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Original Research Article

Prevalence and clinical profile of metabolic syndrome amongst essential hypertensive patients at Navi Mumbai, India

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ABSTRACT

Background: The prevalence of metabolic syndrome (MetS), a pathophysiological and asymptomatic state of numerous complications has been documented in various recent studies worldwide. Inadequate data are available highlighting the magnitude of MetS in country like India whose major health problem has been infectious disease rather than non-communicable disease like hypertension. The aim of the present study was to determine the prevalence of MetS in essential hypertensive patients using the criteria of the National Cholesterol Education Program's adult treatment panel III.
Methods: A cross-sectional study was conducted on 80 hypertensive patients above the age of 40 years at OPD of School of Medicine, D. Y. Patil Deemed to be University, Navi Mumbai. Various anthropometric, biochemical, echocardiographic and ophthalmoscopic data were recorded from the patients using standardized laboratory protocols.
Results: Our studies revealed a prevalence rate of 17.5% of MetS in patients with essential hypertension. Triglyceride level abnormality was found to be more prevalent in our cohort whereas 17% of the total population displayed central obesity. Elevated blood sugar levels were exhibited by 85% of the population revealing the susceptibility towards diabetic condition. Echocardiographic data revealed complications such as concentric left ventricular hypertrophy, global hypokinesia and low heart's ejection fraction ability in some subjects. Our ophthalmoscopic data is suggestive of hypertension related eye complications in half of our study population.
Conclusions: Collectively our results demonstrate an increased prevalence of MetS, therefore early detection and management of MetS in individuals with high risk can aid in preventing many complications in patients.

Keywords: BMI, Hypertension, HDL, Metabolic syndrome, Obesity, Triglycerides

INTRODUCTION

Metabolic syndrome (MetS) is a pathophysiological and asymptomatic state characterized by obesity, insulin resistance, hypertension, dysglycaemia and dyslipidaemia which are known to increase the risk of coronary heart disease (CHD) and type 2 diabetes mellitus.[1,2] Though many decisive factors are employed to identify MetS, it is usually agreed to be having a combination of health issues like large waist circumference, hyperglyceridaemia, reduced HDL, raised blood pressure and increased fasting blood glucose levels.[3,4]

Hypertension is a very common condition that remains undiagnosed until late in its course, leading to life threatening conditions like kidney failure and heart failure. It is one of the most important risk factors in developing cardiac disorders with high morbidity and

mortality.[5] The cause of hypertension is not completely known, but the factors attributed in its pathophysiology are insulin resistance and central obesity.[6,7] Metabolic abnormalities are the result of interaction between the effect of insulin resistance and adverse impact compensatory hyperinsulinemia.[8,9] This hyperinsulinemia from insulin resistance increases blood pressure by activating sympathetic nervous system and renin-angiotensin-aldosterone system, resulting in sodium retention. Increased sodium reabsorption leads to renal vasodilation and volume expansion which in turn results in hypertension.[10,11] MetS is found in about 30-40% of hypertensive patients as revealed from different epidemiological studies and serves to be a strong predictor of development of diabetes mellitus and cardiovascular diseases thereby causing subsequent mortality in near future.[12] The prevalence of MetS worldwide has been well documented in various recent studies. However, to the best of our knowledge, prevalence of MetS in hypertensive patients has not been reported from India so far.

Hence, the objective of present research investigation was to determine the prevalence and clinical profile of metabolic syndrome in essential hypertensive patients.

METHODS

A prospective and cross-sectional study was conducted in 80 subjects having essential hypertension over the period of one year (November 2018-November 2019) according to the Joint National Committee 7 Hypertension guidelines (Table 1) attending the medicine outdoor patient department at D. Y. Patil Hospital, D. Y. Patil Deemed to be University, Navi Mumbai. The study was approved by Institutional ethical committee (IEC) and a well informed consent was taken from all the participants. The subjects involved in the study were examined for various anthropometric parameters and biochemical investigations were carried out in fasting state.

The study included patients having essential hypertension i.e. BP >140/90 or on antihypertensive treatment with age above 40 years. Depending upon the inclusion criteria, both males and females were randomly incorporated in the study. A well informed consent was undertaken from all the subjects.

Subjects with age below 40 years (male/female), secondary hypertensive patient and patients on medications like steroid treatment for any cause were excluded from the study.

The patient's preliminary details, duration of hypertension, lifestyle, serum lipid profile, blood sugar levels and other anthropometric data were recorded in a pre-validated case record form. The diagnosis of MetS was made as per the NCEP – ATP III criteria (Table 1). The presence of more than or equal to any three of the mentioned factors is required for the diagnosis of MetS including subjects undergoing treatment for the mentioned condition.

Table 1: JNC7 hypertension guidelines NCEP- ATP III criteria for metabolic syndrome.

Category	Systolic BP (mmHg)	Diastolic BP (mmHg)	Risk Factor	Defining levels
			Central obesity	
Normal	<120	<80	Men	>102 cm
Pre hypertension	120-139	80-89	Women	>88 cm
			Tri-glycerides	>150 mg/dl
Hypertension (stage 1)	140-159	90-99	**HDL cholesterol**	
			Men	<40 mg/dl
Hypertension (stage 2)	>160	>100	Women	<50 mg/dl
			Blood pressure	>130/>85 mmHg
			Fasting glucose	>110 mg/dl

Blood pressure was measured in each arm using standard adult arm cuff of a mercury sphygmomanometer with the subject's arm supported and at least 10 minutes after rest in sitting position. The average of three measurements of the systolic and diastolic blood pressure was considered. Measurement of height was done using a stadiometer and waist circumference (WC) was measured in a horizontal plane midway between the inferior margin of the ribs and the superior border of the iliac crest using a non-stretchable tape. The average of two measurements taken after inspiration and expiration at nearest half centimetre was calculated. Two-dimensional echocardiography and fundoscopy for each subjects was performed. Blood glucose was measured using GOD/POD method which is considered as gold standard for glucose estimation.[13] Lipid profile was measured using an auto analyzer and lipoprotein fractions were measured enzymatically.[14]

Prevalence of metabolic syndrome was calculated using the following formula,

Prevalence of MetS = (Number of patients with MetS)/(Number of patients with essential hypertension) X 100

Statistical analysis was performed by GraphPad Prism 7.0 software (by using Pearson's Chi-square test and unpaired t test, p value of less than 0.05 was considered significant.

RESULTS

A total of 80 subjects (40 males and 40 females) were involved in the present study depending upon the pre-decided inclusion and exclusion criteria. The mean age of the total subjects was calculated to be 59.29±10.4 years (age range: 40 to 82 years) with almost likely mean age of males and females (Table 2). The mean systolic and diastolic blood pressure recorded in our population was revealed to be 133±26 and 80±13 mmHg respectively. Female subjects were found to be more hypertensive with mean systolic blood pressure as 138.1±25.4 mmHg when compared to males. Diastolic blood pressure was found to be at par in both the population. Mean pulse rate for the total subject was calculated to be 95.4±21 pulse per minute where male subjects displayed 96.7±23 pulse per minute and female population had mean value of 94.2±20 pulse per minute (Table 2).

Table 2: Demographics and characteristics of the study population.

Demographic characteristic	Total	Males	Females
Mean of N	80	40	40
Age (years)	59.29±10.4	59.3±10.9	59.15±10.1
Systolic BP (mmHg)	133±26	129.3±27.5	138.1±25.4
Diastolic BP (mmHg)	80±13	80.6±14	79.4±13
Pulse rate	95.4±21	96.7±23	94.2 ± 20
BMI (kg/m^2)	27.07±3.4	26.47±3.7	27.67±2.9
WC (cm)	97.01±16	98.7±14.4	94.57±17.7
Triglycerides (mg/dl)	172.43±38	174±35	170±42
HDL (mg/dl)	34.4 ± 7.5	33.8 ± 7.4	34.9 ± 7.7
Fasting blood sugar (mg/dl)	210.89±89.6	209.65±93.3	212±86.9
Post prandial blood sugar (mg/dl)	239.9±106.2	249.8±117.7	230.2±94.2

Data represents : Mean±SD

Duration of hypertension in all the patients was recorded and categorized in three classes i.e. 0-5 years, >5-10 years and >10 years. 38.75% of the patients had history of hypertension from 0-5 years followed by 21.25% of patient with 5-10 years of hypertension and rest 40% with more than ten years of hypertension demonstrating that most patients were chronic hypertensives (Figure 1). Likewise, the distribution of percent population of males and females with their respective duration of hypertension is expressed in Table 3.

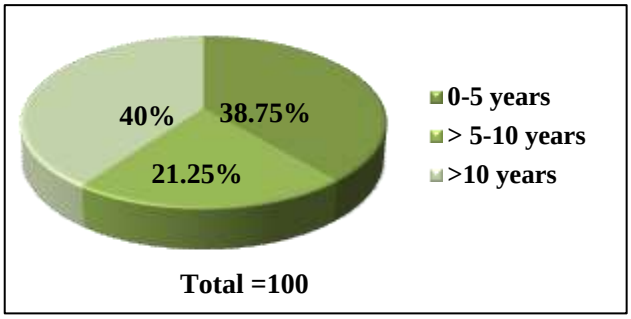

Figure 1: Duration of hypertension in the selected subject population in years.

BMI is a measure of the human body weight in relation to the height and BP is the pressure of the resistance of blood flow against the walls of the arteries. The mean BMI of the total subject was revealed to be 27.07±3.4 kg/m2 which are classified to be overweight as per the WHO guidelines.[15] The mean BMI in male and female was found to be 26.47±3.7 and 27.67±2.9 kg/m^2, respectively (Table 2).

To investigate the obesity level, waist circumference was measured in all the patients. Mean waist circumference of the total patients was calculated to be 97.01±16 cm with a marginal difference when only males (98.7±14.4 cm) and females (94.57±17.7 cm) population were considered (Table 2).

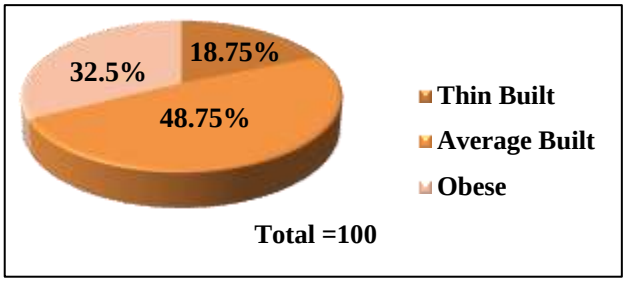

Figure 2: Body Built type of the subjects in the population.

On the basis of measurement of waist circumference and overall body built, the patients were divided in three categories i.e. thin built, average built and obese built. Of the total patients, almost half of the population (48.75%) displayed to have average muscular body type and may be called as mesomorph. On the other hand as shown in Figure 2, 32.50% of the subjects were recorded to have obese body type i.e. endomorphs whereas the lowest percent of patients (18.75%) were observed to be of thin built body type and hence termed as ectomorphs.[16]

Likewise, the distribution of percent population of males and females with body built type is expressed in Table 4. It was evidently noticed that females falling under the category of mesomorph and endomorph were higher as compared to the male patients.

Table 3: Distribution of percent population of males and females with their duration of hypertension.

Duration of hypertension (in years)	Percent population in males	Percent population in females
0-5	35	42.5
>5-10	22.5	20
>10	42.5	37.5

Table 4: Distribution of percent population of males and females with body-built type.

Built of the subjects	Percent population in males	Percent population in females
Thin (ectomorphs)	27.5	10
Average (mesomorphs)	45	52.5
Obese (endomorphs)	27.5	37.5

Average triglycerides and HDL levels of the patients included in our study was revealed to be 172.43±38 mg/dl and 34.4±7.5 mg/dl respectively. The mean of triglyceride levels in males (174±35 mg/dl) was non-significantly different from triglyceride levels in females (170±42 mg/dl). Similarly, the HDL level in male population (33.8±7.4 mg/dl) of the study was found to be very close to the levels of HDL in female population i.e. 34.9±7.7 mg/dl indicating the equal susceptibility of both the genders towards occurrence of dyslipidemia induced complications (Table 2).

Fasting and post prandial blood sugar levels was also investigated in all our subjects. Mean fasting and post prandial blood sugar levels in the total subjects were found to be 210.89±89.6 mg/dl and 239.9±106.2 mg/dl respectively which evidently indicates diabetic condition. Male patients displayed 209.65±93.3 mg/dl mean fasting blood sugar level and 249.8±117.7 mg/dl mean post prandial blood sugar level versus females with 212±86.9 mg/dl and 230.2±94.2 as mean fasting and post prandial blood sugar level respectively (Table 2).

Table 5 represented percent subjects with central obesity, abnormal blood pressure and other abnormal biochemical parameters. 17.5% of the total population displayed central obesity (BMI>30) of which female participants were found to be more. About 58.7% of total subjects exhibited higher systolic blood pressure where 67% of female and 50 % of male subjects had deviated from normal blood pressure range. High levels of abnormal lipid profile were recorded in the patients. In total, 87.5% patients revealed abnormal triglyceride levels (>150 mg/dl) and 85% patients reported to have abnormal HDL levels (<40 mg/dl). Percent of male patients with higher triglyceride levels was found to be more when compared to females whereas for abnormal levels of HDL, male and female subjects were found to be equally vulnerable. Elevated abnormal fasting blood sugar levels (>100 mg/dl) were exhibited by 85% of the total population revealing the susceptibility towards diabetic condition. 87% of females showed abnormal fasting blood sugar when compared to males (82.5%). Similarly abnormal levels of post prandial blood sugar (>140 mg/dl) was exhibited by 76.25% of total population with 82% of females and 77.5% of males displaying higher post prandial blood sugar levels thus reflecting the fact that females may be more prone to the dyslipidemia and hyerglycemic induced complications.

Table 5: Percent subjects with central obesity, abnormal blood pressure, lipid profile and blood sugar levels.

Percent subjects	Total	Males	Females
Central obesity (BMI> 30)	17.50%	10%	25%
Abnormal blood pressure (systolic >120)	58.70%	50%	67.50%
Abnormal triglyceride levels (>150 mg/dl)	87.50%	92.50%	82.50%
Abnormal HDL levels (<40 mg/dl)	85%	85%	85%
Abnormal fasting blood sugar (>100 mg/dl)	85%	82.50%	87.50%
Abnormal post prandial blood sugar (>140 mg/dl)	76.25%	77.50%	82.50%

Table 6: Ejection fraction measurement in all the subjects and distribution of patients in each category.

Ejection fraction (%)	Number of patients showing the corresponding ejection fraction %
15 to 20	2
25 to 30	7
30 to 35	5
35 to 40	3
40 to 50	31
50 to 55	4
55 to 60	24

The anthropometric and biochemical data obtained from all the 80 patients were explored to find any possible correlation amongst the parameters (Figure 3). Scatter plot of BMI versus waist circumference of all the patients shows highly significant positive correlation (r=0.498) between the factors suggesting the interdependent nature

of the factors on each other (Figure 3A). Scatter plot of waist circumference and triglyceride exhibited no correlation (r=0.198) reflecting that both the factors are independent of each other (Figure 3B). Likewise, no correlation was revealed between fasting blood sugar and HDL (Figure 3D). But fasting blood sugar was seen to be positively correlated (r=0.395) with triglycerides (Figure 3C). A significant negative correlation was noticed between BMI and Age which indicates that with increase in age a decrease in BMI can be expected.

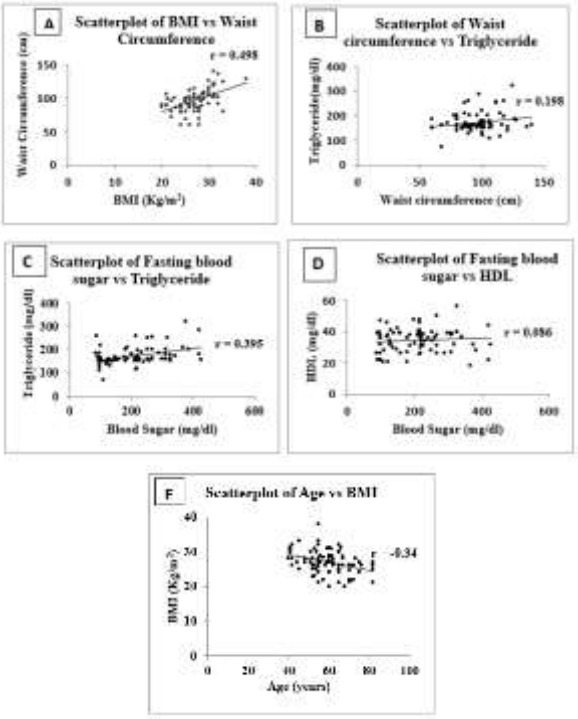

Figure 3: A) Scatterplot of BMI vs waist circumference, B) Scatterplot of waist circumference vs triglycerides, C) Scatterplot of fasting blood sugar vs triglyceride, D) Scatterplot of fasting blood sugar vs HDL, E) Scatterplot of age vs BMI.

For all the subjects, 2D echocardiography test and funduscopy were also performed. Although the echocardiographic examination is usually considered as a second-line study in the evaluation of hypertensive patient's health status, it is one of most commonly used imaging modality to give insight about pathophysiology and clinical implications in hypertensive patients. It can detect anatomical and functional changes easily in a real-time, quick, and reproducible manner.

In our study, 8.7% patients showed left ventricular hypertrophy, 28% patients displayed concentric left ventricular hypertrophy and 1% patient evidently had dilated left atrium. Valve status was also examined in which 18% patients revealed mild mitral regurgitation and 3% subjects suffered from severe mitral regurgitation. Furthermore 1% subjects exhibited severe mitral stenosis and mild aortic stenosis each.

Table 7: Hypertension related complication in the eye of the patients and their frequencies.

Hypertension related complications in eye	Patients with the complication
Grade 1 HR and No evidence DM retinopathy	11
Grade 1 HR and Grade 1 DM retinopathy	6
Grade 1 HR and grade 2 DM retinopathy	1
Only Grade 1 DM retinopathy	1
Grade 2 HR and No evidence DM retinopathy	12
Grade2 HR and Grade 1 DM retinopathy	3
Grade 2 HR and Grade 2 DM Retinopathy	2
Grade 2 HR and Grade 3 DM retinopathy	1
Grade 3 HR and No evidence DM retinopathy	3
Grade 3 HR and Grade 2 DM Retinopathy	1
Normal eye health status / No evidence of HR and DM retinopathy	39

HR- Hypertensive retinopathy, DM- Diabetic mellitus

Overall, 21% of subjects displayed normal 2D echocardiography, 13% patients had global hypokinesia and 1% suffered from severe hypokinesia. Ejection fraction of the heart was also evaluated and is expressed in Table 6. A normal heart's ejection fraction may be between 50 and 70 percent. 28 subjects out of our total study population reflected a normal heart ejection fraction whereas 31 patients were at borderline with 40-50% of heart's ejection fraction. Rest of the population i.e. 17 patients reported a low ejection fraction (below 40%). Hypertensive retinopathy is retinal vascular damage caused by hypertension which usually develops late in the disease. Table 7 represents all hypertension related complication in the eye of the patients and their frequencies were revealed using fundoscopic test. 51% of the population suffered from different grades of hypertensive retinopathy or different grades of diabetic retinopathy or combination of the both.

Individuals with the MetS are at increased risk for a variety of fatal conditions. The prevalence of MetS was investigated and was found to be 17.5% in our patients with essential hypertension.

DISCUSSION

Essential hypertension remains a major modifiable risk factor for cardiovascular disease despite important advances in our understanding of its pathophysiology and the availability of effective treatment strategies.[17-19] Our

present research investigation aims at finding the prevalence of metabolic syndrome and cardio-metabolic risks in patients with essential hypertension in our local Indian population. Our studies revealed a prevalence rate of 17.5% of metabolic syndrome in patients with essential hypertension. Triglyceride level abnormality was found to be more prevalent in our cohort which may be because of the higher proportion of chronic hypertensive patients. 17% displayed central obesity with female participants being predominant. 87.5% and 85% patients revealed abnormal triglyceride and HDL levels respectively. Elevated fasting and post prandial blood sugar levels were exhibited by 85% and 76.25% of the total population respectively revealing the susceptibility towards diabetic condition. Echocardiographic data revealed 28% of patients with concentric left ventricular hypertrophy and 13% population with global hypokinesia. Also 38% of the population had borderline heart's ejection fraction ability whereas 21% displayed low ability of the same which may be due to more susceptibility to coronary artery disease. Our ophthalmoscopic data analysis evidently indicates 51% of the population suffered from hypertension related complications in their eye.

Epidemiological studies have reported positive correlation between BMI and BP worldwide.[20] In a study by Rantala et al, the mean BMI was found to be 29.4±4.4 in males and 28.7±5.3 kg/m^2, respectively in females which is in accordance to our study.[21] Obesity, and in particular central obesity, have been consistently associated with hypertension and increased cardiovascular risk. It has been classified as one of many preventable independent risk factors for hypertension. Based on population studies, risk estimates indicate that at least two-thirds of the prevalence of hypertension can be directly attributed to obesity.[22] The constellation of insulin resistance, abdominal obesity, hypertension, and dyslipidaemia has been designated as the MetS.[23] Numerous prospective studies have been reported exploring the association of metabolic syndrome with abdominal obesity and hypertension in different subjects. Prevalence of MetS in our population is comparatively lesser when compared to the reports of Osuji and Omejua in newly diagnosed hypertensive patients i.e. 31.2%.[24] Sarkar et al, reported a greater percentage prevalence of MetS i.e 25.89% when compared to our study in Holalu village population of Karnataka.[25] A study by Mule et al reported the prevalence of MetS to be around 37% in hypertensive patients.[26] In another investigation by Ulasi et al, the overall prevalence of MetS was 18% in the semi-urban community as against 10% in the rural community increasing to 34.7% and 24.7%, respectively in hypertensive population. They also revealed that 71% of females had central obesity as compared to 17% of males. Abnormal triglyceride levels were detected in about 41.1% of patients which was still lower proportion than that of our study findings.[27] In a recent study, the prevalence of MetS was revealed to be 55.23% and the abnormal triglyceride levels were reported in 36.62% of study population. The same study reported the abnormal levels of HDL in around 66.27% patients.[28] However, our study population had more patients with abnormal TGL, HDL and fasting blood sugar levels in which the association of metabolic syndrome to abdominal obesity and hypertension has been convincingly demonstrated.

The above studies showed a much higher prevalence rate of metabolic syndrome in essential hypertensive patients as compared to our study. It might be because of influence of western lifestyle that the prevalence is more in western countries than in India. Similarly, triglyceride level abnormality was found more prevalent in our study which may be attributed to higher proportion of chronic hypertensive patients. An effective action plan is needed to combat metabolic syndrome in order to prevent its consequences and to avoid the costly management of its complications. Active measures for health promotion, such as adoption of increased physical activity, healthier eating habits and maintenance of normal body weight and control of blood pressure should accompany vigorous management.

CONCLUSION

Our study population revealed to possess MetS with elevated levels of triglyceride abnormality. Higher response rate of the patients is one of the strength of the present investigation albeit the small sample size cannot represent prevalence of MetS accurately in a greater population size. Most of the time hypertensive individuals are at a higher risk of developing MetS as they have a very common additional risk factor i.e. low HDL. Therefore, all hypertensive patients should be aggressively screened for the presence of additional cardiovascular risk factors that constitute the MetS. Moreover, more such studies should be conducted to assess other predictors of MetS and the performance of the health care system in order to implement a comprehensive and cost-effective patient care approach for hypertensive patients.

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