Research Article

Prevalence and risk factors for metabolic syndrome in urban elderly: a community study from Tirupati, Chittoor district, Andhra Pradesh, India

J. Lalu Naik, K. S. N Reddy, B. K. C Reddy, D. Anwar Basha*

Department of Anthropology, Sri Venkateswara University, Tirupati, Andhra Pradesh, India

*Correspondence:
Dr. D. Anwar Basha,
E-mail: anwarbasha.dudekula@gmail.com

ABSTRACT

Background: Metabolic syndrome (MetS) is a major risk factor for the development of type 2 diabetes (T2D) and cardiovascular diseases (CVDs) in the elderly. Present study aimed to discuss the prevalence and risk factors of MetS in the urban elderly population of Tirupati, Chittoor district of Andhra Pradesh.

Methods: A cross-sectional survey is conducted among elderly (aged 60 years and above). A total of 295 participants (males: 108; females: 187) are studied. MetS is defined using the modified adult treatment panel III (ATP III) criteria.

Results: Of the study participants, 34.58% had MetS. Abnormalities in blood pressure, blood sugar, and waist circumference (WC) are the three most common risk factors. The odds ratio for MetS is higher with female sex, older age, and high body mass index (BMI) and lower with a higher education level. There are strong correlations found between BMI and WC, triglyceride and high-density lipoprotein cholesterol (HDL-C), and WC and HDL-C.

Conclusions: The majority of the elderly population in Tirupati urban had at least two risk factors for MetS. Patient education and regular screening are needed for early detection and management of risk factors in order to prevent evolvement to MetS and related chronic diseases.

Keywords: Cardiovascular disease, Adult treatment panel III, Body mass index, Triglyceride

INTRODUCTION

Today on the eve of the 21st century, we see that the world health situation is no longer that clear cut and simple. Many developing countries have made great progress in warfare among infectious diseases and malnutrition, thereby improving the quality and length of life of their people. But rapid urbanization and industrialization in those same countries, together with the adoption of modern lifestyle that adversely affect health have brought new problems in the form of chronic non communicable diseases (NCDs). In many developing countries these new problems are arriving before the elderly are resolved leading to a double burden of the disease.[1,2] In this context, the Metabolic Syndrome (MetS) stands out as a cluster of risk factors for the development of illnesses such as diabetes and cardiovascular diseases.[3,4] It is characterized by central obesity, dyslipidemia (hypertriglyceridemia and low HDL), insulin resistance and increased blood pressure. For the elderly individual, the consequences of this syndrome appear to be even more distinct, mainly due to physiological changes associated with aging.[5,6]

Elderly refers to ages close to or over the average life span of human beings. This cannot be defined with precision because it varies in from community to community. However, a person aged 60 years or above is referred to as 'elderly' in India. The elderly population (≥60 years) account for 8.0 percent of total population in 2011; both the share and size of elderly population is increasing over

time from 5.6 percent in 1961 and it is projected to 12.4 percent by the year 2026.[7] The needs and problems of the elderly vary significantly based on their sociodemographic profile. In this assurance, present study is aimed to evaluate the prevalence of MetS and risk factors in an elderly Tirupati urban population of Chittoor district, Andhra Pradesh.

METHODS

The material selected for the present study is elderly individuals who received a health examination at SVRR Medical College Hospital and four other prominent diabetic clinics in Tirupati town of Andhra Pradesh state. A total of 450 elderly individuals attended in the defined Hospitals/ Clinics. Among them 105 persons are excluded from the study as they do appear exclusion criteria and further another 50 persons could not give consent and hence dropped from the study. Finally, 295 (males: 108; females: 187) sample in the age of 60 years and above (≥60 years) are screened for MetS are selected upon their written consent. The objectives of the study have been explained before taking the written consent. The exclusion criteria include subjects with suffering from any chronic disease or bedridden patients. The protocol, case report forms and consent forms are duly approved by SVU Ethics Committee on Human Subject Research, Sri Venkateswara University, Tirupati, Andhra Pradesh.

A structured and standardized questionnaire is used to collect the data on various sociodemographic variables (sex, education level and living conditions) are collected from each individual via face-to-face in-depth interviews. For the purpose of comparison, the subjects are divided into five age groups, like, 60-64 years, 65-69 years, 70-74 years, 75-79 years and ≥80 years. Body mass index (BMI) is calculated as weight in kilograms/height in metre squares (kg/m^2) and BMI is categorized using the classification recommended for Asians as normal weight is 18.0-24.9 kg/m^2, overweight is 25.0-29.9 kg/m^2 and obese is BMI ≥30.0 kg/m^2.[8] Abdominal adiposity (AO) is defined as WHR >0.85.[9] Three types of health-affecting behaviors are assessed during the interview. Questions regarding alcohol consumption (considered yes if daily use) and smoking tobacco (considered yes if daily use).

The physical assessment included height, weight and circumferences of waist and hip as per the procedure specified by Lohman et al.[10] Blood pressure (BP) is measured with a random zero mudler sphygmomanometer at the study site in a sitting position after the participant rested for at least 5 min. Three consecutive measurements are taken with an interval of three minutes in between. Hypertension (HTN) is diagnosed when the systolic blood pressure is ≥140 mmHg or the diastolic blood pressure is ≥90 mmHg, as per the guidelines prescribed by the Seventh Joint National Committee on detection, evaluation and treatment of high blood pressure.[11] The instruments are calibrated prior to take the measurements.

Fasting blood sample is collected for biochemical investigation after an overnight fast of at least 10 hours. Serum is separated by centrifugation at 2500 rpm for 20 minutes into pre-labeled sterile tubes and used for biochemical analysis for fasting blood glucose (FBG), triglycerides (TG), total cholesterol (TC), and HDL cholesterol (HDLC). MetS is defined according to the census definition of IDF/ NHLBI/ AHA/ WHF/ IAS/ IASO by Alberti et al.[12] Participants are defined as having MetS if they met, or exceeded, the criteria for three or more of the following five variables: – a) WC ≥90 cm in men and ≥85 cm in women; b) BP ≥140/90 mmHg; c) FBG level ≥120 mg%; d) TG ≥200 mg%; and e) HDLC ≥40 mg% .

SPSS 16.0 is used for statistical analysis. Continuous variables are reported in terms of mean±standard deviation (SD) and categorical variables are reported in terms of number and percentage. Differences in proportions and means are assessed using a Chi-square test and Student *t*-test. Pearson correlation analysis is used to measure the correlation between these factors. Statistical significance is set at $p < 0.05$ and $p < 0.01$. Multiple logistic regression analysis is used to examine the associations between various factors (including sex, age groups, BMI groups, education level, and individual MetS components) and MetS. The odds ratios (ORs) are adjusted for smoking status, alcohol consumption and living condition. The study protocol is examined and approved by the Institutional Ethics Committee, Sri Venkateswara University, Tirupati, Andhra Pradesh.

RESULTS

Table 1 shows the basic data of the 295 elderly individuals (males: 108; females: 187). On average, males are significantly older than females (70.4±5.3 vs. 68.8.8 ±5 respectively; p<0.001). The majority is aged between 65-69 age groups (male: 33.33%; female: 35.30%). Smoking habit limited to male (32.41%). For education level, the majority of males and females had primary education (49.83% vs. 34.26% respectively).

Among the components comprising the MetS diagnostic criteria, a higher significant proportion of female participants had HTN, AO and low HDL-C as compared to male participants. There is no sex difference among the prevalence of hyperglycemia (HG), and hypertriglyceridemia (HTG). Females had significantly more risk factors than males (2.23±1.3 vs. 1.79±1.2; p<0.001). In our study, among total population 34.58 percent had MetS. The prevalence of MetS among females is significantly higher than that among males (39.57% vs. 25.93%; p<0.001).

Table 2 registers the correlation coefficients between variables. There are strong positive correlations between BMI and AO, AO and low HDL-C, and HTG and low HDL-C. Among our study participants, we found that female sex (OR, 1.88; 95% CI: 1.45-2.44), age (especially

those aged between 70-74 age group (OR, 1.53, 95% CI, 1.01-2.30), and increased body weight (25.0-29.9 kg/m^2 and ≥30 kg/m^2; OR, 2.64, 95% CI: 1.98-3.54; OR, 5.96, 95% CI: 4.23-8.40) all increased the risk for MetS. High education level, especially with education of high school

and graduation decreased the MetS risk (OR, 0.49, 95% CI: 0.28-0.85; OR, 0.47, 95% CI: 0.27-0.83). Other variables showed no significant differences in multiple logistic regressions.

Table 1: Characteristics of the study population.

Variable	Total (n=295)	Male (n=108)	Female (n=187)	p-value
Age (mean±SD)	69.4±5.5	70.4±5.3	68.8±5.6	0.001**
Age group (years)				
60-64	70 (23.73)	19 (17.60)	51 (27.27)	
65-69	102 (34.57)	36 (33.33)	66 (35.30)	
70-74	73 (24.75)	31 (28.70)	42 (22.46)	0.001**
75-79	39 (13.22)	17 (15.74)	22 (11.76)	
≥80	11 (3.73)	5 (4.63)	6 (3.21)	
Smoking habit	35 (11.86)	35 (32.41)	-	-
Alcohol consumption	22 (7.46)	22 (20.37)	-	-
Education level				
Illiterate	17 (5.76)	2 (1.85)	15 (8.02)	
Primary	147 (49.83)	37 (34.26)	110 (58.82)	0.001**
High school	75 (25.43)	32 (29.63)	43 (23.00)	
Graduation	56 (18.98)	37 (34.26)	19 (10.16)	
BMI (kg/m^2)				
<18.5	9 (3.05)	2 (1.85)	7 (3.74)	
18.5-24.9	132 (44.75)	47 (43.52)	85 (45.45)	0.001**
25.0-29.9	99 (33.56)	41 (37.96)	58 (31.02)	
>30	55 (18.64)	18 (16.67)	37 (19.79)	
Risk factors				
AO	145 (49.15)	34 (31.46)	111 (59.36)	0.001**
HTN	169 (57.29)	57 (52.78)	112 (59.89)	0.013*
HG	156 (52.88)	60 (55.56)	96 (51.34)	0.402
Low HDL-C	74 (25.08)	23 (21.30)	51 (27.27)	0.005*
HTG	65 (22.03)	22 (20.37)	43 (23.00)	0.301
Risk factors (Mean±SD)	2.07±1.3	1.79±1.2	2.23±1.3	0.001**
MetS	102 (34.58)	28 (25.93)	74 (39.57)	0.001**

*p< 0.05; **p< 0.01.

Table 2: Pearson correlation coefficient of risk factors.

Variable	BMI	AO	HTN	HDL-C	HG	HTG	R.F.No.	Age
BMI	-							
AO	0.76**	-						
HTN	0.15**	0.13**	-					
HDL-C	-0.28**	-0.34**	-0.04	-				
HG	0.18**	0.21**	0.11**	-0.17**	-			
HTG	0.17**	0.21**	0.11**	-0.46**	0.20**	-		
R.F. No.	0.43**	0.48**	0.41**	-0.47**	0.41**	0.57**	-	
Age	-0.04	0.12**	0.14**	-0.08**	0.01	0.02	0.07*	-

*p< 0.05; **p< 0.01.

Odds ratios for risk factors for MetS showed in Table 3. The risk of MetS in those overweight and obese is high; 2.64 and 5.96, respectively (p<0.001). The risk factors in

order of significance to MetS are as follow: AO (OR= 9.85, 7.32-13.24), HTN (OR= 5.78, 4.32-7.73), HG (OR=

6.41, 4.83-8.52), low HDL-C (OR= 13.73, 13.40-26.12) and HTG (OR= 15.33, 95% CI: 10.85-21.68).

Table 3: The odds ratio for various factors for metabolic syndrome (MetS).

Variables	OR (95% CI)	p-value
Sex		
Male	Ref.	
Female	1.88 (1.45-2.44)	0.001**
Age group (years)		
60-64	Ref.	
65-69	1.07 (0.77-1.48)	0.708
70-74	1.40 (0.99-1.98)	0.055
75-79	1.53 (1.01-2.30)	0.043*
≥80	1.09 (0.55-2.18)	0.796
Education level		
Illiterate	Ref.	
Primary	0.75 (0.44-1.28)	0.295
High school	0.49 (0.28-0.85)	0.012*
Graduation	0.47 (0.27-0.83)	0.009**
BMI (kg/m^2)		
18.5-24.9	Ref.	
≤18.5	0.37 (0.11-1.22)	0.101
25.0-29.9	2.64 (1.08-3.54)	0.001**
≥30	5.96 (4.23-8.40)	0.001**
Risk factors (Ref: normal)		
AO	9.85 (7.32-13.24)	0.001**
HTN	5.78 (4.32-7.73)	0.001**
HG	6.41 (4.83-8.52)	0.001**
Low HDL-C	13.73 (13.40-26.12)	0.001**
HTG	15.33 (10.85-21.68)	0.001**

*p< 0.05; **p< 0.01.

DISCUSSION

This cross-sectional study, of statistical power, is conducted for the first time among an apparently urban population of Tirupati town, Chittoor district of Andhra Pradesh, a region with a heterogeneous in lifestyles and culture. The prevalence of MetS is found to be 34.58 percent among the urban elderly in the Tirupati town. The intact prevalent is less among elderly Goiania population (58.65%) presented in a study by Vieira et al., nearly equals to the study among urban northern Taiwan (34.3%) carried out by Tsou et al and in urban eastern Indian population (33.5%) enlightened by Prasad et al and more among Brazil population (22.7%) explained in a study with Moreira et al. [6,13-15] and in population of Mumbai city here Western India i.e. 19.52 percent assessed by Apurva Sawant at al.[16]

In the present study, a very high MetS prevalence rate of 39.57 percent is reported among female sex than compare to male sex (25.93%). However, in many of the studies worldwide and in Indian subcontinent, males had a higher prevalence of MetS.[17-20] More stringent cut offs employed in females for waist circumference and HDL partly explain

this variation. Also metabolic changes accompanying menopause might explain the increased prevalence of MetS in females. In spite of higher prevalence of MetS in females, it is widely recognized that male gender is significantly associated with cardiovascular risk.[21,22] Factors protecting females against cardiovascular risk are not clear, but to some extent may be explained by protective effect of endogenous estrogens against atherosclerosis in premenopausal females.[23]

Among the MetS components, higher prevalence rates are seen in HTN (59.893%), AO (59.366%), and HG (51.34%) for females, and HG (55.56%), HT (52.78%), and AO (31.46%) for males. The majority of elderly individuals had two MetS risk factors (total, 30.1%; male, 31.2%; female, 29.5%). The risk factors, AO, HT, and HG are present in all the most common one-factor, two-factor, and three-factor combinations. Addition of low HDL-C and HTG are seen in the most common four-factor combinations. Overall, a higher proportion of elderly had AO, HT, and HG, whether as single or combined risk factors increasing MetS. Therefore, elderly individuals with any one of these risk factors should be aware of the increased risk of developing MetS. These results are recognized by other studies.[24-27]

There are strong positive correlations between BMI and AO, TG and low HDL-C, and AO and low HDL-C. BMI and AO are the common clinical indicators of being overweight and obese. Therefore, for elderly individuals with high BMI, it is also necessary to check for possible AO. Body weight and WC should be routinely measured in the elderly. TG had been shown to have an inverse correlation with HDL-C, and both had similar influences on MetS. In other words, elderly individuals with high TG are at risk for low HDL-C. This study went further to conclude that BMI and AO are the best predictors of dyslipidemia. In our study, AO is inversely correlated with HDL-C and match up to different population studies.[28,29]

Among our urban elderly Tirupati town participants, we found that female sex, age (particularly those >74 years of age), and high BMI (those overweight and obese), increased the MetS risk; high education level (higher than high school) decreased the MetS risk and these outcomes allied to the studies of Hydrie et al., Mabry et al., and Prasad et al.[14,17,18] Other factors showed no significant differences in multiple logistic regression. It may be assumed that enhancing health consciousness in the public and establishing a regular screening system may enable early detection of those at risk for developing MetS. The prevalence of HT, HG, and HTG, increased in those >65 years of age. The prevalence of AO increased in all age groups, whereas the prevalence of low HDL-C decreased in all age groups. The relatively younger elderly population in the urban area is more likely to receive health-related information and execute health-associated behaviors. These results will need to be evaluated by further cohort studies.

CONCLUSION

In conclusion, a high prevalence of MetS in this urban populace of Tirupati town in Chittoor district of Andhra Pradesh strengthens the need for a comprehensive NCDs prevention and control program. This is the first study conducted in this area amidst socioeconomic transition mainly attributed to industrialization and urbanizations. Increasing awareness of cluster of risk factors and how to prevent them comprehensively should be emphasized in population-wide prevention strategies.

ACKNOWLEDGEMENTS

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