, $p = 0.000$], land/property owner [OR: 1.98, CI: 1.64–2.40, $p = 0.000$] were having significant association with MetS. Hindu and Islam believers were having more MetS than Christians.

Table 1 – Cardiovascular diseases amongst person having metabolic syndrome (MetS).

Cardiovascular disease	Metabolic syndrome		Total, n (%)
	No, n (%)	Yes, n (%)	
Hypertension			
Yes	217 (37.8)	357 (62.2)	574 (17.0)
No	1549 (55.4)	1248 (44.6)	2797 (83.0)
Diabetes			
Yes	21 (10.9)	172 (89.1)	193 (5.7)
No	1745 (54.9)	1433 (45.1)	3178 (94.3)
Angina			
Yes	58 (47.5)	64 (52.5)	122 (3.6)
No	1707 (52.6)	1539 (47.4)	3246 (96.4)
Myocardial infraction (MI)			
Yes	4 (40.0)	6 (60.0)	10 (0.3)
No	1762 (52.4)	1600 (47.6)	3362 (99.7)
Stroke			
Yes	2 (11.1)	16 (88.9)	18 (0.5)
No	1764 (52.6)	1590 (47.4)	3354 (99.5)
Other vascular diseases			
Yes	3 (33.3)	6 (66.7)	9 (0.3)
No	1763 (52.4)	1600 (47.6)	3363 (99.7)

Higher the education level more is the MetS occurrence. Those acquiring different assets like for example computer [OR: 7.45, CI: 4.89–11.34, $p = 0.000$] were more vulnerable to MetS, indicating higher socio-economic status having more MetS. Family history of hypertension [OR: 1.51, CI: 1.23–1.85, $p = 0.000$] and diabetes [OR: 4.12, CI: 3.23, $p = 0.000$] also show significant association with MetS (Table 3).

Tobacco consumption [former user (OR: 0.63, CI: 0.47–0.85, $p = 0.002$) and current user (OR: 0.48, CI: 0.42–0.56, $p = 0.000$)], alcohol consumption [OR: 0.49, CI: 0.43–0.57, $p = 0.000$], financial stress [OR: 0.49, CI: 0.43–0.57, $p = 0.000$], depression [OR: 1.88, CI: 1.55–2.28, $p = 0.000$] and less PA [moderate PA (OR: 1.51, CI: 1.24–1.84, $p = 0.000$), mainly sedentary (OR: 1.74, CI: 1.43–2.11, $p = 0.000$)] were significantly associated with MetS. Three

Table 2 – Behavioural risk factor distribution amongst studied population.

Behavioural profile	Metabolic syndrome		Total, n (%)
	No, n (%)	Yes, n (%)	
Tobacco user			
Formerly used	114 (52.8)	102 (47.2)	216 (6.4)
Currently user	1131 (59.4)	774 (40.6)	1905 (56.5)
Never used	521 (41.6)	730 (58.4)	1251 (37.1)
Consumed alcohol			
Yes	929 (61.9)	572 (38.1)	1501 (44.5)
No	837 (44.7)	1034 (55.3)	1871 (55.5)
Financial stress			
Little or none	831 (49.2)	858 (50.8)	1689 (50.1)
Moderate or severe	935 (55.6)	748 (44.4)	1683 (49.9)
Felt stress in last year			
Never or some periods	1367 (53.4)	1193 (46.6)	2560 (75.9)
Several periods or permanent stress	399 (49.1)	413 (50.9)	812 (24.1)
Past 12 months, was ever you felt sad, blue or depressed for 2 weeks or more in a row			
Yes	201 (39.1)	313 (60.9)	514 (15.2)
No	1565 (54.8)	1293 (45.2)	2858 (84.8)
Active at work			
Mainly sedentary	307 (44.6)	382 (55.4)	689 (20.4)
Predominately walking	420 (52.8)	375 (47.2)	795 (23.6)
Mainly walking	232 (50.9)	224 (49.1)	456 (13.5)
Heavy physical labour	376 (62.3)	228 (37.7)	604 (17.9)
Subject does not work	431 (52.1)	397 (47.9)	828 (24.6)
During leisure time			
Mainly sedentary	259 (37.9)	425 (62.1)	684 (20.3)
Mild exercise	398 (53.6)	344 (46.4)	742 (22.0)
Moderate exercise	1104 (58.7)	778 (41.3)	1882 (55.8)
Strenuous exercise	5 (7.8)	59 (92.2)	64 (1.9)

Table 3 – Univariate logistic regression analysis of socio-demographic variables with MetS.

Variable	N (%)	PR (%)	OR	95% CI	p-value
Age group					
20–29	46 (1.4)	19 (41.3)	Ref.		
30–39	893 (26.5)	353 (39.5)	0.92	0.51–1.69	0.810
40–49	1208 (35.8)	576 (47.7)	1.29	0.71–2.35	0.396
50–59	665 (19.7)	378 (56.8)	1.87	1.02–3.43	0.043
60 & above	560 (16.6)	280 (50.0)	1.42	0.77–2.61	0.259
Religion					
Christian	218 (6.5)	66 (30.3)	Ref.		
Hindu	3021 (89.6)	1476 (48.9)	2.20	1.63–2.96	0.000
Islam	133 (3.9)	64 (48.1)	2.13	1.36–3.33	0.001
Gender					
Male	1778 (52.7)	827 (46.5)	Ref.		
Female	1594 (47.3)	779 (48.9)	1.09	0.96–1.25	0.171
Education status					
None	1396 (41.4)	479 (34.3)	Ref.		
1–8 standard	678 (20.1)	304 (44.8)	1.55	1.29–1.87	0.000
9–12 standard	915 (27.1)	582 (63.6)	3.34	2.81–3.98	0.000
College/university	383 (11.4)	241 (62.9)	3.24	2.56–4.11	0.000
Marital status					
Widowed/separated	539 (16.0)	243 (45.3)	Ref.		
Unmarried	189 (5.6)	123 (65.1)	2.25	1.59–3.17	0.000
Married	2644 (78.4)	1239 (46.9)	1.06	0.88–1.28	0.500
Occupation					
Skilled labour	1152 (34.2)	388 (33.7)	Ref.		
Farmer	97 (2.9)	49 (50.5)	2.01	1.32–3.04	0.001
House maker	669 (19.8)	591 (88.3)	14.92	11.43–19.46	0.000
Business	187 (5.5)	133 (71.1)	4.85	3.45–6.80	0.000
Govt. service	249 (7.4)	176 (70.7)	4.74	3.52–6.40	0.000
Self employed	60 (1.8)	42 (70.0)	4.59	2.61–8.08	0.000
Other	958 (28.4)	227 (23.7)	0.61	0.50–0.74	0.000
Car					
No	3152 (93.5)	1444 (45.8)	Ref.		
Yes	220 (6.5)	162 (73.6)	3.30	2.42–4.49	0.000
Motorcycle					
No	2297 (68.1)	884 (38.5)	Ref.		
Yes	1075 (31.9)	722 (67.2)	3.26	2.80–3.80	0.000
Television					
No	656 (19.5)	284 (43.3)	Ref.		
Yes	2716 (80.5)	1322 (48.7)	1.24	1.04–1.47	0.013
Other land/property					
No	2847 (84.4)	1281 (45.0)	Ref.		
Yes	525 (15.6)	325 (61.9)	1.98	1.64–2.40	0.000
Computer					
No	3185 (94.5)	1445 (45.4)	Ref.		
Yes	187 (5.5)	161 (86.1)	7.45	4.89–11.34	0.000
Hypertension (family history)					
No	2941 (87.2)	1362 (46.3)	Ref.		
Yes	431 (12.8)	244 (56.6)	1.51	1.23–1.85	0.000
Diabetes (family history)					
No	2972 (88.1)	1301 (43.8)	Ref.		
Yes	400 (11.9)	305 (76.2)	4.12	3.23–5.25	0.000

times or more consumption of meat [OR: 2.72, CI: 2.01–3.67, $p = 0.000$], fish [OR: 1.31, CI: 1.13–1.52, $p = 0.000$], egg [OR: 2.55, CI: 1.90–3.42, $p = 0.000$], diary product [OR: 4.08, CI: 2.96–5.62, $p = 0.000$], high energy food [OR: 2.29, CI: 1.77–2.98, $p = 0.000$], sweets/deserts [OR: 1.75, CI: 1.39–2.19, $p = 0.000$] and less nuts and oilseed consumption [OR: 1.61, CI: 1.37–1.87, $p = 0.000$] were significantly associated with MetS (Table 4).

Multiple logistic regression analysis shows increasing age [30–39 years (OR: 12.83, CI: 5.61–29.34, $p = 0.000$), 40–49 years (OR: 18.56, CI: 8.11–42.45, $p = 0.000$), 50–59 years (OR: 26.65, CI: 11.49–61.80, $p = 0.000$), 60 years and above (OR: 37.74, CI: 15.97–89.16,

$p = 0.000$)] in comparison with 20–29 years, education status [1–8 standard (OR: 1.38, CI: 1.08–1.78), 9–12 years (OR: 2.95, CI: 2.25–3.86, $p = 0.000$), college/university (OR: 3.44, CI: 2.33–5.05, $p = 0.000$)] in comparison with illiteracy, occupation [house maker (OR: 15.24, CI: 10.73–21.65, $p = 0.000$), business (OR: 1.83, CI: 1.20–2.81, $p = 0.005$), government service (OR: 2.38, CI: 1.54–3.66, $p = 0.000$)] compared to skilled worker, computer owner (OR: 3.69, CI: 2.10–6.47, $p = 0.000$), family history of diabetes (OR: 3.18, CI: 2.10–6.47, $p = 0.000$), feeling stressed in last year (OR: 1.85, CI: 1.45–2.35, $p = 0.000$), moderate PA (OR: 1.45, CI: 1.11–1.90, $p = 0.006$) compared to heavy PA, consuming dairy

Table 4 – Univariate logistic regression analysis of behavioural risk factors with MetS.

Behavioural profile	N (%)	PR (%)	OR	95% CI	p-value
Tobacco user					
Never used	1251 (37.1)	730 (58.4)	Ref.		
Formerly used	216 (6.4)	102 (47.2)	0.63	0.47–0.85	0.002
Currently user	1905 (56.5)	774 (40.6)	0.48	0.42–0.56	0.000
Consumed alcohol					
No	1871 (55.5)	1034 (55.3)	Ref.		
Yes	1501 (44.5)	572 (38.1)	0.49	0.43–0.57	0.000
Financial stress					
Moderate or severe	1638 (49.9)	748 (44.4)	Ref.		
Little or none	1689 (50.1)	858 (50.8)	1.29	1.12–1.47	0.000
Felt stress in last year					
Never or some periods	2560 (75.9)	1193 (46.6)	Ref.		
Several periods or permanent stress	812 (24.1)	413 (50.9)	1.18	1.01–1.38	0.034
Past 12 months, was ever you felt sad, blue or depressed for 2 weeks or more in a row					
No	2858 (84.8)	1293 (45.2)	Ref.		
Yes	514 (15.2)	313 (60.9)	1.88	1.55–2.28	0.000
Active at work					
Heavy physical labour	604 (17.9)	228 (37.7)	Ref.		
Moderate work	1251 (37.1)	599 (47.9)	1.51	1.24–1.84	0.000
Subject does not work	1517 (45.0)	779 (51.4)	1.74	1.43–2.11	0.000
Meat					
<3 times/week	3159 (93.7)	1457 (46.1)	Ref.		
≥3 times/week	213 (6.3)	149 (70.0)	2.72	2.01–3.67	0.000
Fish					
<3 times/week	2305 (68.4)	1048 (45.5)	Ref.		
≥3 times/week	1067 (31.6)	558 (52.3)	1.31	1.13–1.52	0.000
Egg					
<3 times/week	3152 (93.5)	1455 (46.2)	Ref.		
≥3 times/week	220 (6.5)	151 (68.6)	2.55	1.90–3.42	0.000
Dairy products					
<3 times/week	3147 (93.3)	1432 (45.5)	Ref.		
≥3 times/week	225 (6.7)	174 (77.3)	4.08	2.96–5.62	0.000
High energy food					
<3 times/week	3097 (91.8)	1424 (46.0)	Ref.		
≥3 times/week	275 (8.2)	182 (66.2)	2.29	1.77–2.98	0.000
Desserts/sweet					
<3 times/week	3029 (89.8)	1400 (46.2)	Ref.		
≥3 times/week	343 (10.2)	206 (60.1)	1.75	1.39–2.19	0.000
Nuts/seeds					
≥3 times/week	934 (27.7)	366 (39.2)	Ref.		
<3 times/week	2438 (72.3)	1240 (50.9)	1.61	1.37–1.87	0.000

product ≥3 times/week (OR: 2.57, CI: 1.68–3.94, $p = 0.000$) and nuts and oilseed <3 times/week (OR: 2.37, CI: 1.90–2.96, $p = 0.000$) significantly associated with MetS (Table 5).

3.1. Results of qualitative study

Six FGD including 52 individuals having MetS and 27 in-depth interviews were conducted during the study. The results are as follows.

Health care seeking behaviour of persons with MetS: Majority sought health care if they feel any problems (84.8%), while few (15.2%) do not avail timely consultation for any health problem. Fact that ailment reaches its most severe form owe to several factors, encompassing both individual and societal parameters. Following points encompass some of the issues: people have tendency to ignore one's symptoms and pass it as common illness. Prevalence of other forms of treatment (homoeopathic, Ayurvedic, local/herbal medicines, yoga, witch doctors), little faith in prevalent form of

treatment, monetary issues, misinformation about ailments/treatments (medicines will not cure it and only suppress it, there might be severe side effects to medicine, medicines might damage vital organs like kidneys), prior bad experience etc. Many feels that medicine for hypertension should not be taken daily as it may further lower BP, or they may become dependent to it. “Anti-hypertensive should be taken only when BP goes up” was common believe in community (Fig. 1).

Health care preference: Most (78.8%) preferred allopathic medicine. While Ayurvedic treatment was sought by 14.7%, 6.5% sought homoeopathic treatment.

Reasons for seeking healthcare: Majority (75.7%) sought healthcare for early recovery, while 17.6% sought to keep track of health care and 6.7% seek as family members force to seek.

Reasons for not seeking health care: Majority (71.8%) did not seek health care thinking it as minor illness. While 12.7% could not seek health care due to distance to health facility, 9.2% think the consultation is too expensive, 3.6% think that

Table 5 – Multivariate logistic regression analysis with adjusted odds ratio and 95% CI.

Variable	N (%)	PR (%)	AOR	95% CI	p-value
Age group					
20–29	46 (1.4)	19 (41.3)	Ref.		
30–39	893 (26.5)	353 (39.5)	12.83	5.61–29.34	0.000
40–49	1208 (35.8)	576 (47.7)	18.56	8.11–42.45	0.000
50–59	665 (19.7)	378 (56.8)	26.65	11.49–61.80	0.000
60 & above	560 (16.6)	280 (50.0)	37.74	15.97–89.16	0.000
Religion					
Christian	218 (6.5)	66 (30.3)	Ref.		
Hindu	3021 (89.6)	1476 (48.9)	1.10	0.77–1.56	0.595
Islam	133 (3.9)	64 (48.1)	0.92	0.51–1.65	0.787
Education status					
None	1396 (41.4)	479 (34.3)	Ref.		
1–8 standard	678 (20.1)	304 (44.8)	1.38	1.08–1.78	0.010
9–12 standard	915 (27.1)	582 (63.6)	2.95	2.25–3.86	0.000
College/university	383 (11.4)	241 (62.9)	3.44	2.33–5.05	0.000
Occupation					
Skilled labour	1152 (34.2)	388 (33.7)	Ref.		
Farmer	97 (2.9)	49 (50.5)	1.31	0.79–2.16	0.283
House maker	669 (19.8)	591 (88.3)	15.24	10.73–21.65	0.000
Business	187 (5.5)	133 (71.1)	1.83	1.20–2.81	0.005
Govt. service	249 (7.4)	176 (70.7)	2.38	1.54–3.66	0.000
Self employed	60 (1.8)	42 (70.0)	1.53	0.76–3.09	0.231
Other	958 (28.4)	227 (23.7)	0.38	0.29–0.50	0.000
Car					
No	3152 (93.5)	1444 (45.8)	Ref.		
Yes	220 (6.5)	162 (73.6)	1.11	0.72–1.70	0.631
Motorcycle					
No	2297 (68.1)	884 (38.5)	Ref.		
Yes	1075 (31.9)	722 (67.2)	1.24	0.97–1.59	0.074
Television					
No	656 (19.5)	284 (43.3)	Ref.		
Yes	2716 (80.5)	1322 (48.7)	1.10	0.86–1.41	0.418
Other land/property					
No	2847 (84.4)	1281 (45.0)	Ref.		
Yes	525 (15.6)	325 (61.9)	0.94	0.72–1.23	0.687
Computer					
No	3185 (94.5)	1445 (45.4)	Ref.		
Yes	187 (5.5)	161 (86.1)	3.69	2.10–6.47	0.000
Hypertension (family history)					
No	2941 (87.2)	1362 (46.3)	Ref.		
Yes	431 (12.8)	244 (56.6)	1.20	0.89–1.60	0.216
Diabetes (family history)					
No	2972 (88.1)	1301 (43.8)	Ref.		
Yes	400 (11.9)	305 (76.2)	3.18	2.23–4.54	0.000
Tobacco user					
Never used	1251 (37.1)	730 (58.4)	Ref.		
Formerly used	216 (6.4)	102 (47.2)	0.85	0.57–1.27	0.447
Currently user	1905 (56.5)	774 (40.6)	1.04	0.82–1.33	0.699
Consumed alcohol					
No	1871 (55.5)	1034 (55.3)	Ref.		
Yes	1501 (44.5)	572 (38.1)	0.93	0.74–1.15	0.515
Financial stress					
Moderate or severe	1638 (49.9)	748 (44.4)	Ref.		
Little or none	1689 (50.1)	858 (50.8)	1.18	0.94–1.47	0.145
Felt stress in last year					
Never or some periods	2560 (75.9)	1193 (46.6)	Ref.		
Several periods or permanent stress	812 (24.1)	413 (50.9)	1.85	1.45–2.35	0.000
Past 12 months, was ever you felt sad, blue or depressed for 2 weeks or more in a row					
No	2858 (84.8)	1293 (45.2)	Ref.		
Yes	514 (15.2)	313 (60.9)	1.12	0.85–1.48	0.403
Active at work					
Heavy physical labour	604 (17.9)	228 (37.7)	Ref.		
Moderate work	1251 (37.1)	599 (47.9)	1.45	1.11–1.90	0.006
Subject does not work	1517 (45.0)	779 (51.4)	0.87	0.64–1.19	0.416

Table 5 (Continued)

Variable	N (%)	PR (%)	AOR	95% CI	p-value
Meat					
<3 times/week	3159 (93.7)	1457 (46.1)	Ref.		
≥3 times/week	213 (6.3)	149 (70.0)	1.50	0.98–2.29	0.062
Fish					
<3 times/week	2305 (68.4)	1048 (45.5)	Ref.		
≥3 times/week	1067 (31.6)	558 (52.3)	0.90	0.74–1.10	0.322
Egg					
<3 times/week	3152 (93.5)	1455 (46.2)	Ref.		
≥3 times/week	220 (6.5)	151 (68.6)	1.49	1.00–2.23	0.047
Dairy products					
<3 times/week	3147 (93.3)	1432 (45.5)	Ref.		
≥3 times/week	225 (6.7)	174 (77.3)	2.57	1.68–3.94	0.000
High energy food					
<3 times/week	3097 (91.8)	1424 (46.0)	Ref.		
≥3 times/week	275 (8.2)	182 (66.2)	1.19	0.84–1.69	0.307
Desserts/sweet					
<3 times/week	3029 (89.8)	1400 (46.2)	Ref.		
≥3 times/week	343 (10.2)	206 (60.1)	1.15	0.84–1.58	0.363
Nuts/seeds					
≥3 times/week	934 (27.7)	366 (39.2)	Ref.		
<3 times/week	2438 (72.3)	1240 (50.9)	2.37	1.90–2.96	0.000

doctor is not competent to tackle, 2.7% told that family members did not allow to have a health check-up.

Place for seeking treatment: Government healthcare was preferred by 61.6%, whereas 32.7% prefer private clinic, 1.5% preferred private medical store/over the counter medicine and 4.2% preferred traditional system of medicine.

Reason for choosing particular place for treatment: Was proximity by 54.8%, while 23.4% choose due to affordability and 21.8% choose as treatment was better.

Knowledge about previous diabetic status: Amongst diabetics 86.1% know about their status while 13.9% do not know about previous status.

Fig. 1 – Schematic diagram showing the barrier affecting compliance of treatment.

Time of detection of diabetes: Amongst known diabetics 51.6% detected as diabetic since 5 or more years while 32.3% detected within last 1–5 years and 16.1% detected as diabetic within last 1 year.

Treatment history: Among those having indication for use of statin was not utilized as treatment in 99.5%, only 0.5% people use various statins as treatment. Among people who utilize statins, Atorvastatin (96.5%) is mostly used followed by Rosuvastatin (3.5%). Commonest dosage was 5 mg/daily. Diuretic treatment was non-prevalent and so were other forms of treatment viz. ARB, ACE and antiplatelet. Insulin treatment was also non-prevalent. Beta-blocker treatment was complied by 6.2% and Ca channel blocker treatment in 9.2%. Oral hypo-glycemics was utilized by 84.1% making it the most prevalent form of treatment. Amongst diabetics 36.1% were not taking any medicine. Blood testing was done by 69.4% to know their diabetic status while 30.3% do not do blood testing regularly. Blood test was done in a monthly interval by 28%, quarterly interval in 12%, half yearly in 8%, annually in 8%, more frequently in 16% and never in 28% amongst diabetics.

4. Discussion

MetS was common in 47.6%, more common amongst men than women and was higher in well educated people and those hailing from higher economic status. Gender difference in access to medical care co-exist both in India and other developing countries.¹⁴ Hypertension was found in 62.2% cases of MetS whereas diabetes was present in 89.1% with MetS. Family history of hypertension and diabetes show significant association with MetS. Tobacco consumption, alcohol consumption, financial stress, depression and less PA were significantly associated with MetS. Three times or more consumption of meat, fish, egg, dairy product, high-energy food, sweets/desserts and nuts and oilseed consumption were significantly associated with MetS.

Globally tobacco was the leading cause of morbidity and mortality, responsible for 18% deaths in high-income countries, 11% in middle-income countries, and 4% in low-income countries.¹⁵ However, with smoking prevalence falling in high-income countries but still increasing in many middle and low income countries, the global burden from tobacco will shift increasingly from higher to lower income countries.

Multiple logistic regression analysis shows increasing age, education status, occupation, computer owner, persons with family history of diabetes, persons feeling stressed in last year, moderate PA, those consuming dairy product ≥ 3 times/week and nuts and oilseed consumption of < 3 times/week significantly associated with MetS. Several epidemiological studies demonstrated hypertension as independent risk factor for development of T2DM. Furthermore hypertension and diabetes often co-exists in same individual.^{16,17}

The relationship between hypertension and T2DM is complex. Hypertension may exert impact upon the onset of T2DM through increasing vasoconstriction and vascular rarefaction, reducing skeletal muscle insulin sensitivity and detecting post receptor insulin signalling.¹⁸ A positive

feedback link between hypertension and diabetes can facilitate onset of T2DM and worsen manifestation of each other.¹⁹ Hypertension and T2DM share many contributing behavioural and biological risk factors such as lack of PA, too much sedentary time and high dense energy food intake.

Qualitative study revealed most study participants (78.8%) preferred allopathic medicine whereas Ayurvedic treatment was sought by 14.7% and 6.5% sought homoeopathic treatment. Distance to health care facility, expensive services, incompetent health care provider, lack of awareness, less priority given by family member were common reason for non-compliance, while government health care facility was the preferred place for seeking care amongst those compliant, although a sizable proportion who can afford prefers doing to private practitioner.^{20,21}

Factor influencing place of treatment was distance or accessibility, affordability and quality of care. Regular blood testing was not done by 30.3%. Oral hypo-glycemics is the most prevalent form of treatment amongst diabetic subjects with MetS, while use of statin is very poor. The risk of CVD is significantly higher in patients with T2DM (with or without hypertension) and hypertensive controls compared to healthy controls.²²

Our study revealed physical inactivity as one risk factor of MetS. Recent reports have equated impact of PA to smoking with respect to worldwide burden of non-communicable diseases (NCDs).²³ Physical activity is a challenging variable to measure due to inherent complexity and diversity of human behaviour. Clinical trials showing intervening with lifestyle modification or medications for individuals at high risk for hypertension may delay onset of hypertension.²⁴

Indian Government launched National Program for Prevention & Control of Cancer, Diabetes, Cardiovascular Diseases and Stroke (NPCDCS) to address high prevalence of NCDs.²⁵ Risk factor control requires multidisciplinary approach, which includes approaching social determinants of health, health-care financing, improving medical education and health system strengthening.²⁶

There is a need to do facility assessment to know the facility gap in provision for CVD care and to improve the quality of care and utilization of services. Provision of outreach services at regular interval can also be planned to address distance issue. Our assessment of depression and anxiety symptoms was based on self-report of symptoms using validated questionnaire and not on the Diagnosis and Statistical Manual (DSM) criteria based on clinical diagnosis interview. Second limitation may be recall bias expected in dietary assessment.

5. Conclusion

There is greater prevalence of MetS along with hypertension and diabetes. Behavioural risk factors such as tobacco use, low fruits and vegetables intake and high visible fat intake are higher. Right approach towards curbing the emergence of hypertension and diabetes amongst person with MetS may be to keep them under surveillance with application of all levels of prevention as and when needed.

Conflicts of interest

The authors have none to declare.

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