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Research Article

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Study of risk factors for metabolic syndrome in subjects from rural area of Kurnool district

Pandit Vinodh Bandela[*1], J. G. Ambekar[2], Nilima N. Dongre[3], K. Durga Prasad[4] and B. B. Devaranavadagi[5]

[1]Research Scholar, Department of Biochemistry, BLDEU'S, Shri B.M. Patil Medical College, Vijayapur, Karnataka
[2]Professor, Department of Biochemistry, BLDEU'S, Shri B.M. Patil Medical College, Vijayapur, Karnataka
[3]Associate Professor, Department of Biochemistry, BLDEU'S, Shri B.M. Patil Medical College, Vijayapur, Karnataka
[4]Professor, Department of Biochemistry, Santhiram Medical College, Nandyal, Andhra Pradesh
5Prof.and HOD, Department of Biochemistry, BLDEU'S, Shri B.M. Patil Medical College, Vijayapur, Karnataka

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ABSTRACT

The ongoing rapid urbanization of India offers rural population the opportunity not only of economic improvement but also substantial health risk. The non-communicable disease (NCD) risk in India is increasing proportionally with increased risk for metabolic syndrome (MetS). There is no published data on metabolic syndrome risk factors from rural population of Kurnool district. To assess the MetS risk factors among rural population of Kurnool district using modified NCEP ATP III criteria. We studied 344 individuals with the age range 20-60 years. The risk factors for MetS were considered on the basis of modified NCEP ATP III criteria was defined by modified NCEP ATP III criteria, determined in terms of age and sex. Other variables were evaluated by using simple logistic regression methods. A total 33.65% men and 29.49% women were at high risk for MetS. Increased WC (52.03%) and decreased HDL-C (73.83%) followed by hypertriglyceridemia (37.50%); hypertension (36.04%); and hyperglycemia (18.02%) are found to be the main culprits for MetS in this population. The other physiological and behavioural CVD risk factors are as follows smoking 23.83%, alcohol intake 27.03%, history of type 2 DM 13.27%, history of HTN 11.91%, family history of type 2 DM 11.91% and family history of hypertension 7.55%.. Based on BMI percentage of underweight subjects is 6.10%; overweight/obesity (BMI ≥25.0)-57.26% and only 34.88% subjects are with normal BMI. MetS is present in 21.27% of subjects with normal BMI. Cardiovascular risk index calculated by Castelli index I, II and non HDL/HDL-c have shown significant correlation (r=0.0625; 0.0575; 0.0578 respectively) with number of MetS risk factors. MetS is present in 36.11% sedentary life style subjects whereas it was 30.88% among the subjects doing normal to hard work life style. MetS risk factors were high among this population. Central obesity and decreased HDL-c are found to be major risk factors. This scenario needs a better appraisal in order to create awareness to prevent or reduce these modifiable MetS risk factors among this population.

Key words: Kurnool, Prevalence, Metabolic Syndrome (MetS)

INTRODUCTION

Metabolic syndrome is a multi-dimensional risk factor of atherosclerotic cardiovascular disease (ASCVD) and type 2 diabetes mellitus (T2DM).[1, 2] According to World Health Report 2002, CVDs are going to be the largest cause of death and disability by 2020 [3] and by 2030 diabetes mellitus (DM) afflict up to 79.4 million individuals in India, while china (42.3 million) and the US (30.3 million).[4] The National Cholesterol Education Program (NCEP) The Adult Treatment Panel (ATP III) defines MetS as 3 or more of the following abnormalities:

hypertriglyceridemia, low HDL, high fasting glucose, excessive waist circumference, and hypertension.[5] These risk factors may oscillate with ethnic population, region and country.[6]

Our previous hospital based cross sectional studies reported 19.80%[7]; 29.6% [8] prevalence MetS in adults of Nandyal an urban area of Kurnool district, Andhra Pradesh, India using WHO, modified NCEP ATP III criteria in the year 2012, 2013 respectively. This scenario deserves better appraisal to assess prevalence of metabolic syndrome among rural population at ground level.

Therefore we have under taken this study designed with an objective to assess the metabolic syndrome and related risk factors among apparently healthy rural adults (20-60 years) of this population. This research provides a substratum to explore the pathophysiology and treatment modalities of associated cluster risk factors with the entity of metabolic syndrome.

EXPERIMENTAL SECTION

This transversal study is conducted in Neravada, located in Kurnool district of Andhra Pradesh, India. Total 344 subjects aged 20 to 60 years analyzed for MetS in the year 2014. Simple random technique applied for selection of participants.

Inclusion criteria: - Apparently healthy adults (aged 20-60 years) are included.

Exclusion criteria: - Pregnant women, lactating mothers and those who are severely ill excluded from this study.

The required data information is collected from the subject by a face to face interview, anthropometric, clinical and biochemical examination. The data variables are shown in table-1.

Table 1: The variables used in the present Study

STUDY VARIABLES	
Demographic	Age, Gender
Behavioural	Smoking, tobacco Chewing and alcohol consumption
Clinical Examination	Weight (kg), Height (cm), Waist circumference (WC)cm Blood Pressure (BP)
Oral Questionnaire	Family history (FH)/History of diabetes, Hypertension (HTN), type of work and History corresponding medication
Biochemical tests	Fasting blood sugar (FBS), Total cholesterol(T.CHO), Triglycerides (TG), HDL-cholesterol (HDL-C)

The WC is measured at the level of uppermost lateral border of the iliac crest, made at a normal minimal respiration, at the end of gentle exhaling. BP is recorded, the average of two brachial systolic and diastolic blood pressure readings were taken.

5 ml of fasting blood samples after 12 hours overnight fasting were collected for analysis of biochemical parameters like FBS, T.CHO, TG and HDL-c etc. All the investigations are done on the same day on a semi automated analyzer (Transasia–Erba Chem. V5 X) using standard protocol. VLDL-C is calculated using the formula TG/5; LDL-C by subtracting VLDL-C and HDL-C from total cholesterol (Freidwald formula) and body mass index (BMI) was calculated by dividing weight by height squared (kg/m^2).

Cigarette smoking is defined by history of smoking at least 100 cigarettes in one's lifetime, alcohol drinking is defined as at least once in a week alcohol consumption, physical activity is defined as participating in moderate or vigorous activity for 30 minutes or more per day at least 3 days per week and family history is defined as at least one of the parent, brother or sister diagnosed as diabetic in a life time by self reporting.

The participants were divided based on their age into 4 groups i.e., 21-30, 31-40, 41-50 and 51-60 years. The MetS defined by Asian specific modified NCEP ATP III criteria. Presence of any three following risk factors is considered as positive for risk of MetS. Central obesity - WC > 90 cm (men), > 80 cm (women); BP - SBP ≥ 130 mmHg and / or DBP ≥ 85 mmHg or medical treatment for previously diagnosed hypertension; hypertriglyceridemia - TG ≥ 150 mg/dL; low HDL-C < 40 mg/dL (men), < 50 mg/dL (women); impaired FBS ≥ 100 mg/dl. The Atherogenic ratios (AR) were calculated as follows: Atherogenic Index of Plasma (AIP) = log (TG/HDL); Castelli Risk Index (CRI-1) = TC/HDL; Castelli Risk Index (CRI-2) = LDL/HDL; Atherogenic Coefficient (AC) = non HDL/HDL.

During the entire study the utmost care was taken according to Helsinki Declaration about patient confidentiality. The study was approved by Institutional Ethical Committee (IEC). Written Informed consent of participants was taken prior to study

STATISTICAL ANALYSIS

Data analysis was done by graph pad instat 3 version. Mean and standard deviation (S.D.) of the numerical variables were calculated. Un-paired student's "t" test is used for statistical significance. A p value <0.05 was considered significant. Correlation was seen by applying correlation coefficient.

RESULTS

The study includes 344 subjects comprising Males (n=205) & Females (139). The data in **Table 2** shows gender difference in MetS risk factors in percentage. Among 344 subjects, 110 (31.97%) are at risk of MetS, impact is more in men than women 33.65% (n=69); 29.49% (n=49) respectively.

Table 2 Showing gender difference in Percentage of risk factors for MetS

Variable	**Men** % (n)	**Women** % (n)
Central obesity	50.73(104)	53.95 (75)
Elevated SBP	27.31(56)	37.41 (25)
Elevated DBP	20.00(41)	18.70 (26)
Hyper triglyceridemia	42.92(88)	29.49 (41)
Low HDL-C	63.90(131)	88.48(123)
Impaired fasting plasma glucose	20.48(42)	14.38 (20)

Graph: 1 showing relative number of modified NCEP ATP III criteria obeyed by the subjects. Any one or two risk factors present in 60.46% subjects. Only 7.5% are without any risk factors.

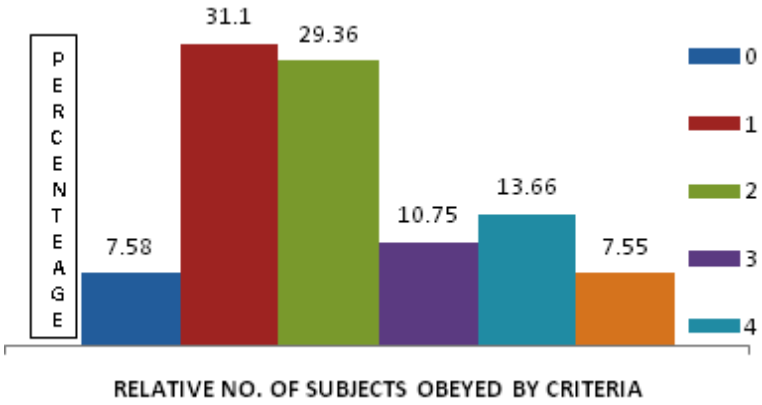


Table 3 is showing predominance (%) of MetS in study age groups. Women at the age of 51-60 years are more prone as compared to men.

Table 3 Predominance (%) of metabolic syndrome by age and gender

Age Group	Total	Men % (n)	Women % (n)
21-30	22.58	23.94 (17)	20.75 (11)
31-40	28.73	33.33 (16)	23.07 (9)
41-50	38.75	38.77 (19)	38.70 (12)
51-60	49.05	45.94 (17)	56.25 (9)

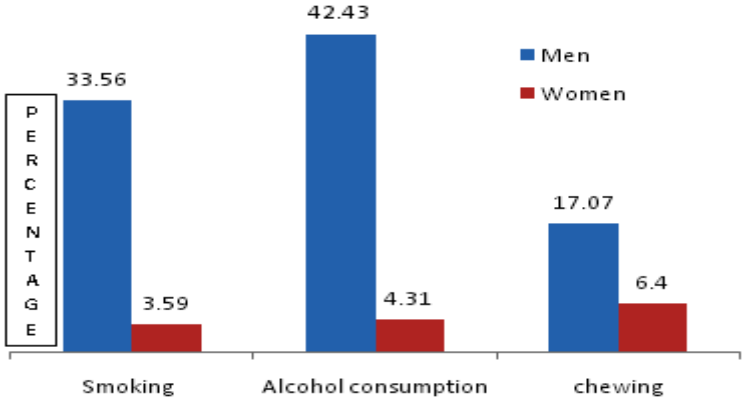
The analysis of BMI shows underweight is 6.10%; overweight/obesity-57.26% and only 34.88% subjects are with normal BMI. Total 60.97% men and 53.23% women are overweight / obese. MetS present in 21.27% of subjects with normal BMI.

Table 4 is showing Mean±SD of atherogenic risk index lipid ratios of MetS positive and negative subjects, and correlation with number of risk factors of an individual

Atherogenic risk index lipid ratio	MetS **positive**	MetS **negative**	R	R^2
Atherogenic index of plasma (AIP)	0.65±0.13	0.52±0.10*	0.2697	0.0727
Castelli Risk Index -1 (CRI-1)	5.64±5.75	3.99±0.84*	0.2500	0.0625
Castelli Risk Index -2 (LDL/HDL)	3.62±4.73	2.31±0.80*	0.2398	0.0575
Atherogenic Co-efficient (Non HDL/HDL)	4.59±5.77	2.99±0.84*	0.2404	0.0578

*r = coefficient variation; R^2= coefficient determination * = significant*

Graph: 2 showing percentage of smoking, alcohol consumption, chewing in men and women. Relative risk ratio (RR) for the development of MetS in alcohol consumption is 1.517 (p=0.0266; CI 1.517 to 1.076); smoking-1.837 (p=0.0018; CI 1.269 to 2.661); chewing- 2.127 (p=1.232 to 3.672).



History of type 2 diabetes is present in 13.27%; hypertension -11.91%; family history of-diabetes-11.91%; family history of hypertension-7.55% subjects. However impaired fasting blood glucose levels are present in 58.69 % subjects, who are already under treatment for DM. Furthermore, it was 68.29% in case of hypertension. MetS is present in 36.11% sedentary life style subjects whereas 30.88% among the subjects doing normal to hard work life style.

DISCUSSION

The importance of MetS lies in the cardiometabolic risk factors of the criteria applied in screening. This syndrome will elevate the risk for development of ASCVD by 2 fold and T2DM by 3-fold. [9] The current study implemented a modified NCEP ATP III criterion that is specific for Asian. A total 31.97 % (men-33.65%; women-31.97%) were at high risk for MetS. Chow CK et.al. [10], MA Njelekela et al [11], L Fezeu et.al. [12] also noted high prevalence of MetS in men compared to women. The reverse is reported by T Ahonen et al [13], Y He et al [14]. This may attribute to high prevalence of waist girth (obesity) in men than women among this population.

The contribution of MetS components may oscillate with ethnic population, gender and country. [15] We identified elevated WC and decreased HDL-C is the consistent cluster components for MetS among this population. **[Table-2]** The results were in accordance with PC Deedwaina et al [16], Seerat Hussain et.al. [17] This occurs commonly irrespective of MetS definition applied. The obesity plays a role in the development of MetS and appears to precede the appearance of the other MetS component.[15] The approximate cut off level of WC [calculated using mean±2SD method] for appearing two other MetS factors in men is 83.86; it is 75.62 in case of women seems to be very low. However, in support to this we observed 21.27% MetS among the subjects with normal BMI. This condition gives us a scope to study other risk factors for MetS among this population. In multiple logistic regression model education (OR=1.358) and sedentary life style (OR=1.265) has no effect on MetS, while smoking (OR=0.4388) and alcohol (OR=0.5650) are showing significant effect.

The risk of MetS is increased with increasing age. Significant difference is noted in men and women at the age group 51-60 years that is prevalence decreased in men than women. **[Table 3]** In Finnish study [18] the prevalence of MetS was found to increase with increasing age in women. This gives an impression that the CVD risk will be increased in women by post menopausal, and in accordance with Regitz-ZV [15] et al who reported that women develop cardiovascular disease (CVD) at an older age compared men. In supporting to this, the age based fragmented analysis of current data revealed that MetS is 44.68% in women with ≥ 41 years of age while it was only 21.73% in men.

On evaluation of lipid ratios **[Table 4]** of the current study, we observed that AIP is statistically higher in MetS positive subjects compared to negative subjects (p=<0.0001). Consequently it has shown significant positive

correlation with number of MetS risk factors of an individual. It is suggested that AIP values of -0.3 to 0.1 are associated with low, 0.1 to 0.24 with medium and above 0.24 with high Cardiovascular risk.[19] We observed that mean AIP of MetS positive and negative subjects is >0.24. This may attribute to high abdominal obesity in this population, that causes deranged (high TG and low HDL-C) lipid pattern. An inverse relationship between TG and HDL-C is noted by several studies and that the ratio of TG to HDLc is a strong predictor of infarction. [20]

The Castelli Risk Ratio (CRI) is based on three important lipids i.e. TC, LDL and HDL-C. CRI-1 calculated as the ratio of [TC/HDL] and CRI-2 as [LDL/HDL]. [21] A Significant difference is observed between MetS positive and negative subjects in respect individual lipid parameters. However the mean values of TC is 166.77 and TG 146.02 found to be under normal range i.e. <200 mg/dl; < 150mg/dl respectively in MetS positive subjects. Whereas the ratio of these parameters has shown a clear cut statistically significant variation between MetS positive and negative subjects. Even though CRI-1 mean is slightly above the upper limit for the normal range i.e. >3.0 in MetS negative subjects, CRI-2 is under allowed range i.e. <3.0. In PROCAM study [22], it was observed that subjects with >5 of Castelli index-2 had six times higher rate of coronary events. The Quebec Cardiovascular study shown variations in Castelli index 1 and 2 ratios may be associated with more substantial alterations in metabolic indices predictive of ischemic heart disease risk and related to MetS. [23]

Studies have shown that non-HDL is similar to Apo-B in assessing atherogenic cholesterol and lipoprotein burden. [24] Atherogenic Coefficient (AC), calculated as non-HDL/HDL is a measure of cholesterol in LDL, VLDL, IDL lipoprotein fractions with respect to HDL. It reflects atherogenic potential of the entire spectrum of lipoprotein fractions. As per ATP III guidelines non HDL is the second target of therapy after LDL especially in individuals with increased triglycerides.[25] In the current study AC ratio is high in MetS positive subjects compared to negative one and significantly correlated with number of MetS risk factors. It gives an impression that atherogenic index will increase correspondingly with increasing MetS risk factors.

Alcohol consumption is high in both the gender (men 42.43% / women 4.31%) compared to smoking (men 35.56% / women 3.59 %). Overall 27.03% alcoholism; and 23.83% smoking was reported.**[Graph 2]** According to Global Adults Tobacco Survey (GATS) – 2010, smoking is about 15% in men and 1.90% in women.[26] Ganesh Kumar et.al.[27] has reported 16.8% alcohol consumption men and 1.3% in women among the rural population of Tamilnadu. The National health profile survey reported 11%-20% alcohol consumption. [28] In this current study alcohol and smoking is high in women compared to other studies. The Relative Risk Ratio (RR) showed that chewing of non smoke tobacco was a strong risk factor for MetS; this may due to 75% of them are having habit of alcohol consumption and smoking. The risk for MetS with alcohol consumption is low (r=1.517 CI 1.076 to 2.139) whereas along with smoking it is high (r=1.738 1.258 to 2.401). This gives an impression that clustering of modifiable risk factors may increase the cardio metabolic risk.

CONCLUSION

Metabolic syndrome related risk factors are high among this population. Males were at high risk may be due to high prevalence of central obesity. Females with postmenopausal age group are at high risk than males this may attributed to hormonal changes at this age. Most of the subjects receiving regular medication for diabetes and hypertension, having elevated blood pressure and fasting blood glucose levels. This warrants strategies that would improve awareness and promote healthy life-styles to reduce the risk for metabolic syndrome there by cardiovascular risk in this population.

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