

DIETARY RISK FACTORS OF METABOLIC SYNDROME IN DIBRUGARH DISTRICT OF ASSAM

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ABSTRACT**BACKGROUND**

As India is considered as the diabetic capital of the world, a huge burden of undiagnosed Metabolic Syndrome (MetS) is a possibility. Early intervention can be planned if MetS can be detected early along with risk factor assessment to avert cardiovascular morbidities.

The aim of this study was to assess the dietary risk factor of metabolic syndrome.

MATERIALS AND METHODS

Community based cross-sectional study was 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 Organisation's STEPS questionnaire for behavioural risk factors along with dietary history, anthropometric assessment and laboratory investigations were conducted in three stages. Food frequency questionnaire was used for dietary assessment. Statistical analysis was done using rates, ratio, proportion, univariate and multivariate analysis.

RESULTS

MetS was 47.6% (1606 of 3372 screened). Mean age of study population was 47.1 ± 10.9 years. Behavioural risk factors like tobacco, alcohol consumption was high and significantly associated with metabolic syndrome (p= 0.000). Similarly financial stress, feeling stressed in last one year (p=0.034), lower physical activity level were also significantly associated with metS (p=0.000). Consumption of meat (p=0.000), egg (p=0.000), fast food (p=0.000), pickled vegetable (p=0.000) and sweet snacks (p=0.000) was found significantly higher amongst those with metabolic syndrome. Significant association was also seen with number of meals served per day and metS (p=0.000).

CONCLUSION

Dietary risk factors of cardiovascular diseases were rampant amongst persons with MetS. Dietary risk factor survey and counselling on healthy diet can be implemented in these population to give opportunity for early intervention.

KEYWORDS

Metabolic Syndrome (MetS), Dietary Risk Factor, Food Frequency Questionnaire (FFQ), Cardiovascular Disease (CVD), Assam.

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BACKGROUND

Atherosclerotic Cardiovascular Disease (CVD) is the leading cause of death and a major contributor to disability globally. The same group of diseases also resulted in the maximum number of years of life lost 1 (YLL) to premature mortality in 2010.¹ Globally, deaths from non-communicable diseases are expected to climb to 49.7 million in 2020, an increase of 77% in absolute numbers and increase in their share of the total from 55% in 1990 to 73% in 2020.² Risk factors like high BP, obesity, smoking, alcohol consumption, low

physical activity, etc. contributing to the development of non-communicable diseases were more prevalent in the developed countries.² However, the "World Health Report 2002: reducing risks, promoting healthy life," indicates a rise in their prevalence even in the developing countries. A disturbing increase in the prevalence of overweight among children has taken place over the past twenty years in developing countries as diverse as India, Mexico, Nigeria and Tunisia.³ Non-communicable diseases like Obesity, Diabetes mellitus, Hypertension, Coronary artery disease and Stroke in adults have been related to the prevalence of risk factors in childhood.⁴ 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.⁵ Strong association of abdominal obesity with metabolic abnormalities has prompted the National Institute of Health (NIH) of the United States of America and

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the World Health Organisation (WHO) to issue guidelines for use of gender-specific, Waist Circumference (WC) cut points to identify abdominal obesity.⁶ MetS was diagnosed based on modified ATP III guidelines if any three of the following abnormalities were present: abdominal obesity (defined as WC \geq 90 cm for men and \geq 80 cm for women according to modified Asia Pacific World Health Organisation guidelines), high blood pressure (systolic blood pressure (sBP) \geq 130 mmHg, diastolic blood pressure (dBP) \geq 85 mmHg or who self-reported hypertension and on anti-hypertensives), hypertriglyceridaemia or low HDL cholesterol. Obesity was defined as Body Mass Index (BMI) \geq 25 kg/m² according to modified Asia Pacific World Health Organisation guidelines.^{6,7} Previous study done in similar population to assess behavioural risk factors with hypertension and prehypertension showed significant association of behavioural risk factors like stress, high energy food, tobacco use, alcohol, overweight/obesity and diabetes with prehypertension, physical inactivity, high energy food, tobacco use, alcohol, extra salt and diabetes with hypertension.⁸ Hence, there is a definite need to monitor the prevalence of metabolic syndrome and its association with dietary risk factors in this population.

MATERIALS AND METHODS

Dibrugarh District of Assam 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.⁹

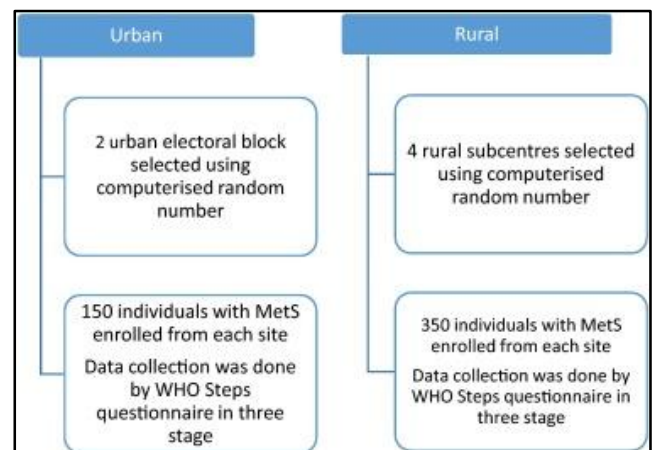
Institutional Ethics Committee approval from Assam Medical College and necessary permissions were obtained from Joint Director of Health Services and the Assam Branch of the Indian Tea Association. Written informed consent, sought from all eligible and those consenting included. If a participant could 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.

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.

Cross-sectional study with multistep sampling was undertaken in the district including a representative population. Initially, sub-centres were enlisted from which four rural and two urban electoral block were selected using computerised 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 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 stepwise approach to surveillance (STEPS).



MetS was defined by modified NCEP ATP III and IDF groups. Presence of any three of five factors is required for diagnosis of MetS: abdominal obesity, hypertriglyceridaemia (TG \geq 1.7 mmol/L); low HDL cholesterol (HDL cholesterol \leq 1.03 mmol/L for men and \leq 1.29 mmol/L for women); elevated blood pressure (sBP \geq 130 mmHg and/or dBP \geq 85 mmHg or current use of antihypertensive drugs); impaired fasting glucose (fasting plasma glucose \geq 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. 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).

Dietary risk factors were assessed by food frequency questionnaire. Most variables, collected as continuous measures and standard definitions were used for categorical classifications. Information about each risk factor was described for the entire population. Student's t-test was used for continuous variables, and chi-square test for dichotomous variables. Univariate and multivariate analysis was done for dietary risk factors. Statistical analysis was done using SPSS software.

RESULTS

A total of 3372 individuals were screened in the community by house to house survey, of which 1606 were found to be having metabolic syndrome. Therefore, the prevalence of metabolic syndrome was 47.6% (1606 out of 3372). The average age of study population was 47 years (47.1 + 10.9 years), which ranges from 20 - 95 years (Figure 1).

Significant difference was observed between age (p=0.000), religion (p=0.000), educational status (p=0.000), marital status (p=0.000) and occupation (p=0.000), while gender was not a significant determinant of metabolic syndrome (p=0.178) (Table 1).

Prevalence of behavioural risk factors was high amongst the studied population. Tobacco consumption (any form) was 64.9% (56.5% current user, while 6.4% former user). Metabolic syndrome was significantly associated with tobacco use (p=0.000). Alcohol consumption was prevalent amongst 44.5% (1501) population, which is also significantly associated with metabolic syndrome (p=0.000). Similarly, financial stress of moderate-to-severe level amongst 49.9% (1638) population was significantly associated with metabolic syndrome (p=0.000). When asked about feeling of stress in last one year 24.1% (812) informed about having several episodes or permanent episodes, which is also significantly high amongst those having metabolic syndrome (p=0.034). Only 17.9% (604) do heavy physical work, while 37.1% (1251) do moderate work and 45% (1517) subjects were mainly sedentary at workplace. There is significantly lower physical activity level of persons with metabolic syndrome (p=0.000). During leisure time 20.3% (684) were mainly sedentary, while 22% (742) do mild exercise and only 1.9% (64) do strenuous exercise with a significant higher rates amongst those having metabolic syndrome (p=0.000) (Table 2).

Dietary risk factors for cardiovascular disease were more common amongst those with metabolic syndrome. Food frequency questionnaire was used for dietary assessment. Most of the population consume meat once weekly (64.1%, 2163) and the frequency of consumption was significantly more amongst those having metabolic syndrome (p=0.000). Similarly most of the people consume fish on a weekly basis (84.8%, 2859); not significantly different amongst those with or without metabolic syndrome (p=0.149). Consumption of egg less than once in a month or never was found in 38.1% (1284) and weekly in 64.1% (2163) population, which is again significantly higher amongst those having metabolic syndrome (p=0.000). Consumption of milk and other dairy product was very rare, as majority 65.1% (2194) consumed less than once per month, but significantly higher amongst persons with metabolic syndrome (p=0.000). Overall fast food consumption was also less amongst the population as majority 69.4% (2341) consumed less than once in a month, but consumption was

significantly higher amongst those with metabolic syndrome (p=0.000). Similarly consumption of different types of sauce though rare (78.1% consume less than once in a month), but significantly high amongst those having metabolic syndrome (p=0.000). Consumption of pickled vegetables was also significantly higher (p=0.000) amongst those with metabolic syndrome. Consumption of sweet snacks was less than once per month or never in 44% (1483), while 36.2% (1222) consumed it weekly, while 37% persons with metabolic syndrome consumed it daily. Statistically significant difference was observed in this category of food item intake also (p=0.000). Only 20.6% population consumes nuts daily, while it was found significantly higher amongst those with metabolic syndrome (p=0.000).

Number of meals consumed was four times or more in 19.8% (666), while majority 60.9% (2054) consumed 3 times and 19.3% (652) consumed meal twice a day. Amongst more than four times consumer of meal 57.5% were having metabolic syndrome. There was significant association of number of meals served per day with metabolic syndrome (p=0.000). Vegetable consumption was high in frequency amongst the overall population, as majority (78.9%, 2660) consumed vegetables daily. Though daily consumption of vegetables was less amongst those with metabolic syndrome, but overall there is higher intake of cooked vegetable amongst those with metS (p=0.000) (Table 3).

Univariate and multivariate analysis of dietary risk factors of metabolic syndrome Odds ratio was significantly high for daily consumption of egg (OR 10.58 (3.681 - 30.429) p=0.000, AOR 4.43 (1.463 - 13.460) p=0.008), dairy product (OR 6.64 (4.360 - 10.125) p=0.000; AOR 3.81 (2.326 - 6.255) p=0.000), fast food (OR 4.48 (2.143 - 9.398), p=0.000; AOR 4.82 (1.891 - 12.334), p=0.001), pickled vegetables (OR 2.24 (1.389 - 3.639), p=0.001, AOR 1.54 (0.889 - 2.674), p=0.124), Sweet snacks (OR 2.80 (1.609 - 4.872) p=0.000, AOR 1.56 (0.804 - 3.036), p=0.188), nuts and oilseeds vegetables (OR 0.58 (0.480 - 0.701), p=0.000, AOR 0.54 (0.755 - 1.291), p=0.000) (Table 4).

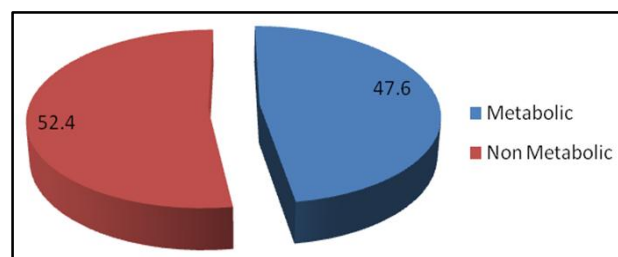


Figure 1. Prevalence of Metabolic Syndrome amongst Studied Population

Variable	Total n (%)	Metabolic Syndrome		Chi-square	P-value
		No, n (%)	Yes, n (%)		
Age Group	20 - 29	46 (1.4)	27 (58.7)	48.115	0.000
	30 - 39	893 (26.5)	540 (60.5)		
	40 - 49	1208 (35.8)	632 (52.3)		
	50 - 59	665 (19.7)	287 (43.2)		

	60 and above	560 (16.6)	280 (50.0)	280 (50.0)		
Religion	Christian	218 (6.5)	152 (69.7)	66 (30.3)	28.162	0.000
	Hindu	3021(89.6)	1545 (51.1)	1476 (48.9)		
	Islam	133 (3.9)	69 (51.9)	64 (48.1)		
Gender	Male	1778 (52.7)	951 (53.5)	827 (46.5)	1.873	0.178
	Female	1594 (47.3)	815 (51.1)	779 (48.9)		
Education status	None	1396 (41.4)	917 (65.7)	479 (34.3)	230.930	0.000
	1-8 standard	678 (20.1)	374 (55.2)	304 (44.8)		
	9 -12 standard	915 (27.1)	333 (36.4)	582 (63.6)		
	College/University	383 (11.4)	142 (37.1)	241 (62.9)		
Marital Status	Unmarried	189 (5.6)	66 (34.9)	123 (65.1)	24.902	0.000
	Married	2644 (78.4)	1405 (53.1)	1239 (46.9)		
	widowed	539 (16.0)	295 (54.7)	244 (45.3)		
Occupation	Farmer	97 (2.9)	48 (49.5)	49 (50.5)	864.154	0.000
	Skilled labour	260 (7.7)	161 (61.9)	99 (38.1)		
	General Labour	892 (26.5)	603 (67.6)	289 (32.4)		
	Housewife	669 (19.8)	78 (11.7)	591 (88.3)		
	Business	187 (5.5)	54 (28.9)	133 (71.1)		
	Govt. Service	239 (7.1)	71 (19.7)	168 (70.3)		
	Professional	10 (0.3)	2 (20.0)	8 (80.0)		
	Self-Employed	60 (1.8)	18 (30.0)	42 (70.0)		
Other	958 (28.4)	731 (76.3)	227 (23.7)			

Table 1. Socio-Demographic Determinant of Metabolic Syndrome

Behavioural Profile		Total n (%)	Metabolic Syndrome		Chi-square	P-value
			No, n (%)	Yes, n (%)		
Tobacco user	Formerly used	216 (6.4)	114 (52.8)	102 (47.2)	95.108	0.000
	Currently user	1905 (56.5)	1131 (59.4)	774 (40.6)		
	Never used	1251 (37.1)	521 (41.6)	730 (58.4)		
Consumed alcohol	Yes	1501 (44.5)	929 (61.9)	572 (38.1)	98.281	0.000
	No	1871 (55.5)	837 (44.7)	1034 (55.3)		
Financial stress	Little or none	1689 (50.1)	831 (49.2)	858 (50.8)	13.648	0.000
	Moderate or severe	1638 (49.9)	935 (55.6)	748 (44.4)		
Felt stress in last year	Never or some periods	2560 (75.9)	1367 (53.4)	1193 (46.6)	4.486	0.034
	Several periods or permanent stress	812 (24.1)	399 (49.1)	413 (50.9)		
Active at work	Heavy physical labour	604 (17.9)	376 (62.3)	228 (37.7)	32.099	0.000
	Moderate work	1251 (37.1)	652 (52.1)	599 (47.9)		
	Subject does not work	1517 (45.0)	738 (48.6)	779 (51.4)		
During leisure time	Mainly sedentary	684 (20.3)	259 (37.9)	425 (62.1)	138.970	0.000
	Mild exercise	742 (22.0)	398 (53.6)	344 (46.4)		
	Moderate exercise	1882 (55.8)	1104 (58.7)	778 (41.3)		
	Strenuous exercise	64 (1.9)	5 (7.8)	59 (92.2)		

Table 2. Prevalence of Behavioural Risk Factors amongst Studied Population and Difference in Proportion amongst those with Metabolic Syndrome in Comparison with those without Metabolic Syndrome

Diet Profile		Total n (%)	Metabolic Syndrome		Chi-square	P-value
			No, n (%)	Yes, n (%)		
Meat	< per month - never	189 (5.6)	93 (49.2)	96 (50.8)	58.293	0.000
	Monthly	986 (29.2)	614 (62.3)	372 (37.7)		
	Weekly	2163 (64.1)	1048 (48.5)	1115 (51.5)		
	Daily	34 (1.0)	11 (32.4)	23 (67.6)		
Fish	< per month - never	111 (3.3)	54 (48.6)	57 (51.4)	5.328	0.149
	Monthly	265 (7.9)	148 (55.8)	117 (44.2)		
	Weekly	2859 (84.8)	1503 (52.6)	1356 (47.4)		
	Daily	137 (4.1)	61 (44.5)	76 (55.5)		

Egg	< per month - never	1284 (38.1)	784 (61.1)	500 (38.9)	82.919	0.000
	Monthly	864 (25.6)	437 (50.6)	427 (49.4)		
	Weekly	1193 (35.4)	541 (45.3)	652 (54.7)		
	Daily	31 (0.9)	4 (12.9)	27 (87.1)		
Dairy Products	< per month - never	2194 (65.1)	1244 (56.7)	950 (43.3)	144.201	0.000
	Monthly	454 (13.5)	173 (38.1)	281 (61.9)		
	Weekly	560 (16.6)	322 (57.5)	238 (42.5)		
	Daily	164 (4.9)	27 (16.5)	137 (83.5)		
Fast Food	< per month - never	2341 (69.4)	1271 (54.3)	1070 (45.7)	91.853	0.000
	Monthly	362 (10.7)	116 (32.0)	246 (68.0)		
	Weekly	626 (18.6)	256 (40.9)	370 (59.1)		
	Daily	43 (1.3)	9 (20.9)	34 (79.1)		
Fish/Soya Sauce	< per month - never	2634 (78.1)	1400 (53.2)	1234 (46.8)	115.59	0.000
	Monthly	241 (7.1)	52 (21.6)	189 (78.4)		
	Weekly	474 (14.1)	300 (63.3)	174 (36.7)		
	Daily	23 (0.7)	14 (60.9)	9 (39.1)		
Pickled vegetables	< per month - never	2012 (59.7)	1134 (56.4)	878 (43.6)	46.796	0.000
	Monthly	383 (11.4)	152 (39.7)	231 (60.3)		
	Weekly	903 (26.8)	453 (50.2)	450 (49.8)		
	Daily	74 (2.2)	27 (36.5)	47 (63.5)		
Sweet Snacks	< per month - never	1483 (44.0)	893 (60.2)	590 (39.8)	68.563	0.000
	Monthly	610 (18.1)	278 (45.6)	332 (54.4)		
	Weekly	1222 (36.2)	575 (47.1)	647 (52.9)		
	Daily	57 (1.7)	20 (35.1)	37 (64.9)		
Desserts/Sweet	< per month - never	719 (21.3)	398 (55.4)	321 (44.6)	37.890	0.000
	Monthly	645 (19.1)	375 (58.1)	270 (41.9)		
	Weekly	621 (18.4)	261 (42.0)	360 (58.0)		
	Daily	1387 (41.1)	732 (52.8)	655 (47.2)		
Nuts/Seeds	< per month - never	1524 (45.2)	844 (55.4)	680 (44.6)	166.391	0.000
	Monthly	515 (15.3)	177 (34.4)	338 (65.6)		
	Weekly	639 (19.0)	272 (42.6)	367 (57.4)		
	Daily	694 (20.6)	473 (68.2)	221 (31.8)		
Number of Meals served per day	2 times	652 (19.3)	349 (53.5)	303 (46.5)	33.039	0.000
	3 times	2054 (60.9)	1134 (55.2)	920 (44.8)		
	4 times and more	666 (19.8)	283 (42.5)	383 (57.5)		
Vegetables Cooked	< per month - never	82 (2.4)	11 (13.4)	71 (86.6)	59.502	0.000
	Monthly	37 (1.1)	11 (29.7)	26 (70.3)		
	Weekly	593 (17.6)	318 (53.6)	275 (46.4)		
	Daily	2660 (78.9)	1426 (53.6)	1234 (46.4)		

Table 3. Dietary Risk Factor Distribution amongst Studied Population and Difference in Prevalence amongst those with Metabolic Syndrome in Comparison with those without Metabolic Syndrome

Variables		OR (95% CI)	P-value	AOR (95% CI)	P-value
Meat	< per month - never	Ref.		Ref.	
	Monthly	0.58 (0.429 - 0.803)	0.001	0.73 (0.499 - 1.085)	0.121
	Weekly	1.03 (0.766 - 1.388)	0.842	1.31 (0.906 - 1.918)	0.149
	Daily	2.02 (0.930 - 4.388)	0.074	1.41 (0.586 - 3.426)	0.439
Fish	< per month - never	Ref.		Ref.	
	Monthly	0.74 (0.480 - 1.168)	0.202	1.12 (0.664 - 1.912)	0.658
	Weekly	0.85 (0.585 - 1.249)	0.417	1.01 (0.636 - 1.632)	0.937
	Daily	1.18 (0.714 - 1.950)	0.517	0.81 (0.444 - 1.478)	0.493
Egg	< per month - never	Ref.		Ref.	
	Monthly	1.53 (1.28 - 1.824)	0.000	1.29 (1.064 - 1.576)	0.010
	Weekly	1.89 (1.610 - 2.217)	0.000	1.66 (1.315 - 2.111)	0.000
	Daily	10.58 (3.681 - 30.429)	0.000	4.43 (1.463 - 13.460)	0.008
Dairy Products	< per month - never	Ref.		Ref.	
	Monthly	2.12 (1.729 - 2.617)	0.000	1.30 (1.024 - 1.668)	0.031

	Weekly	0.96 (0.802 - 1.168)	0.733	1.75 (1.195 - 2.566)	0.004
	Daily	6.64 (4.360 - 10.125)	0.000	3.81 (2.326 - 6.255)	0.000
Fast Food	< per month - never	Ref.		Ref.	
	Monthly	2.51 (1.991 - 3.187)	0.000	0.89 (0.652 - 1.237)	0.510
	Weekly	0.82 (0.687 - 0.983)	0.032	0.64 (0.462 - 0.892)	0.008
	Daily	4.48 (2.143 - 9.398)	0.000	4.82 (1.891 - 12.334)	0.001
Fish/Soya Sauce	< per month - never	Ref.		Ref.	
	Monthly	4.12 (3.005 - 5.658)	0.000	1.69 (1.108 - 2.593)	0.015
	Weekly	0.65 (0.538 - 0.805)	0.000	0.50 (0.317 - 0.790)	0.003
	Daily	0.72 (0.315 - 1.691)	0.462	0.14 (0.045 - 0.466)	0.001
Pickled Vegetables	< per month - never	Ref.		Ref.	
	Monthly	1.96 (1.571 - 2.453)	0.000	1.90 (1.469 - 2.463)	0.000
	Weekly	1.28 (1.096 - 1.502)	0.002	1.60 (1.237 - 2.082)	0.000
	Daily	2.24 (1.389 - 3.639)	0.001	1.54 (0.889 - 2.674)	0.124
Sweet Snacks	< per month - never	Ref.		Ref.	
	Monthly	1.80 (1.494 - 2.186)	0.000	1.29 (1.019 - 1.633)	0.034
	Weekly	1.70 (1.462 - 1.985)	0.000	1.42 (1.117 - 1.805)	0.004
	Daily	2.80(1.609 - 4.872)	0.000	1.56 (0.804 - 3.036)	0.188
Desserts/Sweet	< per month - never	Ref.		Ref.	
	Monthly	0.89 (0.720 - 1.106)	0.300	0.86 (0.685 - 1.090)	0.218
	Weekly	1.71 (1.377 - 2.124)	0.000	0.90 (0.701 - 1.163)	0.429
	Daily	1.10 (0.926 - 1.329)	0.260	0.99 (0.778 - 1.279)	0.984
Nuts/Seeds	< per month - never	Ref.		Ref.	
	Monthly	2.37 (1.925 - 2.918)	0.000	1.49 (1.169 - 1.899)	0.001
	Weekly	1.67 (1.390 - 2.018)	0.000	1.32 (1.054 - 1.658)	0.016
	Daily	0.58 (0.480 - 0.701)	0.000	0.54 (0.755 - 1.291)	0.000
Number of Meals served per day	2 times	Ref.		Ref.	
	3 times	0.93 (0.783 - 1.115)	0.452	0.86 (0.713 - 1.046)	0.133
	4 times and more	1.55 (1.254 - 1.937)	0.000	0.98 (0.755 - 1.291)	0.924
Vegetables Cooked	< per month - never	Ref.		Ref.	
	Monthly	0.36 (0.142 - 0.946)	0.038	0.25 (0.089 - 0.729)	0.011
	Weekly	0.13 (0.070 - 0.258)	0.000	0.29 (0.138 - 0.620)	0.001
	Daily	0.13 (0.71 - 0.254)	0.000	0.26 (0.133 - 0.528)	0.000

Table 4. Univariate and Multivariate Analysis of Dietary Risk Factors of Metabolic Syndrome

DISCUSSION

Prevalence of metabolic syndrome and associated dietary and behavioural risk factors like tobacco, alcohol consumption, financial stress, feeling of stress in last one year and physical inactivity are common in the studied population. Consumption of meat, egg, fast food, pickled vegetable and sweet snacks was found significantly higher amongst those with metabolic syndrome. Similarly, there is significant association of number of meals served per day with metabolic syndrome.

A study done on the same district covering tea garden population also reported high prevalence of tobacco (85.2%) and alcohol consumption (69.7%).⁸ The same study also reported that 61.6% of the tea garden populations were taking extra salt and there was significant association between salt intake and hypertension. Similar findings have been reported in studies across the globe.^{10,11}

It is generally agreed that stress aggravates blood pressure and pre-disposes the individual to develop hypertension.¹² In our study also stress was found to be associated with metabolic syndrome, which is an important risk factor of hypertension and cardiovascular disease.

A higher prevalence of metS, low physical activity levels, higher stress are all interrelated and were more prevalent in this population. Multifactorial risks will need multiple strategies for risk mitigation. Promotion of physical activity and the simultaneous reduction in sedentary occupations remain important strategies in population subgroups along with dietary modification. Metabolic syndrome was found to be lower in another population based study covering the industrial population of same district reported in 2006 compared to our study results (26.6% vs. 47.6%)¹³ indicating increasing trend of metabolic syndrome in the population.

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.¹⁴

Indian Government launched National Program for Prevention and Control of Cancer, Diabetes, Cardiovascular Diseases and Stroke (NPCDCS) to address high prevalence of Non-Communicable Diseases (NCDs).¹⁵ Risk factor control requires multidisciplinary approach which includes approaching social determinants of health, health-care financing, improving medical education and health system strengthening.¹⁶ Dietary promotion needs to be tried as a community based intervention to address such high prevalence of metabolic syndrome.

Fruit and vegetable intake though beneficial for overall cardiovascular health, declines age advances from childhood to adolescence. In addition, there is a steady increase in consumption of Sugar Sweetened Beverages (SSB) among children and adolescents over the last few decades.¹⁷ On the other hand, health enhancing as well as health compromising physical activity patterns are known to cluster with dietary choices and smoking behaviour.¹⁸ In contrast, a "health-conscious" low fat diet that included high consumption of vegetables, legumes and nuts, rye, cheese and other dairy products was inversely associated with the same cardiovascular risk factors.¹⁹ A diet low in saturated and trans fats with moderate-to-high consumption of items like whole grain cereals, low fat dairy items, fruits, vegetables and fibre rich food types appear to be beneficial for overall cardiovascular health.²⁰ Several studies have shown that primary prevention of these disorders by risk factor education in the community has better benefits compared to secondary prevention for cardiovascular mortality as well as morbidity.²¹⁻²³ Intervention of dietary modification can be carried out in such population as a population based measures for better documentation of effects.

Limitation of our study may be recall bias expected in dietary assessment. Second limitation may be in 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.

CONCLUSION

Metabolic syndrome was very much prevalent along with its behavioural and dietary risk factors. Health promotion and early intervention targeting the risk factor approach needs to be carried out as a community based intervention in such population.

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