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Metabolic Syndrome Risk Factors in Rural Population of Kurnool District

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Abstract

Background: The ongoing rapid urbanization of India offers rural population opportunity not only economic improvement but also substantial health risk. The non-communicable disease (NCD) risk in India is increasing proportionally with increased metabolic syndrome (MS) risk factors – a multidimensional risk factor for NCD such as cardiovascular and type 2 diabetes. There is no published data on MS risk factors from rural population of Kurnool district.

Aim: To assess the MS risk factors among rural population of Kurnool district using modified NCEP ATP III criteria

Method: The sample was 344 individuals aged 20-60 years. MS 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.

Results: A total 33.65% men and 29.49% women were at high risk for MS. 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 driving forces for MS in this population. The other physiological and behavioural CVD risk factors are as follows smoking 23.83%, alcohol intake 27.03%, history (H) of type 2 DM 13.27%, history of HTN 11.91%, family H/DM 11.91% and family H/HTN 7.55%. Total 68.29%, 58.69% subjects under anti-hypertensive and diabetic medication are having elevated blood pressure and fasting blood glucose levels. Based on BMI underweight is 6.10%; overweight/obesity-57.26% and only 34.88% subjects are with normal BMI. MS is present in 21.27% of subjects with normal BMI. Cardiovascular risk index calculated by Castelli index I, II and non HDL/HDL-c were shown significant correlation (r=0.0625; 0.0575; 0.0578 respectively) with number of MS risk factors. MS is present in 36.11% sedentary life style subjects whereas it was 30.88% among the subjects doing normal to hard work life style.

Conclusion: MS risk factors were high among this population. Central obesity and decreased HDL-c are found to be major risk factors. Atherogenic index is correspondingly increased with number MS risk factors of a subject. This scenario needs a better appraisal in order to create awareness to prevent or reduce these modifiable MS risk factors among this population.

Key Words: *Kurnool, Prevalence, Metabolic Syndrome*

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 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 MS 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 MS 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 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.

MATERIALS AND METHODS

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

participants. Pregnant, lactating mothers, severely ill and persons with non reliable information are excluded for 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 were shown in table-1.

Table 1: study variables of the current 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, 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 sample after 12 hours overnight fasting were collected to estimate FBS, T.CHO, TG and HDL-c 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) is calculated by dividing weight by height squared (kg/m^2). Smoking was defined as life time history of smoking at least 100 cigarettes, alcohol drinking is defined as at least once per 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., 20-30, 31-40, 41-50 and 51-60 years. The MS defined by Asian specific modified NCEP ATP III criteria. Any three following risk factor presence is required for of diagnosis MS. 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 and <0.01 considered highly significant. Correlation was seen by applying correlation coefficient.

RESULTS

Among 344 subjects, 110 (31.97%) are at risk of MS, impact is more on men than women 33.65% (n=69); 29.49% (n=49) respectively. Based on the criteria enumerated above, predominance of central obesity is 52.03%; hypertension 36.04%; hypertriglyceridemia 37.50%; decreased HDL-C 73.83% and hyperglycemia 18.02%. [Table: 2]

Table 2 Showing gender difference in prevalence of MS risk factors %(n)

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)

Table-3 is showing comparision of demographic, anthropometric and biochemical indices between subjects without and with MS. Statistically significant difference was noted. Mean (SD)

Table 3: (n= 344) *P<0.0001 significant; HDL-C =high density lipoprotein cholesterol;

Variables		Number of MS risk factors	
		< 3 ,n=234, 68.02%	≥3, n=110, 31.97%
Age		32.87±11.09	41.26 ±11.67*
Waist circumference(cm)	Men	84.39±9.47	96.82±7.86*
	Women	77.57±9.95	91.58±11.81*
Triglycerides (mg/dl)		132.67±20.78	146.02±26.96*
HDL-C (mg/dl)		39.62±6.67	37.28±6.08*
Fasting blood glucose (mg/dl)		83.52±14.20	95.23±31.58*
Total Cholesterol (mg/dl)		154.58±21.93	166.77±28.07*
Very low density lipoprotein (VLDL)		26.59±4.07	29.27±5.30*
Low density lipoprotein (LDL)		88.39±23.75	100.01±28.37*
Body mass index (BMI)	Men	25.27±4.70	28.08±4.20*
	Women	24.47±4.82	27.63±5.44*

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.

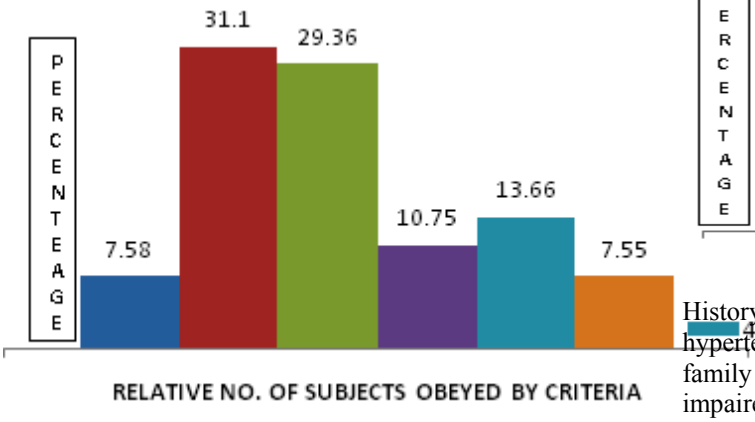


Table 4 Showing predominance (%) of MS in study age groups. Women at the age of 51-60 years are dominated men while men are in reset of the groups.

Table 4 Prevalence of metabolic syndrome by age and gender

Age Group	Total	Men % (n)	Women % (n)
20-30	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)

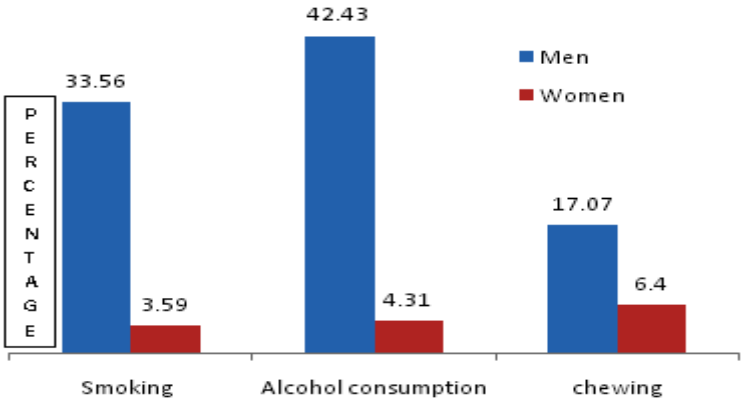
The analysis of BMI shows underweight is 6.10%; overweight/obesity-57.26% and only 34.88% subjects are with normal BMI. Total 60.97% men and 53.23% women are overweight / obese. MS present in 21.27% of subjects with normal BMI.

Table 5 showing Mean±SD of lipid ratios between MS positive and negative subjects. And correlation with number of risk factors of an individual.

Table 5: r = coefficient variation; R^2= coefficient determination * = significant

Ratio	MS positive	MS negative	R	R^2
Log(TG/HDL)	0.65±0.13	0.52±0.10*	0.2697	0.0727
TC/HDL	5.64±5.75	3.99±0.84*	0.2500	0.0625
LDL/HDL	3.62±4.73	2.31±0.80*	0.2398	0.0575
Non HDL/HDL	4.59±5.77	2.99±0.84*	0.2404	0.0578

Graph: 2 showing percentage of smoking, alcohol consumption, chewing in men and women. Relative risk ratio (RR) for the development of MS 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. MS 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 MS 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 total31.97 % (men-33.65%; women-31.97%) were at high risk for MS. Chow CK etal [10], MA Njelekela etal [11], L Fezeu etal [12] also noted high prevalence of MS in men compared to women. The reverse is reported by T Ahonen etal [13], Y He etal [14]. This may attribute to high prevalence of waist girth (obesity) in men than women among this population.

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

The risk of MS 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 4]** In Finnish study [18] the prevalence of MS 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 MS is 44.68% in women with ≥ 41 years of age while it was only 21.73% in men.

On evaluation of lipid ratios **[Table 5]** of the current study, we observed that AIP is statistically higher in MS positive subjects compared to negative subjects (p=<0.0001). Consequently it has shown significant positive correlation with number of MS 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 MS positive and negative subjects is >0.24. This may attribute to high abdominal obesity in this population, that causes deranged (high TG and low HDLc) lipid pattern. An inverse relationship between TG and HDLc 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 MS 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 MS positive subjects. Whereas the ratio of these parameters has shown a clear cut statistically significant variation between MS positive and negative subjects. Even though CRI-1 mean is slightly above the upper limit for the normal range i.e. >3.0 in MS 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 MS. [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 MS positive subjects compared to negative one and significantly correlated with number of MS risk factors. It gives an impression that atherogenic index will increase correspondingly with increasing MS 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 etal[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 MS; this may due to 75% of them are having habit of alcohol consumption and smoking. The risk for MS 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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