Metabolic syndrome and its components among population of Holalu village, Karnataka

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Abstract

Back ground: Increased prevalence of metabolic syndrome is seen in the rural population as well owing to urbanization and life style changes in them.

Objective: To determine the metabolic syndrome and its components in the study population.

Materials and Methods: Retrospective analysis of the data collected during Community Outreach Program conducted at Holalu village was done. Data consisting of anthropometric measurements, blood pressure, and laboratory parameters such as fasting blood sugar and lipid profile of 460 subjects were obtained. Metabolic syndrome was diagnosed based on ATP III criteria. Data were analyzed by χ^2-test using SPSS software, version 15.

Result: Study population consisted of 229 female and 219 male subjects with mean age of 54.14 ± 12.19 and 54.61 ± 13.23 years, respectively. Among 116 (25.89%) subjects diagnosed as metabolic syndrome, 82 were female and 34 male subjects. It was observed that various components of metabolic syndrome such as fasting blood sugar increased significantly with the increase in age in both male and female subjects, whereas high blood pressure and abdominal obesity showed significant increase only in female subjects.

Conclusion: Metabolic syndrome is more prevalent in females than in male subjects of Holalu village. Study also showed increases in number of components and in individual components of metabolic syndrome with increase in age. Early detection of the individual components of metabolic syndrome would help in early treatment and prevention of progression to metabolic syndrome.

KEY WORDS: Cardiovascular disease, metabolic syndrome, noncommunicable diseases, rural population, syndrome X

Introduction

Prevalence of noncommunicable diseases (NCDs) are increasing in recent days owing to the faulty lifestyle habits such as improper diet, inadequate physical activity, and psychological stress. Metabolic syndrome (MetS) is one of the important NCDs, which has an increasing trend in our country.[1]

MetS is a group of disorders characterized by obesity, hypertension, glucose intolerance, and dyslipidemia. MetS is also associated with increased risks of cardiovascular disease such as diabetes mellitus and cardiovascular mortality.[2]

Criteria for diagnosing MetS is given by National Cholesterol Education Program (NCEP) Adult Treatment Panel (ATP) III guidelines that involves waist circumference (WC), blood pressure (BP), high-density lipoprotein-cholesterol (HDL-C), triglyceride (TG), and fasting blood sugar (FBS) as its components.[3]

Prevalence of MetS and other cardiovascular diseases are showing an increasing trend in developed countries.[4]

Increase in the prevalence of MetS is not only seen in urban population but also in the rural population of developing countries owing to urbanization leading to unhealthy diet pattern with increased intake of fat, salt, and sugar.[5]

Sedentary lifestyle modifications owing to increasing mechanization even in rural areas have led to increased obesity. The changes in occupation and advent of newer technologies also has led to unhealthy lifestyle and increase in the

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prevalence of cardiovascular diseases.[6,7] Previous studies have shown that there is an increased prevalence of MetS in Asians and more so among the elderly people.[8,9]

This study was undertaken with the objective of assessing the distribution of MetS and its components in rural population of a village in Mandya district, Karnataka, India.

Materials and Methods

The data were obtained from the Community Outreach Program (COP) conducted by the Department of Biochemistry, Mandya Institute of Medical Sciences, Mandya, at Holalu village. Population of Holalu village according to voter list who were aged more than 30 years were 1,799 individuals—910 were female and 889 male subjects, of which 460 subjects voluntarily participated in the COP. Among 460 participants, 448 study subjects with complete data were considered for the analysis and were analyzed retrospectively.

Physical measurements such as height, weight, and WC were taken into consideration. Body mass index was calculated using the formula weight/(height)^2. Data of BP (mm Hg) measured twice using sphygmomanometer—sitting position in the right arm after 5 min of rest, and average of systolic and diastolic BPs were taken.

During the COP, overnight fasting 2–3 mL of venous blood was collected by venipuncture under strict aseptic precautions, in nonvacuum plain tube with clot activator. The sera separated from these samples were tested for glucose level and lipid profile.

Biochemical investigations were done in Central Diagnostic Laboratory, MIMS, Mandya. Samples were analyzed using fully automated random access auto analyzer ERBA XL-300 (Transasia). FBS was estimated by GOD-PAP methodology, total cholesterol by CHOD-POD methodology, serum TGs by GPO peroxidase methodology, HDL by direct determination (enzyme selective protection method), and low-density lipoprotein (LDL) by using Friedwald's formula in samples where the serum TG was less than 400 mg/dL.

MetS was diagnosed using NCEP ATP III criteria that suggest that diagnosis of MetS can be made in presence of any three of the following five components. Abdominal obesity can be measured by WC (males: >102 cm and females: >88 cm), serum TG > 150 mg/dL, HDL-C in males < 40 mg/dL and in females < 50 mg/dL, BP ≥ 130/85 mm Hg, and FBS ≥ 110 mg/dL.

Statistical analysis was done using SPSS software, version 15. Arithmetic mean and its standard deviation were calculated for the parameters. The χ^2-test was used to determine the level of significance in study population. Values of $p < 0.05$ were considered statistically significant.

Result

Among the 448 study participants, 219 were male and 229 female subjects. The demographic distribution of study population is shown in Table 1.

Table 1: Distribution of study population based on age and gender

Age (years)	Sex		Total, *n* (%)
	Male, *n* (%)	Female, *n* (%)	
≤40	38 (8.5)	37 (8.3)	75 (16.7)
41–50	59 (13.2)	74 (16.5)	133 (29.7)
51–60	53 (11.8)	53 (11.8)	106 (23.7)
>60	69 (15.4)	65 (14.5)	134 (29.9)
Total	219 (48.9)	229 (51.1)	448 (100)

n = number of participants.
$p = 0.66$.

Table 2: MetS in study population based on age and gender

Age (years), *n*	Sex		Total, *n* (%), *n* = 448
	Male, *n* (%), *n* = 219	Female, *n* (%), *n* = 229	
≤40 (75)	3 (7.9)	6 (16.2)	9 (12)
41–50 (133)	14 (23.7)	23 (31.1)	14 (23.7)
51–60 (106)	4 (7.5)	26 (49.1)	4 (7.5)
>60 (134)	13 (18.8)	27 (41.5)	13 (18.8)
Total (448)	34 (15.5)	82 (35.8)	34 (15.5)
p	0.049*	0.008*	0.027*

$p < 0.05$; *, statistically significant.

Mean age of the study population was 54.1 ± 12.2 years and 54.6 ± 13.2 years for female and male subjects, respectively. Study population was grouped in to four groups based on age as ≤40, 41–50, 51–60, and > 60 years.

Distribution of MetS Based on Age and Gender

The overall prevalence of MetS (NCEP ATP III) was 25.6% in the study population [Table 2]. Female subjects showed significantly higher prevalence (35.8%) when compared with male subjects (15.5%; $p < 0.05$). The prevalence of MetS was found to be increasing with age ($p = 0.027$). Furthermore, the increase was found to be more significant in female ($p = 0.008$) than in male subjects ($p = 0.049$). Distribution of number of MetS components based on age and gender is shown in Table 3. Female subjects were found to show a higher number of MetS components than male subjects with increase in age ($p = 0.009$).

Individual Components of MetS With Respect to Gender

The distribution of individual components of MetS among male and female subjects is reported in [Figure 1]. Abdominal obesity showed increased prevalence in female subjects ($p < 0.001$), whereas male subjects showed a higher prevalence of raised BP ($p = 0.005$).

Individual Components of MetS With Respect to Age

Furthermore, the analysis of the data pertaining to the distribution of individual components of MetS in various age

Table 3: Distribution of number of MetS components based on age and gender

Number of components	Males				Females			
	≤ 40 years, *n* = 38 (%)	41–50 years, *n* = 59 (%)	51–60 years, *n* = 53 (%)	> 60 years, *n* = 69 (%)	≤ 40 years, *n* = 37 (%)	41–50 years, *n* = 74 (%)	51–60 years, *n* = 53 (%)	> 60 years, *n* = 65 (%)
0	5 (13.2)	7 (11.9)	5 (9.4)	7 (10.1)	4 (10.8)	8 (10.8)	1 (1.9)	5 (7.6)
1	14 (36.8)	15 (25.4)	18 (33.9)	24 (34.8)	20 (54.1)	19 (25.7)	8 (15.1)	16 (24.6)
2	16 (42.1)	23 (38.9)	26 (49.1)	25 (36.2)	7 (18.9)	24 (32.4)	18 (33.9)	17 (26.1)
3	3 (7.9)	14 (23.7)	4 (7.5)	12 (17.4)	4 (10.8)	16 (21.6)	12 (22.6)	17 (26.1)
4 &5	0 (0)	0 (0)	0 (0)	1 (1.4)	2 (5.4)	7 (9.4)	14 (26.4)	10 (15.4)
p	0.48				0.003*			

n = number of participants.
p < 0.05; *, statistically significant.

Table 4: MetS components among males of various age groups

Number of components	Males				*p*
	≤ 40 years, *n* = 38 (%)	41–50 years, *n* = 59	51–60 years, *n* = 53	> 60 years, *n* = 69	
Abdominal obesity	1 (2.6)	0 (0)	1 (1.9)	0 (0)	0.396
Hypertriglyceridemia	30 (78.9)	43 (72.9)	29 (54.7)	38 (55.1)	0.18
Low HDL-C	1 (2.6)	1 (1.7)	0 (0)	1 (1.4)	0.745
High BP	19 (50)	38 (64.4)	39 (73.6)	50 (72.5)	0.07
Hyperglycemia	4 (10.5)	21 (35.6)	13 (24.5)	25 (36.2)	0.02*

n = number of participants.
p < 0.05; *, statistically significant.

Table 5: MetS components among females of various age group

Number of components	Females				*p*
	≤ 40 years, *n* = 37 (%)	41–50 years, *n* = 74 (%)	51–60 years, *n* = 53 (%)	> 60 years, *n* = 65 (%)	
Abdominal obesity	10 (27.0)	39 (52.7)	37 (69.8)	38 (58.5)	0.019*
Hypertriglyceridemia	27 (72.9)	44 (59.5)	42 (79.2)	40 (61.5)	0.74
Low HDL-C	2 (5.4)	1 (1.4)	3 (5.7)	2 (3.1)	0.536
High BP	11 (29.7)	38 (51.4)	33 (62.3)	41 (63.1)	0.006*
Hyperglycemia	4 (10.8)	21 (28.4)	21 (39.6)	21 (32.3)	0.02*

n = number (percentage).
p < 0.05; *, statistically significant.

groups showed statistically significant increase in abdominal obesity ($p = 0.019$), hypertriglyceridemia ($p = 0.075$), high BP ($p < 0.001$), and raised FBS ($p = 0.002$) with increase in age [Figure 2].

Individual Components of MetS Based on Both Age and Gender

Individual components of MetS among male and female subjects in age groups are shown in Tables 4 and 5, respectively. It was observed hyperglycemia significantly increases with increasing age in both male and female subjects, whereas high BP and abdominal obesity significantly increased only in female subjects.

Discussion

MetS, also known as MetS X, is a constellation of abdominal obesity, elevated BP, elevated fasting plasma glucose, high serum TGs, and low high-density cholesterol levels. The diagnosis of MetS defined by the NCEP ATP III guidelines was used for the management.[3]

Obesity is the primary event in the occurrence of metabolic syndrome, especially increase in abdominal fat indicated by WC. Obesity is considered as a factor that leads to insulin resistance, diabetes mellitus, high BP, and dyslipidemia. Insulin resistance is said to be the key component for increased risk factors of MetS.[10]

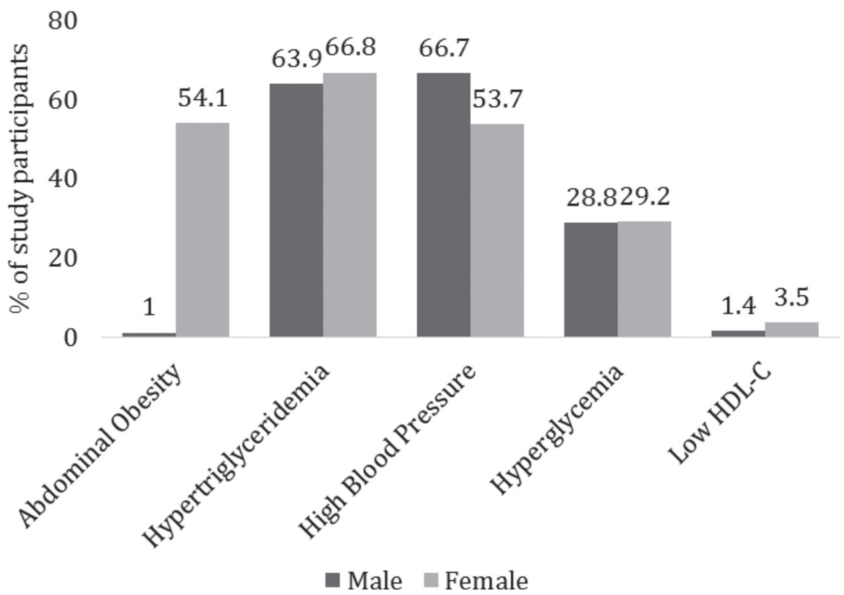

Figure 1: Gender-specific prevalence of individual MetS components.

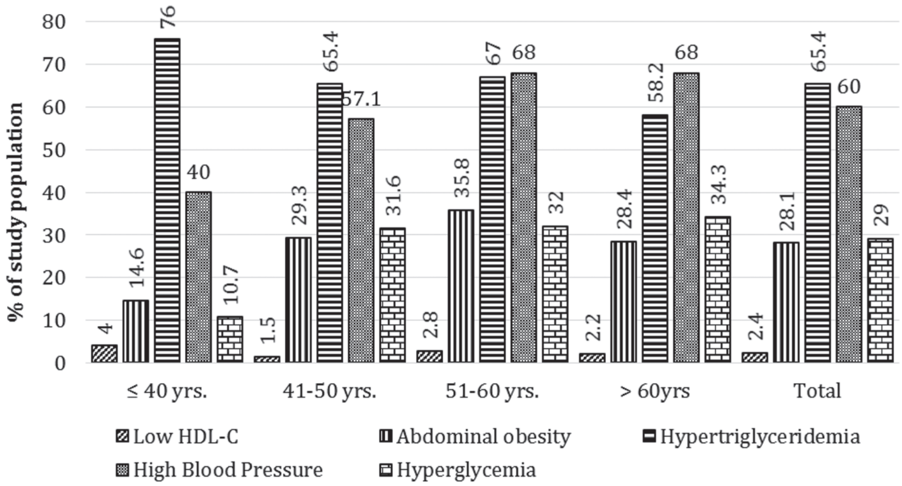

Figure 2: MetS components among different age groups.

Mortality and morbidity caused owing to NCDs such as cardiovascular diseases, diabetes, cancers, and chronic respiratory diseases are showing an increasing trend. According to the WHO reports, 63% of the global death in 2008 was owing to NCDs making it the leading cause of death in the world.[11] NCDs are estimated to account for 60% of total deaths in India, and probability of premature mortality owing to NCDs between the age group of 30 and 70 accounts for 26% of total deaths according to the WHO.[12]

Prevalence of MetS is about 23.7% in adult US population.[13] About 33.5% prevalence was reported in a study conducted on urban population.[14] In an urban–rural comparison study conducted by Weng et al.,[15] male subjects showed a higher prevalence of MetS in urban population when compared with rural population, whereas prevalence of MetS was similar among both urban and rural women. Previous studies also have shown that the prevalence of the MetS is age dependent and significantly increases with increasing age.[16]

This study done in rural population shows that around 15% of men and 35% of women were diagnosed with MetS and its prevalence significantly increased with increase in age. This association with increased age may be owing to relative physical inactivity and falling basal metabolic rate with age.

Study conducted by Thiruvagounder et al.[17] showed a high prevalence of MetS among male subjects when compared with female subjects in local Indian population. However, the study conducted by He et al.[18] on the elderly subjects showed a higher prevalence of MetS in female than male subjects. A clinical study conducted by Dasgupta et al.[19] showed that postmenopausal status increases the risk of metabolic syndrome, and it also showed components such as low HDL-C level and abdominal obesity are more frequently associated when compared with other components of MetS.

This study showed that the prevalence of MetS was higher in females when compared with male subjects; this was most prominently owing to increased prevalence of abdominal obesity in female subjects and could also be because the majority of female participants were in premenopause or menopausal age group.

According to study conducted by Barbara et al.,[20] increase in number of components of MetS increases the risk of incident cardiovascular disease 5 years later. This study showed that the number of components increased with increase in age.

Prevalence of various components of MetS also exhibits their role in prevalence of MetS. According to a study by Ishizaka et al.[21], hypertension was the most commonest component involved. Study conducted by Prasad et al.[22] showed that high BP and abdominal obesity were the commonest components found in South Asian population. This study showed abdominal obesity was the most commonly occurring component of MetS in females, whereas high BP was the commonest component in male subjects.

Major limitation of our study is size of the study population. Educational and socioeconomic status was not taken in to account.

Additional long-term prospective studies would be required after the interventions in a larger community involving all the age group to analyze the effect of the health education and appropriate primary and secondary interventional measures to prevent MetS and its individual components in the population.

Conclusion

Government of India has taken various steps to reduce the mortality and morbidity caused owing to NCD. Government of India has initiated National Program for Prevention and Control of Cancers, Diabetes, Cardiovascular Diseases and Stroke (NPCDCS) focusing on health education, prevention, early diagnosis, and management of NCD. Studies similar to this would help in the early diagnosis of various risk factors for NCDs. It would be possible to prevent various cardiovascular diseases such as diabetes and hypertension in the population by early diagnosis of the components of MetS. Even the presence of individual component of MetS would lead to higher risk of future cardiovascular events. The rural areas should also be screened for components owing to shift in trend of MetS in rural areas owing to urbanization. Early diagnosis should be followed by controlling impaired glucose levels, dyslipidemia, and hypertension by counseling and appropriate medications. Interventions should also be aimed to reduce cardiovascular risk factors by increasing physical activity, adopting a healthy nutritional food pattern, and health education. It will be better to educate the people at a community level in rural population by physicians, government, school, and social organizations and help them improvise their lifestyle and dietary habits. Early diagnosis and treatment would decrease the mortality and morbidity and can also help in betterment of public health.

References

1. Bhalavi V, Deshmukh PR, Goswami K, Garg N. Prevalence and correlates of metabolic syndrome in the adolescents of rural wardha. Indian J Community Med 2015;40(1):43–8.
2. Mottillo S, Filion KB, Genest J, Joseph L, Pilote L, Poirier P, et.al. JACC Vol. 56, No. 14, 2010.
3. Expert Panel on Detection, Evaluation of and Treatment of High Blood Cholesterol in Adults. Executive summary of the Third Report of the National Cholesterol Education Program (NCEP). Expert Panel on Detection, Evaluation and Treatment of High Blood Cholesterol in Adults (Adult Treatment Panel III) JAMA 2001;285(19):2486–97.
4. Aguilar M, Bhuket T, Torres S, Liu B, Wong RJ. Prevalence of the metabolic syndrome in the United States, 2003–2012. JAMA 2015;313(19):1973–4.
5. Nestel P, Lyu R, Low LP, Sheu WH, Nitiyanant W, Saito I, et al. Metabolic syndrome: recent prevalence in Èast and Southeast Asian populations. Asia Pac J Clin Nutr 2007;16(2):362–7.
6. Misra A, Khurana L. Obesity and the metabolic syndrome in developing countries. J Clin Endocrinol Metab 2008;93(11 Suppl 1): S9–30.
7. Gharipour M, Sarrafzadegan N, Sadeghi M, Khosravi A, Hoseini M, Boroujeni HK, et al. The metabolic syndrome and associated lifestyle factors among the Iranian population. Adv Biomed Res 2015;4:84.
8. Enas EA, Mohan V, Deepa M, Farooq S, Pazhoor S, Chennikkara H. The metabolic syndrome and dyslipidemia among Asian Indians: a population with high rates of diabetes and premature coronary artery disease. J Cardiometab Syndr 2007;2(4):267–75.
9. Vishram JKK, Borglykke A, Andreasen AH, Jeppesen J, Ibsen H, Jørgensen T, et al. (2014) Impact of age and gender on the prevalence and prognostic importance of the metabolic syndrome and its components in Europeans. The MORGAM prospective cohort project. PLoS ONE 2014;9(9).
10. Salazar MR, Carbajal HA, Espeche WG, Dulbecco CA, Aizpurua M, Marillet AG, et al. Relationships among insulin resistance, obesity, diagnosis of the metabolic syndrome and cardio-metabolic risk. Diab Vasc Dis Res 2011;8(2):109–16.
11. World Health Organization. *Global Status Report on Noncommunicable Diseases 2010*. Available at: http://www.who.int/nmh/publications/ncd_report_full_en.pdf (last accessed on August 21, 2015).

12. World Health Organization. *Noncommunicable Diseases Country Profiles 2014*. Available at http://www.who.int/global-coordination-mechanism/publications/ncds-country-profiles-eng.pdf?ua=1 (last accessed on August 21, 2015).
13. Ford ES, Giles WH, Dietz WH. Prevalence of the metabolic syndrome among US adults: findings from the third National Health and Nutrition Examination Survey. JAMA 2002;287(3):356–9.
14. Prasad DS, Kabir Z, Dash AK, Das BC. Prevalence and risk factors for metabolic syndrome in Asian Indians: a community study from urban Eastern India. J Cardiovasc Dis Res 2012; 3(3):204–11.
15. Weng X, Liu Y, Ma J, Wang W, Yang G, Caballero B. An urban-rural comparison of the prevalence of the metabolic syndrome in Eastern China. Public Health Nutr 2007;10(2):131–6.
16. Hildrum B, Mykletun A, Hole T, Midthjell K, Dahl AA: Age-specific prevalence of the metabolic syndrome defined by the International Diabetes Federation and the National Cholesterol Education Program: the Norwegian HUNT 2 study. BMC Public Health 2007;7:220.
17. Thiruvagounder M, Khan S, Sheriff DS. The prevalence of metabolic syndrome in a local population in India. Biochemia Medica 2010;20(2):249–52.
18. He Y, Jiang B, Wang J, Feng K, Chang Q, Fan Li. Prevalence of the metabolic syndrome and its relation to cardiovascular disease in an elderly Chinese population. J Am Coll Cardiol 2006;47(8):1588–94.
19. Dasgupta S, Salman M, Lokesh S, Xaviour D, Saheb SY, Prasad BV, et al. Menopause versus aging: the predictor of obesity and metabolic aberrations among menopausal women of Karnataka, South India. J Midlife Health 2012;3(1):24–30.
20. Klein BE, Klein R, Lee KE. Components of the metabolic syndrome and risk of cardiovascular disease and Diabetes in Beaver Dam. Diabetes Care 2002;25(10):1790–4.
21. Ishizaka N, Ishizaka Y, Toda E, Hashimoto H, Nagai R, Yamakado M. Hypertension is the most common component of metabolic syndrome and the greatest contributor to carotid arteriosclerosis in apparently healthy Japanese individuals. Hypertens Res 2005;28(1):27–34.
22. Prasad DS, Kabir Z, Dash AK, Das BC. Prevalence and risk factors for metabolic syndrome in Asian Indians: a community study from urban Eastern India. J Cardiovasc Dis Res 2012; 3(3):204–11.

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