International Journal of Community Medicine and Public Health
Palanichamy T et al. Int J Community Med Public Health. 2020 Nov;7(11):4609-4614
http://www.ijcmph.com
pISSN 2394-6032 | eISSN 2394-6040

DOI: https://dx.doi.org/10.18203/2394-6040.ijcmph20204765

Original Research Article

Prevalence, combinations and associations of components of MetS among adults aged 40 years and above from rural Kerala: a cross-sectional study

Thiyagarajan Palanichamy*, Vasantha Elango

Department of Community Medicine, Karuna Medical College, Vilayodi, Kerala, India

Received: 01 October 2020
Accepted: 16 October 2020

***Correspondence:**
Dr. Thiyagarajan Palanichamy,
E-mail: drptrajan@gmail.com

ABSTRACT

Background: Metabolic syndrome (MetS) is a growing public health concern worldwide. A nation-wide diabetes screening campaign by the union health ministry found rural areas of selected district of Kerala had16% prevalence of lifestyle diseases. One of the objectives of WHO developed action plan for global implementation of strategies in prevention and control of non-communicable diseases (NCDs) advocates identifying MetS, a simple clinical tool, for predicting diabetes mellitus and cardiovascular diseases among population. The study aimed to estimate the prevalence of metabolic syndrome and its components among the adults aged 40 and above from rural Kerala and to determine the association with socio-demographic characteristics like co-variables of the study population.
Methods: A cross-sectional study conducted among adult subjects aged 40 and above from rural field practice areas visiting RHTC. Socio-demographic profile, personal habits and history on NCDs recorded. Blood pressure and abdominal circumference measured. Fasting plasma glucose (FPG), triglyceride (TG), and high-density lipoprotein (HDL) levels were estimated. Modified NCEP-ATP III (SAS), 2009 criteria was used to diagnose MetS. Study variables were analysed for associations and comparison of means with appropriate statistical methods.
Results: The prevalence of metabolic syndrome (MetS) was 29.3%. 57.9% elevated FPG, 37% Triglyceridemia, 24% sub-optimal HDL, 38.3% abdominal obesity, 38.3% elevated BP, 52% insulin resistance were recorded. Among MetS subjects 50% were in 50-59 years age group and MetS had statistically significant association with age (p value 0.005).
Conclusions: Moderate prevalence of metabolic syndrome among rural subjects needs strengthening health education and screening services on NCDs.

Keywords: Association, Component combinations, MetS, Rural population

INTRODUCTION

Metabolic syndrome (MetS) is a growing public health concern worldwide. It is a cluster of obesity, dyslipidaemia, high blood sugar and hypertension with mandatory insulin resistance.[1] The underlying etiological mechanisms is a complex interplay of ageing, genetic and inappropriate lifestyle.[2] Studies from East Asia have reported the higher prevalence of MetS among the Koreans and Indians.[3] National Family Health Survey-3 (NFHS-3) report revealed 14.8% of women and 12.1% of men were overweight or obese.[4,5] MetS and its components also form a conceptual base for understanding the pathophysiological link between metabolic risks, diabetes mellitus, and cardiovascular disease (CVD).[6-8] Studies have reported prevalence of 17 to 51.28% of MetS and its components among patients admitted with myocardial infarction.[9,10] The sudden

affluence in socioeconomic scenario in many villages of Kerala has brought change in disease profiles. Union health ministry's nation-wide screening campaign found 16% prevalence of lifestyle diseases in rural Kerala.[11] Also, studies from Kerala have reported a crude prevalence of diabetes in rural villages range from 14.6% to 22%.[5,12] WHO action plan for global strategy in prevention and control of non-communicable diseases (NCD) advocates identifying MetS, a clinical tool, for predicting diabetes mellitus and cardiovascular diseases among population.[13] Only few studies from rural settings of India found in literature.[14-19] Hence, our study was aimed to estimate the prevalence of metabolic syndrome and its components among the adults aged 40years and above from rural Kerala and to determine the association of metabolic syndrome with socio-demographic characteristics of the study participants.

METHODS

This cross-sectional study was carried out during 5 months period from July to November 2018 among the adults attending the Rural Health Training Centre from villages belonging to Vilayodi, the rural field practice area of Karuna medical college, Kerala. Ethical clearance was obtained from IEC before the start of the study. The study area is a part of Perumatty panchayat in Kerala and had around 38.5% of adults aged 40years and above (according to Perumatty panchayat demographic data from Census 2011). The literature reported prevalence range 15 to 22% of diabetes, among rural adults from Kerala.[5,12] Taking into account of 22% prevalence of diabetes, the most common component of MetS, the sample size was calculated using the formula $N = (Z(1-\alpha))^2 (pq) / L^2$. With the set 95% CI, 7% level of precision and 10% non-response rate the sample size arrived was 148, rounded off to 150. The adults aged 40years and above visiting the RHTC of Karuna medical college from July 2018 were enrolled as consecutive samples strictly following the inclusion and exclusion criteria.

Inclusion criteria

Adults aged 40 years and above visiting rural health training centre were included.

Exclusion criteria

Critically ill subjects, chronic liver and renal disease patients, mentally challenged persons, pregnant/lactating women and those who did not give consent were excluded.

Data collection

After obtaining informed written consent, the study subjects were interviewed with a questionnaire consist of basic socio-demographic profile, personal habits, treatment history on blood sugar and blood pressure. Blood pressure was measured by auscultation method in the dominant arm after the subjects were comfortably seated with their feet kept parallel on the ground for 5 minutes. Two readings were taken at an interval of two minutes. The average of the two readings was taken as final blood pressure level. Subjects were advised to stand erect. At the end of expiration abdominal circumference was measured using a standard non-elastic inch-tape transversely around the midpoint between the iliac crest and lower rib margin in the mid axillary line, keeping the inch tape parallel to the floor, without compressing the skin. All the study subjects were advised to come in the next day morning with 12 hours fasting.

Those participants coming in the next day fulfilling fasting criteria were drawn 3 ml of venous blood sample in sterile conditions. The collected of blood sample were preserved and sent to the central lab of the institute's hospital for processing in fully automated biochemical analyser. The study subjects who did not come in the next day of the enrolment or those who did not meet the fasting criteria were given further chances within next two weeks for testing. They were reminded by contacting them on the previous day of their testing day. Fasting plasma glucose level was detected by glucose oxidase-peroxidase method using reagent kits. Triglyceride levels were estimated by glycerol-kinase-peroxidase method. HDL estimation was by direct HDL cholesterol method. Modified National Cholesterol Education Program Adult Treatment Panel III criterion, including specifications to the people of south Asian origin (ATP III South Asian Specific (SAS), 2009) was used to detect MetS.[22] NCEP ATP III criterion for fasting plasma glucose was revised in 2005 to meet American Diabetes Association (ADA) recommendations.[2,23]

Statistical analysis

Collected data were analysed for frequency distributions, associations and difference in mean values using appropriate statistical methods using SPSS software.

RESULTS

Out of 150 subjects enrolled in the study sample 133 subjects completed the study. The non-response rate is 11%. There were 60 males and 73 females with mean age 54.53±11.8. Majority of subjects had admitted of having mixed diet (76.7%) and moderate exercise (46.6%) level. Few male subjects were smokers (13.5%) and alcoholics (16.5%) (Table 1). Elevated FPG levels were found in 79 subjects (57.9%) mean FBS of 114.9±35.1 mg/dL. Elevated TG and low HDL levels were found in 49(37%) and 32(24%) subjects respectively. The mean TG level was 147.5±59.7 mg/dL) and the mean HDL level was 53.8±11.2 mg/dL (Male:51.5±11.8; Female:55.6±10.4). Central abdominal obesity was found in 51 subjects (38.3%) with mean abdominal circumference of 85.1±7.9cms (M: 88.9±7.9; F: 82±6.5). Elevated blood pressure levels were found in 51 subjects (38.3%). The

mean Systolic BP was 117.41±15 mmHg (Male:122.9±15.4; Female:112.9±12.8). The mean diastolic BP was 76.6±8.9 mmHg (M:80±8.2; F:73.8±8.5) (Table 2).

Table 1: Socio-demographic characteristics of study participants (N=133).

Character	Sub-category	Males		Females		Total	
		Number	%	Number	%	Number	%
Age group (in years)	40-55	22	16.5	44	33.08	66	49.6
	≥56	38	28.5	29	21.8	67	50.4
Diet type	Vegetarian	14	10.5	17	12.8	31	23.3
	Mixed	46	34.6	56	42.1	102	76.7
Physical activity	Light	22	16.5	11	8.3	33	24.8
	Moderate	26	19.5	36	27.1	62	46.6
	Heavy	12	9	26	19.5	38	28.6
Smoking	No	42	31.6	73	54.9	115	86.5
	Yes	18	13.5	0	0	18	13.5
Alcoholism	No	38	28.6	73	54.9	111	83.5
	Yes	22	16.5	0	0	22	16.5

Table 2: Prevalence of components of MetS among the study participants.

Component	Males		Females		Total
	Number	%	Number	%	Number (%)
No risk component	11	8.3	22	16.5	33 (24.8)
Elevated FPG	37	23.3	42	31.5	79 (59.3)
Elevated TG	25	18.8	24	18.0	49 (36.8)
Low HDL	16	12.0	16	12.0	32 (24.0)
Central obesity	27	20.3	24	18.0	51 (38.3)
Elevated blood pressure	36	27.06	15	11.2	51 (38.3)

FPG-Fasting plasma glucose; TG-Triglycerides; HDL-High density lipoprotein

Table 3: Prevalence of metabolic syndrome and its association and relative risk with social variables (N=133).

Category	Sub-category	MetS (+)	MetS (-)	Chi-Square test		Odds	
				χ^2 value	P value	OR	95% CI
Age	≥56 years	27 (40.3)	40 (59.7)				
	40-55 years	12 (18.2)	54 (81.8)	7.847	0.005	3.07	1.4-6.7
	Total	39	94				
Sex	Males	21 (35.0)	39 (65.0)				
	Females	18 (24.7)	55 (75.3)	1.7	0.192	1.65	0.78-3.85
	Total	39	94				
Diet	Vegetarian	13 (41.9)	18 (58.1)				
	Mixed	26 (25.5)	76 (74.5)	3.1	0.078	0.5	0.2-1.0
	Total	39	94				
Physical activity	High	9 (23.7)	29 (76.3)				
	Low-Mod.	30 (31.5)	65 (68.4)	0.82	0.366	0.67	0.3-1.6
	Total	39	94				
Smoking	Yes	8 (8.6)	10 (24.3)				
	No	31 (26.9)	84 (73.0)	2.95	0.085	2.4	1.0-6.0
	Total	39	94				
Alcoholic	Yes	8 (38.1)	13 (61.9)				
	No	31 (27.7)	81 (72.3)	0.926	0.336	1.6	0.6-4.2
	Total	39	94				

*p value <0.05 is statistically significant

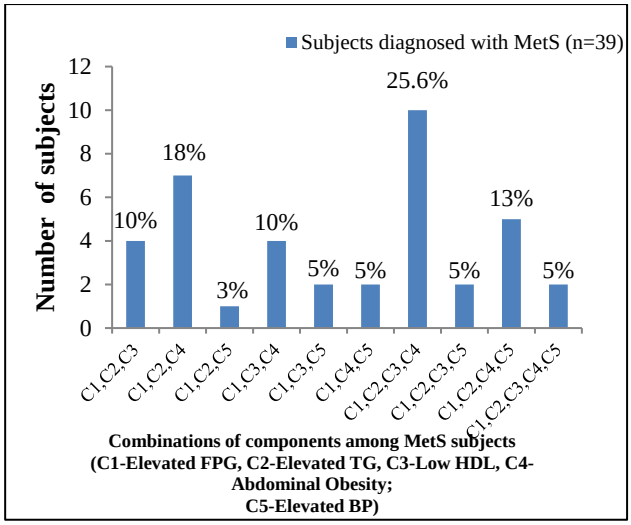

Figure1: Combinations of components of MetS among subjects diagnosed with MetS.

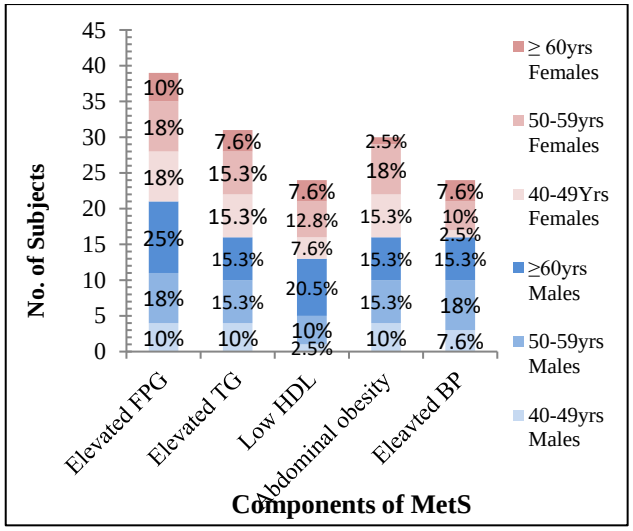

Figure 2: Distribution of MetS components among MetS subjects according to their age group and sex categories (n=39).

Table 4: ANOVA for significance in difference between mean values of components of MetS.

Descriptives					ANOVA					
Effects (years)		**N**	**Mean±SD**	**95% CI**		**SS**	**df**	**MS**	**F**	**P value**
FPG	40-49	62	107.0±29.0	100.4-114.9	b/w groups	7512	2	3756	3.147	0.046*
	50-59	27	119.0±35.9	106.4-136.2						
	≥ 60	44	123.4±40.3	113.4-136.7	w/t groups	155151	130	1193		
TG	40-49	62	139.3±63.9	123.1-155.6	b/w groups	7815.1	2	3907	1.098	0.337
	50-59	27	156.2±7.3	133.5-178.8						
	≥ 60	44	153.6±4.4	137.1-170.2	w/t groups	462542	130	3558		
HDL Male	40-49	21	52.8±10.3	48.1-57.5	b/w groups	58.0	2	29.0	0.202	0.817
	50-59	12	50.8±12.0	43.1-58.4						
	≥ 60	27	50.7±13.0	45.6-55.9	w/t groups	8184.9	57	143.5		
Female	40-49	41	58.1±10.5	54.8-61.5	b/w groups	659.6	2	329.8	3.239	0.045*
	50-59	15	53.6±11.5	47.2-60.0						
	≥ 60	17	51.8±7.0	47.5-54.7	w/t groups	7127.6	70	101.8		
AC Male	40-49	21	87.8±6.3	84.9-90.7	b/w groups	274.9	2	137.4	2.187	0.122
	50-59	12	93.4±7.2	88.9-97.9						
	≥ 60	27	88.2±9.2	84.6-91.9	w/t groups	3582.6	57	62.8		
Female	40-49	41	82.2±6.6	80.1-84.3	b/w groups	139.4	2	69.71	1.698	0.190
	50-59	15	83.9±6.6	80.2-87.6						
	≥ 60	17	79.8±5.6	76.9-82.6	w/t groups	2873.4	70	41.04		
Systole BP	40-49	62	112.0±1.8	109.4-114.7	b/w groups	3342.9	2	1671	8.444	0.000*
	50-59	27	121.4±4.3	115.2-126.8						
	≥ 60	44	122.5±6.5	117.2-127.3	w/t groups	25733	130	197.9		
Diastole BP	40-49	62	73.1±8.2	71.5-75.1	b/w groups	1464	2	732	10.56	0.000*
	50-59	27	79.8±7.7	76.8-83.2						
	≥ 60	44	79.6±8.7	76.8-82.0	w/t groups	9004	130	69.2		

*P value <0.05 is statistically significant

In this cross-sectional study 39 subjects (29.3%) had MetS. Among these 29 subjects 27 (69.2%) were in above 55 years age group. Among males 21 (35%) and females 18(24.7%) were having MetS. In this study MetS was diagnosed in 13 vegetarians (41.9%) and 26 (25.5%) mixed diet consuming subjects. Among different physical activity levels prevalence of MetS was high among those who had admitted of having moderate level of physical activity (33.9%) compared to other categories. Eight

subjects each among smokers (44.4%) and alcoholics (38.1%) had MetS in our study (Table 3).

Among females raised blood sugar was the most frequently occurring component and elevated blood pressure was the least frequently occurring component. Whereas, in males, elevated blood pressure was the most frequently occurring and low HDL was the least frequently occurring components. Other components were found to be occurring in almost equal frequency in both sexes (Figure 1).

Elevated FPG, elevated TG, low HDL and abdominal obesity have been the most commonly occurring combinations among MetS subjects (25.6%) (Figure 2). The statistical significance in the difference in mean values of FPG, TG, HDL level, abdominal circumference and blood pressure for different age groups are presented in Table 4.

DISCUSSION

In this cross-sectional study the magnitude of metabolic syndrome (MetS), using modified NCEP-ATP III criterion-specific to South Asian ethnicity, was found to be moderate(29.3%). MetS was found to be having statistically significant association with age (χ2 value-7.847, p value-0.00). The risk of getting into MetS diagnosis is 3times higher for subjects of more than 55years age (OR-3.03, CI-1.7-6.7) among this study participants. Prevalence of MetS was found to be more among males compared to females. Even though MetS was found to be not having statistically significant association for sex (χ2 value-1.70, P value-0.192) the risk of getting diagnosed as MetS subjects was slightly higher for males compared to the females (OR-1.6, CI-0.77-3.48).

In a large community-based study from Kerala by Harikrishnan et al similar prevalence of MetS(29% according to IDF criteria) had been reported.[20] On the other hand Srinivasan et al have found 60.9% of metabolic syndrome in their study among population attending rural tertiary care centre.[21] They have also found 3rd , 4th and 5th decades of age group had almost similar prevalence when compared to the 20% increased prevalence in females aged >60 years. Banerjee et al have reported that the prevalence of MetS was 44.6% (35.4%) in males and 55.6% in females) and the prevalence of MetS was increasing with age (31.9% in 18-28 years, 46.7% in 29-39 years and 48.0% in 40-49 years) among their study participants from urban field practice area.[15] Early in 1992, Enas et al found that the prevalence of metabolic syndrome increases from 10% at age 20 to 29 years to 53% by the age of 60 years by their study on metabolic syndrome and dyslipidemia among Asian Indians.[6]

In our study 57.9% of subjects had elevated FPG levels, 37% had elevated TG level, 24% had low HDL level, 38.3% had abdominal obesity and 38.3% had elevated blood pressure levels. Harikrishnan et al had found 36.1% elevated FPG, 24.3% elevated TG, 58.6% of obesity and 42.2% of elevated BP and 36.7% of reduced HDL-C in their study participants.[20] The differences in prevalence of MetS components between our study and their study may be due to different study setting and large sample size in their study.

In our study elevated FPG, elevated TG, low HDL and abdominal obesity all four formed the most common combination (25.6%) among the MetS subjects. Pradeep et al have reported that diabetes mellitus, hypertension, central obesity and dyslipidemia are found to be the most common components among MI patients with MetS and the positive predictive value was highest for waist circumference followed by fasting blood sugar, blood pressure, low HDL cholesterol in descending order.[9]

In our study little higher prevalence of MetS was found among vegetarians (41.9%), subjects stating moderate physical exercise level (33.9%), smokers (44.4%) and alcoholics (38%) compared to their counter parts. But, there was no statistically significant association found on these findings among different diet groups (χ2 value-3.108, P value-0.078), physical exertion level (χ2 value-0.816, P value-0.366), smoking (χ2 value-2.958, P value-0.085) and alcoholism habits (χ2 value-0.927, P value-0.336) and MetS status.

In our study the relative risk for different diet groups(OR-0.5, CI-0.2-1.0) and physical activity categories (OR-0.67, CI-0.3-1.6) in acquiring MetS were not found to be correlative compared to the smoking(OR-2.4, CI-1.0-6.0) and alcoholism (OR-1.6, CI-0.6-4.2) habits. The study reports by Selvraj et al and Mohan et al have stated that correlations of physical inactivity with increased risk of metabolic syndrome where physically inactive women are at 1.4 times higher risk compared to physically active women.[19,23] These findings can be largely explained by comparing the abysmally low level of awareness regarding exercise and weight control with comparison to the fast adapting urban lifestyle among rural population in Kerala because of they are being in conservative communities.

CONCLUSION

The prevalence of metabolic syndrome and its components were found to be at moderate levels in this rural community. Elevated FPG, elevated TG, low HDL and abdominal obesity have been the most commonly occurring combinations among MetS subjects. MetS was found to have statistically significant association with age.

Limitations

This cross sectional study done in a health care setting. Studies needed to be done from households with larger

sample size and with more objective quantifications of certain co-variables like physical activity levels for better generalizability of our findings.

Recommendation

We recommend standardising and strengthening the screening for metabolic syndrome through improved NCD clinics in rural primary health care and health education on diet pattern, physical exercise levels and personal habits to improve the awareness about metabolic syndrome among rural communities.

Funding: No funding sources
Conflict of interest: None declared
Ethical approval: The study was approved by the Institutional Ethics Committee

REFERENCES

1. Sande MA, Walraven GE, Milligan PJ, Banya WA, Ceesay SM, Nyan OA, et al. Family history: an opportunity for early interventions and improved control of hypertension, obesity and diabetes. Bulletin. WHO. 2001;79(4):321-8.
2. International Diabetes Federation. The IDF Consensus Worldwide Definition of the Metabolic Syndrome. International Diabetes Federation; 2006. Available at http://www.idf.org/webdata/docs/IDF_ Meta_def_ final.pdf. Accessed on 12 July 2020.
3. Pandit K, Goswami S, Ghosh S, Mukhopadhyay P, Chowdhury S. Metabolic syndrome in South Asians. Indian J Endocr Metab. 2012;16(1):44-55.
4. Report of National Family Health Survey-3 (NFHS-3). 2007. Available at rchiips.org/ NFHS/ nfhs3. shtml. Accessed on 12 July 2020.
5. Kumar VG. High prevalence of type2 diabetes mellitus and other metabolic disorders in a rural village in central Kerala. J Assoc Physicians India. 2009;57:563-7.
6. Enas EA, Yusuf S, Mehta JL. Prevalence of coronary artery disease in Asian Indians. Am J Cardiol. 1992;70(9):945-9.
7. Reaven GM. Insulin resistance, compensatory hyperinsulinaemia and coronary heart disease: syndrome X revisied. In: Jafferson LS, Cherrington AD, eds. Handbook of Physiology. New York, NY. Oxford University Press. 2001:1169-1197
8. Gaziano JM, Hennekens CH, O' Donnell. Fasting triglycerides, high-density lipoprotein, and risk of myocardial infarction. J Am Heart Association. 2001;96:2520-5.
9. Pradeep A, Thomas L. A study on clinical profile of metabolic syndrome and its impact on myocardial infarction at a tertiary care Hospital in Kerala. Int J Pharm Sci Res. 2018;9(9):3919-25.
10. Jose R, Manojan KK, Augustine P, Nujum ZT, Althaf A, Haran JC, et al. Prevalence of Type 2 Diabetes and Prediabetes in Neyyattinkara Taluk of South Kerala. Academic Med J India. 2013;1(1):43-9.
11. NHM-NPCDCS-National NCD cell Report. Nation-wide campaign for screening diabetes in rural areas by the Union health ministry. 2013. NHM-NPCDCS-National NCD cell Union health Ministry, Government of India. Available at: nhm. gov.in /index1.php?lan =1&level=2&sublinkid=1048&lid. Accessed on 12 July 2020.
12. Jacob AM, Anjana MS, Kaippallil JD. Some aspects of human population with special reference to certain diseases in Kaviyoor panchayat, Thiruvalla taluk, Pathanamthitta district, Kerala. J Academia. 2013;65:78-85.
13. 2008-2013 Action plan for the Prevention and Control of Non-communicable Diseases in the WHO regions. WHO Report 2009. Available at www.who.int./nmh/publicaions/ 9789241597418/en/ Accessed on 12 July 2020.
14. Mohan V, Pradeepa S, Surendar J, Indulekha K, Chella S, Anjana RM. Prevalence of metabolic syndrome and its association with coronary artery disease among an urban elderly south Indian population (CURES 145). J Assoc Physicians India. 2016;64:20-5.
15. Banerjee R, Dasgupta A, Naskar NN, Kundu PK, Pan T, Burman J. A study on the prevalence of metabolic syndrome and its components among adults aged 18-49 years in an urban area of West Bengal. Indian J Community Med. 2019;7:93-9.
16. Roshni M. Metabolic syndrome and the frequency of occurrence of its components in urban South Indian population. British J Med Res. 2014;4(29):4855-67.
17. Rajendran S, Manju M, Premkumar A, Mishra S. Prevalence of metabolic syndrome and its components among young adults at a tertiary care hospital in Puducherry. Med Pulse Int J Biochem. 2018;8(1):1-6.
18. Thankappan KR, Bela S, Prashant M. Risk factor profile for chronic non-communicable diseases: results of a community-based study in Kerala, India. Indian J Med Res. 2010;131:53-63
19. Selvaraj I, Gopalakrishnan S, Lograj M. Prevalence of metabolic syndrome among rural women in a primary health centre area in Tamil Nadu. Indian J Public Health. 2012;56(4):314-7.
20. Harikrishnan S, Sarma S, Sanjay G, Jeemon P, Krishnan MN, Venugopal K, et al. Prevalence of metabolic syndrome and its risk factors in Kerala, South India: Analysis of a community based cross-sectional study. PLoS One. 2018;13:e0192372.
21. Srinivasan S. Metabolic syndrome in rural Kerala: a hospital based study. Int J Adv Med. 2016;3(4):898-904.
22. NCEP 5th report. 2002. Circulation 106. National Cholesterol Education Program (NCEP) expert panel on detection, evaluation, and treatment of high blood cholesterol in adults (Adult Treatment Panel III).Final report (2009).
23. Tan CE, Ma S, Wai D, Chew SK, Tai ES. Can we apply the National Cholesterol Education Program Adult Treatment Panel definition of the metabolic syndrome to Asians? Diab Care. 2004;27:1182-6.

Cite this article as: Palanichamy T, Elango V. Prevalence, combinations and associations of components of MetS among adults aged 40 years and above from rural Kerala: a cross-sectional study. Int J Community Med Public Health 2020;7:4609-14.