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Prevalence of Metabolic Syndrome and Associated Risk Factors among Men in a Rural Health Centre Area in Tamil Nadu

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Background: MetS is one of the emerging health problems of the world with prevalence higher among Asians, including Indians, and is rising especially in the rural area. Hence, the objectives were to estimate the prevalence of MetS and its association with life style risk factors among adult men.

Methods: Cross-Sectional based study conducted in the rural area of Kancheepuram District recruiting 360 participants at the age group of 20-40 years by PPS from 9 villages and from each village participants were selected by simple random sampling. Using modified NCEP-ATP III guidelines, criteria for MetS were defined and the prevalence and its associated lifestyle risk factors were evaluated.

Results: The prevalence of MetS was found to be 16.7%. Higher prevalence was observed among the older age group 31-40 years with 32.4%. Among the five components of MetS, most observed component was Hypertriglyceridemia followed by high WC, abnormal DBP with 31%, 14% and 7% respectively. In Logistic Regression analysis, variables like Increased age, alcohol intake, high WC, raised TG level, raised FBS level and high average DBP were strongly associated with MetS as it was statistically significant.

Conclusion: The present study showed a high prevalence of MetS amongst men 31-40 years and strong association between MetS and lifestyle risk factors could be a major health problem in rural area, indicating that it was not necessarily a result of modernization. These findings make it critical to plan further healthcare interventions to prevent the adverse consequences of the disease.

Key Words: Metabolic syndrome, Tamil Nadu, Rural men, National cholesterol education program

INTRODUCTION

The metabolic syndrome (MetS), globally is a major health problem associated with increased morbidity and mortality from Cardiovascular disease (CVD). MetS is a conglomerate of various risk factors which is known to increase the risk for development of CVD. Various terms which have been ascribed for this constellation of findings are syndrome X, insulin resistance syndrome, "deadly quartet" and obesity dyslipidemia syndrome [1,2]. MetS repre-

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sents a group of cardiovascular risk factors, including Hyperglycemia, elevated Blood Pressure (BP), elevated Triglyceride (TG) levels, central obesity and decreased High-Density Lipoprotein Cholesterol (HDL-C) [3]. It will exacerbate the progression of CVD if left untreated. The estimates of the prevalence of MetS ranged from 21.3% to 32.8% among the participants in the Framingham Offspring Study and San Antonio Heart Study [4].

The prevalence of MetS is high among Asians including Indians, and is rising, particularly with the adoption of modernized lifestyle. Many studies in India have reported a high prevalence of MetS [5-7]. The number of people with the MetS also differs by sex, race, and ethnicity [8]. In the United States of America, the prevalence of the MetS in the adult population was estimated to be more than 25%. Similarly, the prevalence of MetS in 7 European countries was approximately 23%. It was estimated that 20-25% of South Asians have developed MetS and many more may be prone to it [9,10].

Nationally representative studies regarding the prevalence of the MetS are generally not available from any South Asian country. Available data indicate that the prevalence of the MetS in Asian Indians varies according to region, extent of urbanization, lifestyle patterns, and socioeconomic/cultural factors [11]. Overall prevalence ranges between 10 to 40% depending on age and sex. Recent data show that about one-third of the urban population in large cities in India have MetS [12,13]. In a South Indian study, the prevalence of MetS was estimated to be 25.8%, 23.2%, and 18.3% according to the International Diabetes Federation (IDF), World Health Organization (WHO), and National Cholesterol Education Program(NCEP)–Adult Treatment Panel (ATP) III definitions, respectively, implicating a discord between the same [7].

The rural prevalence of MetS is found to be reasonably low compared to the urban prevalence. A recent survey in Central India observed an overall MetS prevalence as per NCEP ATP III criteria to be 5.0% in the adult rural population. When NCEP ATP III criteria were modified using waist circumference (WC) cut- offs recommended by Asia-Pacific guidelines, MetS was seen in 9.3% (8.2% in males and 10.7% in females) [14].

Selvaraj et al. conducted a study in the rural background in Tamil Nadu among women with prevalence of 30.7% [15]. Scanty information is available about the magnitude of MetS in the rural areas especially young adult Males in India including Tamil Nadu. Hence the present study was undertaken in the rural area of Kancheepuram district with a primary objective, to estimate the prevalence of MetS among men in the age group of 20-40 years of rural population and to evaluate the association of life style risk factors with MetS.

The prevalence of this syndrome is high among Asians, including Indians, and is rising, especially in the rural background area. However, not many studies were focused on young adult men in the rural area of Tamil Nadu. Hence, the objectives were to estimate the prevalence of Metabolic Syndrome among adult men 20-40 years and to assess the association between the life style risk factors and metabolic syndrome in Kancheepuram district.

MATERIALS AND METHODS

A cross-sectional study conducted from June 2015 to July 2016 in a rural population served by SRM Rural Health Centre, Kancheepuram district, about 84 Kms away from Chennai City. The present study was conducted among the population from 9 villages (Mamandur, Vadapathy, Meiyur, S.Mambakkam, Sirupinayur, Thiruvanthavur, Kodithandalam, Natarajapuram, Samathuvapuram) with total population of 13,493. Among which, overall 6554 were males and the 20-40 years old age group numbered 3011 were included in this study. Participants who were not available in their households at the time of data collection and who all were not willing to participate in the study were excluded. As per NCEP ATP III criteria, the overall prevalence of metabolic syndrome in India including urban, rural and tribal areas ranges from 30 to 50% [16-18] and taking the prevalence as 32% with limit of accuracy 5%, the sample size was worked out to be 334. The anticipated non-response in providing blood samples was 10% and accordingly to compensate for the non-response, the final sample size arrived at was 360.

The Men in the age group of 20-40 years were listed out from the Family Folder list which was maintained in the SRM Rural Health Center, Kancheepuram District for the

year 2014. They were serially numbered. Using this as the sampling frame, 360 men were selected by Probability Proportional to Size (PPS) from 9 villages. From each village, subjects were selected by simple random sampling using computer random number generator.

1. Ethical approval

Institutional ethical committee approval was obtained prior to the start of study and informed consent was taken from all the study subjects.

2. Metabolic syndrome definition

Modified NCEP ATP III definition [19].

The clinical components of metabolic syndrome include abdominal obesity, high triglyceride, low high density- lipoprotein cholesterol, high blood pressure, and high fasting glucose. The 2001 ATP III definition requires the presence of three or more of the following five components:

1) Waist Circumference > 90 cm in men and > 85 cm in women,

2) Triglycerides ≥ 150 mg/dL or drug treatment for Hypertriglyceridemia,

3) HDL-C < 40 mg/dL in men and < 50 mg/dL in women or drug treatment for low HDL-C,

4) Blood pressure ≥ 130/85 mmHg or drug treatment for previously diagnosed hypertension, and

5) FBG ≥ 110 mg/dl or drug treatment for elevated glucose.

3. Data collection

Pre-designed, pre-tested, semi-structured questionnaire with few modifications for the present study were further validated and detailed information regarding demographic, socioeconomic, behavioral and health status was collected from each study subject. Anthropometric measurements (waist circumference (WC), weight and height) and blood pressure were obtained using standard procedures. Privacy of each participant was strictly considered when taking the measurements.

4. Laboratory method

Blood samples were drawn using standard phlebotomy procedure from an antecubital vein between 8 am and 9 am after a 12-14 hour overnight fast. They were analyzed for fasting glucose levels, serum triglycerides (enzymatic kit methods: Vital Diagnostics Pvt. Ltd, Mumbai); and serum High Density Lipoprotein (HDL-C) (Kit method: Bayer Diagnostics, Baroda) using a semi-auto-analyzer from an accredited lab (ISO certified) located at Tambaram, Chennai. The Laboratory results were validated with another lab of same ISO standards and every 50th participant's results were validated to rule out any misinterpretations.

5. Data analysis and statistical methods

The collected data was analyzed using relevant descriptive and inferential statistical techniques using Statistical Package for the Social Sciences (SPSS) for Windows 20.0 (SPSS Inc.,) Illinois, Chicago. Magnitude of MetS was ex-

Table 1. Prevalence of metabolic syndrome based on demographic profile of study participants (N = 360)

Background variables	Frequency (%)	Metabolic syndrome (%)
Age		
20-30	212 (58.9)	12 (5.6)
31-40	148 (41.1)	48 (32.4)
Education		
Illiterate	14 (3.8)	3 (21.4)
School	258 (71.6)	47 (18.2)
College	88 (24.4)	10 (11.3)
Occupation		
Unskilled	7 (1.9)	2 (28.6)
Semi-skilled	226 (62.8)	30 (13.3)
Skilled	127 (35.3)	28 (22.0)
Type of family		
Nuclear	87 (24.2)	16 (19.1)
Joint	273 (75.8)	44 (15.9)
Standard of living index		
Low	6 (1.7)	0 (0)
Medium	47 (13.1)	11 (23.4)
High	307 (85.2)	49 (15.9)
Marital status		
Unmarried	166 (46.1)	12 (7.2)
Married	194 (53.9)	48 (24.7)
Smoking habits		
Smoker	29 (8.1)	10 (34.5)
Non-smoker	331 (91.9)	50 (15.1)
Alcohol habits		
Alcoholic	55 (15.3)	22 (40.0)
Non-alcoholic	305 (84.7)	38 (12.5)
Physical activity		
Hepa active	12 (3.3)	3 (25)
Minimal active	304 (84.4)	45 (14.8)
Inactive	44 (12.2)	12 (27.3)

pressed in percentage and 95% confidence interval (CIs). Chi-square tests were used to study associations between categorical variables. Unadjusted odds ratio (ORs) were computed to assess the strength of association between independent variables (age, sex, socioeconomic status, smoking and alcohol and family history of HTN, DM) and dependent variables (MetS) along with their 95% CIs. All statistical tests were considered statistically significant when two-sided $p < 0.05$.

RESULTS

The Demographic information profile of the study participants is provided in Table 1 and, their biochemical and clinical profile in Table 2. The prevalence of MetS was found to be 16.7%. In this study, the mean age of the study participants was 29.18 (± 6.738) years. The mean BMI of the study participants was 23.6 (± 3.7). The mean Systolic BP was 118.5 (± 5.7) mmHg. The mean Diastolic BP was 79.1 (± 5.4) mmHg. The mean Fasting Triglyceride level in this study was 140.6 (± 21.4) mg/dl. Similarly, the mean Fasting HDL levels was 32 (± 4.8) mg/dl. The mean FBS (fasting blood sugar) levels was 86.1 (± 21.7) mg/dl.

Table 2. Prevalence of metabolic syndrome based on biochemical and clinical profile of the study participants (N = 360)

Background variables	Frequency (%)	Met S(%)
Fasting triglyceride level		
Normal (< 150 mg/dl)	248 (68.9)	16 (6.4)
Abnormal (≥ 150 mg/dl)	112 (31.1)	44 (39.3)
Fasting HDL-cholesterol level		
≥ 40 mg/dl	347 (96.4)	56 (16.1)
< 40 mg/dl	13 (3.6)	4 (30.8)
Fasting blood sugar		
<110 mg/dl	344 (95.6)	48 (13.9)
≥ 110 mg/dl	16 (4.4)	12 (75)
Systolic blood pressure		
<130 mm Hg	353 (92.8)	48 (13.9)
≥ 130 mm Hg	26 (7.2)	12 (75)
Diastolic blood pressure		
< 85 mm Hg	334 (92.8)	43 (12.9)
≥ 85 mm Hg	26 (7.2)	17 (65.4)
BMI		
< 24.9	257 (71.4)	34 (13.2)
25-29.9	78 (21.7)	16 (20.5)
≥ 30	25 (6.9)	10 (40)
Waist circumference		
≤ 90 cm	309 (85.8)	29 (9.4)
> 90 cm	51 (14.2)	31 (60.8)
Family history		
F/H diabetes mellitus	14 (39)	2 (14.3)
F/H hypertension	6 (1.7)	3 (50)
F/H diabetes and hypertension	7 (1.9)	4 (57.1)
No F/H	333 (92.5)	51 (15.3)

The association of demographic variables of the study participants with MetS is shown in Table 3 which showed that men in the age group of 31-40 yrs, married men, unskilled and semiskilled workers, alcoholics and smokers were at higher risk of developing metabolic syndrome and are statistically significant. Table 4 shows the association of biochemical and clinical variables with MetS were almost all the factors are having risk of developing MetS and was found to be statistically significant at p value < 0.05.

Table 5 shows that after applying binary logistic regression for variables, which was statistically significant using Chi-square test, which revealed strong association of variables such as increased age, Alcohol intake habit, high Waist Circumference, raised TG level, raised FBS level and high average Diastolic BP with Metabolic Syndrome at p value < 0.05.

DISCUSSION

This study showed that the overall prevalence of Metabolic Syndrome (according to mod. NCEP ATP III criteria [19]) among men between 20-40 years was 16.7%. The prevalence of metabolic syndrome was increased with age among group 31-40 yrs with 32.4%. Similar findings were reported by Karimi et al. with 18.9% among males in rural community in Iran [20] and Deepa et al. reported 17.1% among males in Chennai [7]. In contrast, higher prevalence was reported by Peixito et al. [21] and Pathania et al. reported with 33.6% among males of rural Goa and Haryana respectively [22]. Kamble et al. reported lesser prevalence of 8.2% among rural Wardha men [23]. Findings were reported by Jain et al. [24], with higher prevalence of MetS among aged more than 25 years than among less than aged 25 years with 14.8% and 7.4% respectively.

Among the five components of metabolic syndrome, most commonly observed component was High Triglycerides followed by High waist circumference and abnormal Diastolic

Table 3. Association of demographic variables with metabolic syndrome (N = 360)

Variables	MetS	Non-MetS	OR	95 CI	χ^2, df & p-value
Age					
31-40	48	100	8.0	4.07-15.74	χ^2 = 44.98, df = 1, p < 0.001
20-30	12	200			
Type of family					
Nuclear	16	68	1.24	0.65-2.33	χ^2 = 1.0, df = 1, p = 0.50
Joint	44	232			
Marital status					
Married	48	146	4.22	2.16-8.26	χ^2 = 19.79, df = 1, p < 0.001
Unmarried	12	154			
Occupation					
Unskilled & semi-skilled	30	104	1.88	1.08-3.29	χ^2 = 5.03, df = 1, p = 0.02
Skilled	30	196			
Standard of living index					
Low & medium	11	42	1.38	0.66-2.86	χ^2 = 0.75, df = 1, p = 0.39
High	49	258			
Smoking history					
Smoker	10	19	2.95	1.29-6.73	χ^2 = 7.20, df = 1, p = 0.007
Non-smoker	50	281			
Drinking alcoholic history					
Alcoholic	22	33	4.68	2.47-8.86	χ^2 = 25.44, df = 1, p < 0.001
Non-alcoholic	38	267			
Physical activity					
Hepa active	3	9	1		
Minimal active	45	259	0.52	0.14-1.99	χ^2 = 0.03, df = 1, p = 0.58
Inactive	12	32	1.13	0.26-4.87	χ^2 = 0.03, df = 1, p = 0.87

MetS: metabolic syndrome, OR: odds ration, CI: confidence interval.

BP with 31%, 14% and 7% respectively. Men who had abnormal Waist Circumference (14.2%) as per NCEP ATP III criteria modified for Asian Indians [25] had 14.9 times higher risk of Metabolic Syndrome than those who had normal WC and was highly statistically significant. The association of waist circumference with higher prevalence metabolic syndrome was supported by other authors [7,17,22,26]. Similarly, study by Kamble [23], 16% of the study participants were with high Waist Circumference. In contrast, higher proportion of participants with high waist circumference 51.7%, was reported by Peixoto et al. [21]. Men who had abnormal HDL levels were 2.3 times at higher risk of developing MetS. In contrast, Gyakobo et al. 32.3% prevalence of MetS were reported among low HDL-C level participants and 9.7% prevalence among high TG level participants [27]. Positive association of Abnormal Fasting and MetS were observed by many authors [7,17,22]. In contrast, study conducted by Arthi et al. 38% prevalence were observed among the impaired fasting glycemic group and 24% among the Euglycemic group [26]. Significant association of SBP and DBP with MetS was reported by Kanjilal, et al. [28] similar to our study findings.

After using Binary Logistic Regression, variables like Increased age, Alcohol intake, high Waist Circumference, raised TG level, raised FBS level and high average Diastolic BP were strongly associated with Metabolic Syndrome as it was statistically significant.

The present study being a cross sectional study carries the inherent limitations of cross sectional studies, thereby disabling the understanding of true temporal relationships between lifestyle disease diseases. Cross-sectional data cannot assess the effect of lifestyle on the incidence of MetS, and longitudinal cohort studies are, therefore, needed.

CONCLUSION

This study documents one-fourth of the study population with metabolic syndrome and high proportions were ob-

Table 4. Association of clinical & biochemical variables with MetS (N = 360)

Variables	MetS	Non-MetS	OR	95 CI	χ^2, df, & p-value
Triglyceride level					
High	44	68	9.38	4.98-17.67	χ^2 = 59.89, df = 1, p < 0.001
Normal	16	232			
High density lipoprotein-cholesterol					
Low	4	9	2.309	0.69-7.76	χ^2 = 1.93, df = 1, p = 0.16
Normal	56	291			
Fasting blood sugar					
High	12	4	18.43	5.69-59.67	χ^2 = 41.023, df = 1, p < 0.001
Normal	48	296			
Diastolic blood pressure					
> 85 mm of Hg	17	9	12.78	5.36-30.48	χ^2 = 47.89, df = 1, p < 0.001
< 85 mm of Hg	43	291			
Systolic blood pressure					
> 130 mm of Hg	6	1	33.22	3.92-281.46	χ^2 = 24.505, df = 1, p < 0.001
< 130 mm of Hg	54	299			
Body mass index					
< 24.9	34	223	1		
25-29.9	16	62	1.69	0.87-3.27	χ^2 = 2.5, df = 1, p = 0.11
≥ 30	10	15	4.37	1.82-10.51	χ^2 = 12.4, df = 1, p < 0.001
Waist circumference					
High	31	20	14.96	7.58-29.54	χ^2 = 83.27, df = 1, p < 0.001
Normal	29	280			
Family history of hypertension/diabetes mellitus or both					
Yes	9	18	2.77	1.77-6.49	χ^2 = 5.84, df = 1, p = 0.01
No	51	282			

MetS: metabolic syndrome, OR: odds ration, CI: confidence interval.

Table 5. Logistic regression of variables with metabolic syndrome

No.	Variables	B	SE	Wald	df	Sig.	Exp (B)	95 CI for EXP(B)	
								Lower	Upper
1	Age	2.079	0.345	36.286	1	0.000	8.00	4.067	15.737
2	Occupation	0.446	0.532	0.701	1	0.402	1.561	0.550	4.430
3	Marital status	1.081	0.561	3.715	1	0.054	2.946	0.982	8.841
4	Family history	0.280	0.823	0.116	1	0.734	1.323	0.264	6.635
5	Smoking	0.293	0.772	0.144	1	0.704	1.340	0.295	6.084
6	Alcohol	1.624	0.557	8.506	1	0.004	5.074	1.703	15.115
7	BMI	−0.297	0.523	0.323	1	0.570	0.743	0.267	2.070
8	WC	3.569	0.630	32.089	1	0.000	35.49	10.323	122.03
9	TG	3.802	0.665	32.686	1	0.000	44.79	12.167	164.94
10	FBS	3.898	1.16	11.107	1	0.001	49.28	4.980	487.71
11	Average SBP	2.914	3.53	0.679	1	0.410	18.43	0.018	18869.8
12	Average DBP	4.487	0.838	28.653	1	0.000	88.84	17.184	459.31

B: co-efficient, SE: standard error, Wald: Z score, df: degree of freedom, Sig: significancem, Exp (B): odds ratio, CI: confidence Interval, BMI: body mass index, WC: waist circumference, TG: triglycerol, FBS: fasting blood sugar, SBP: systolic blood pressure, DBP: diastolic blood pressure.

served in the older age group 31-40 years with 32.4%, on applying the NCEP ATP III (mod) criteria for Asian Indians. The prevalence of Metabolic Syndrome was found to be positively associated with socio-demographic variables

like increased age, married men, unskilled workers, positive family history, obese BMI, High Waist circumference, High TG levels, High FBS levels, and high DBP and SBP levels. This revealed that metabolic syndrome (or its contributing variables) could be a major health problem even in rural background, indicating that this syndrome was not necessarily a result of modernization or urbanization. An additional adverse impact of adoption of urban life styles (perhaps primarily mediated through dietary changes) was also apparent on cardiovascular risk factors and metabolic syndrome. Knowledge and awareness about MetS may be imparted through appropriate Information, Education and Communication (IEC) or Behavior Change Communications (BCC) activities about weight reduction, restricting alcohol intake and smoking, increase in physical activity and proper regular screening of Blood Pressure, Blood Sugars and Serum Cholesterol Levels. If abdominal obesity or increased waist circumference is kept at check, MetS incidence can be controlled by and large in the young population, which in turn lowers the chances of MetS incidence with increasing age. However, if 3-6 months of efforts at remedying risk factors prove insufficient, then drug treatment is frequently required. Utilization of this information, early identification, treatment and prevention of the Metabolic Syndrome, present a major challenge for Community Physicians, and public health policy makers and stakeholders in the regional health sector.

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