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METABOLIC SYNDROME: A GROWING HEALTH CHALLENGE FOR YOUNG AND ELDERLY POPULATION OF WESTERN U.P. IN INDIA

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ABSTRACT

Background & Objectives: Metabolic Syndrome is a growing epidemic of the world affecting not only developed countries but developing nations like India as well. Many studies have indicated that Asian Indian are particularly susceptible to early and fatal form of CVD or related events due to high prevalence of such metabolic disorders. The study aims at the prevalence of Metabolic Syndrome in the young adult and its presentation in elderly in a rapidly urbanizing population of western U.P. **Subjects/ Methods**: A hospital based cross-sectional; observational study on patients attending the specialty OPD for metabolic syndrome (MetS) who fulfils the IDF 2005 criteria for MetS in age group of 18 yrs and above. Anthropometric parameters were recorded which includes Waist Circumference, Weight, Height and BMI. Blood for Fasting plasma Glucose, Fasting Triacylglycerol and HDL-Cholesterol was measured using well calibrated Dry auto-analyser. Chi-square test and student t-test were used for group comparison. A P-value of <0.05 is used to establish statistical significance. **Results**: 161 subjects were included in the study which includes 76 subjects as MetS cases [34 males (44.7%) and 42 females (55.3%)] and 85 subjects as age and sex matched controls [61 males (71.8%) and 24 females (28.2%)]. 28.9% of the patients of Metabolic Syndrome were between 16-25 years of age, 32.9% were between 25-35 years of age, 22.4% were between 35-45 years of age and 14.5% of the patient between 45-55 yrs. 59.2% individuals had increase TG, 88.1% were Low HDL, 78.9% were Elevated BP and 35.5% elevated Fasting plasma Glucose. All the subject had increased waist circumference as an essential criteria for diagnosis of MetS. **Conclusion:** More components were found in higher age group then the younger age groups with Women representing higher proportion in the groups having same components of MetS. MetS was found to be increasingly prevalent in younger age groups.

KEY WORDS: Metabolic Syndrome, Obesity, BMI, IDF.

INTRODUCTION

The Metabolic Syndrome (MetS) is a constellation of risk factors in an individual which predisposes the person to a greater risk of developing Type2 Diabetes Mellitus (T2DM) and Cardiovascular Diseases (CVDs).[1][2] At present the most accepted definition is that of consensus definition incorporating International Diabetic Federation (IDF) new definition criteria (2005) and American Heart Association /National Heart, Lung, and Blood Institute (AHA/NHLBI) definitions (2004).[3]

The MetS is rising globally along with increasing incidence of obesity and has affected both developed as well as developing countries like India. According to a recent study in India, 88 million individuals were overweight, 135 million individuals had Generalized Obesity (defined by BMI ≥ 25 kg/m2 for both genders based on the World Health Organization Asia Pacific Guidelines) with or without abdominal obesity, 153 million individuals has abdominal obesity or central obesity and 107 million individuals has Combine Obesity. [4] Despite the fact that these figures were national projection of their large scale study subjects from three regions of the country, it is an emphatic statement inviting a critical thinking on raising prevalence of Obesity and MetS especially against the backdrop of heightened susceptibility of Asian Indians to CVDs.

Numerous study have indicated that Asian Indians has a tendency for early and severe form of manifestation of

CVD or CVD related events due to proportionately higher incidence Glucose intolerance, atherogenic Dyslipidemia, Thrombotic tendency, subclinical inflammation and endothelial dysfunction as compare to their western counterpart.[5] Although MetS as a screening tool is less popular in western countries due to better screening tools, its significance for Asian Indian is paramount as a rapidly developing nation where better health care facilities are still in primitive stage and 'out of reach' for a larger population, this simple technique help to assess the risk factors and also study has shown that good scoring system like Framingham Risk Scores (FRS) and others may underestimate the CV risk in Indian patients despite documented CAD.[6]

Excess body fat, thick truncal subcutaneous fat, and abdominal adiposity are important predisposing factors for development of insulin resistance in Asian Indian children and the prolong duration of their illness due to early onset is a major setback.[7]

The frequency of distribution of MetS in Asian Indian population has been between 20%-40% and depends on the diverse culture, region, state of socioeconomic transformation and the criteria being used to define the syndrome [table 1]. For instance, a study in Northern India has shown a prevalence percentage of 38.5% and 40.4% in the same population by using different criteria of ATPIII and IDF respectively (C. Mangat et al, Chandigarh 2010).[8] The reason for the difference with increased prevalence using IDF criteria has been attributed to 1) ethnic specific measurement of the waist circumference for central obesity and 2) the cut of value for fasting plasma glucose (FPG) which is low in case of IDF (FPG, 100 mg/dl) than the ATP III (FPG, 110mg/dl) criteria.

Table 1: Prevalence of Metabolic Syndrome in India by different diagnostic criteria.

Studies	Criteria for Diagnosis			Location
	ATP III [17]	IDF [18]	JIS*	
CURES-34[9]	18.3%	25.8%	-	Chennai
Boloor Diabetes [10]	-	29.7%	-	Mangalore
Kolkata [11]	31.4%	-	-	Kolkata & Suburbs of West Bengal
Chandigarh [8]	38.5%	40.4%	-	Chandigarh
CARDIAC evaluation Camp [12]	19.5%	-	-	Mumbai
Orissa [13]	-	-	33.5%	Berhampur
Wardha [14]	17.6%	-	-	Wardha
Dibrugarh [15]	-	32.9%	-	Dibrugarh
Goa [16]	36.9%	-	-	Goa

* *JIS:Joint Interim Statement: Joint interim statement of five major scientific organizations – the International Diabetes Federation, the National Heart, Lung, and Blood Institute, the American Heart Association, the World Heart Federation, the International Atherosclerosis Society, and the International Association of the Study of Obesity.*

The Present study highlight the increasing prevalence of MetS in younger age group and also increased severity in older age group in a region of Western Uttar Pradesh (North Indian state) where rapidly changing life style form a rural to urban transition characterised by less physical work and also westernization of food habit and fast-food culture which is consider be more fashionable, has brought these chronic, non-communicable disease a major health issue.

SUBJECTS AND METHODS

The present study was a cross-sectional; observational study carried on patients attending the specialty OPD for MetS in a teaching Institute in North India from December 2012 to June 2014. The public were encourage to attend the OPD which was initiated for bringing awareness to the growing prevalence MetS in the region, yet a collective and more effective strategy involving volunteer for public health worker is felt due to failure of Obesity/MetS being recognised as disease entity in the region.

Individuals age 18yrs and above were included as study subject using International Diabetic Federation 2005 Criteria. [Table 2] A total of 161 subjects were selected which has all aspect of data to be analysed. Of the 161 subject 76 fulfilled criteria of Metabolic Syndrome, as defined by the International Diabetic federation in 2005.

Table 2: International Diabetic Federation Criteria 2005 for Metabolic Syndrome

International Diabetic Federation 2005 criteria for Metabolic Syndrome
Central obesity (defined as waist circumference ≥ 90cm for Asian men ≥ 80cm for Asian women) plus any two of the following four factors:
1. Raised TG level: ≥ 150 mg/dL (1.7 mmol/L), or specific treatment for this lipid abnormality
2. Reduced HDL cholesterol: < 40 mg/dL (1.03 mmol/L) in males and < 50 mg/dL (1.29 mmol/L) in females, or specific treatment for this lipid abnormality
3. Raised blood pressure: systolic BP ≥ 130 or diastolic BP ≥ 85 mm Hg or Treatment of previously

diagnosed hypertension
4. Raised fasting plasma glucose (FPG) ≥ 100 mg/dL (5.6 mmol/L), or previously diagnosed type 2 diabetes

According to this definition, a person is identified as having the metabolic syndrome if they have central obesity (defined with ethnicity specific values) plus two others risk factors like Raised triglycerides; Reduced HDL cholesterol; Raised blood pressure; or Raised fasting plasma glucose.

We have focused more on central obesity components of the above definition more so because visceral adiposity remains one of the most important established risk factor for T2DM and CVD in many large scale studies like IDEA and HOPE.[19-22] They have concluded that abdominal adiposity worsens the prognosis of patients with CVD and that abdominal obesity, measured by the waist circumference, showed a graded relationship with both CVD and diabetes at all levels of BMI. [19, 20]

In the randomly selected age and sex matched control group of 85 subjects, anthropometric profile suggest that they are Normal, Over-weight & Obese but do not satisfy criteria of Metabolic Syndrome (MetS) to be included as study cases.

Ethical Clearance from the Institutional Ethical Committee was obtained prior to the study and Informed consent from the patients was taken from each subjects.

For Overweight and Obesity, WHO Asia Pacific guidelines were used to define overweight as BMI 23–24.9 kg/m2 and Obesity as BMI ≥25 kg/m2. [23]

Weight: Weight is taken in Kilogram by an electronic weighing machine (Commercial scale) which is well calibrated and compared with other standard weighing machine in the hospital. Weight was recorded to nearest of 0.5 kg.

Height: Height is taken in centimetres using a height scale to the nearest 0.1cm.

Abdominal girth: Abdominal girth is measured using a measuring tape and reading is recorded in centimetre to the nearest of 0.1 cm. The level of measurement will be at midway between lower costal margin and iliac crest which approximately correspond to mid umbilicus level. The tape will be hold in parallel to the floor and without compression of the skin at normal expiration.

Blood pressure: The measurement of blood pressure is taken in sitting posture after resting for minimum of 10-15 minutes. Three consecutive reading is recorded at an interval 2-5 minutes on the same day or in subsequent OPDs before final conclusion of high blood pressure as define by Joint National Committee 7 (JNC 7).

Biochemical profile

1. Fasting blood glucose
2. Lipid profile includes fasting HDL and TG

Estimation of Fasting Plasma Glucose, Fasting TG and HDL-C: Fasting Plasma Glucose (FPG), serum TG and HDL-C were processed in Vitros-250 auto analyzer using readymade dry chemistry kits procured from Ortho-Clinical Diagnostics, Johnson & Johnson, USA.

The laboratory is a NABL accredited laboratory with effective internal and external (EQAS, Biored) quality control system to ensure quality results.

All the data so collected were duly recorded on Data Collection Ticket (DCT) and after collecting the complete data, it was compiled, results and observations drawn and statistically analysed using SPSS software and Microsoft Excel sheet.

Data analysis

Data was analysed by using Excel 2007, R2.8.0 Statistical Package for the Social Sciences (SPSS) for windows version 20.0 (SPSS Inc; Chicago, IL,USA). Chi-square test and student t-test were used for intergroup comparison. ANOVA was used for drawing statistical significance of the different components of Metabolic Syndrome.

A P-value of <0.05 is used to establish statistical significance.

RESULT AND DISCUSSION

The prevalence of MetS represents truly the "tip of the ice-berg" phenomenon with the larger actual portion of this emerging non-communicable disease (NCD) remaining submerged in the general public without being aware.

It was found in the present study that the mean (±SD) of the age in the patients of metabolic Syndrome was 33 ±10.74; Pathania D *et al* (2013) reported mean ±SD as 45.74 ± 6.45 years; Mangat *et al* (2010) reported as 49.46 ± 13.24 years.

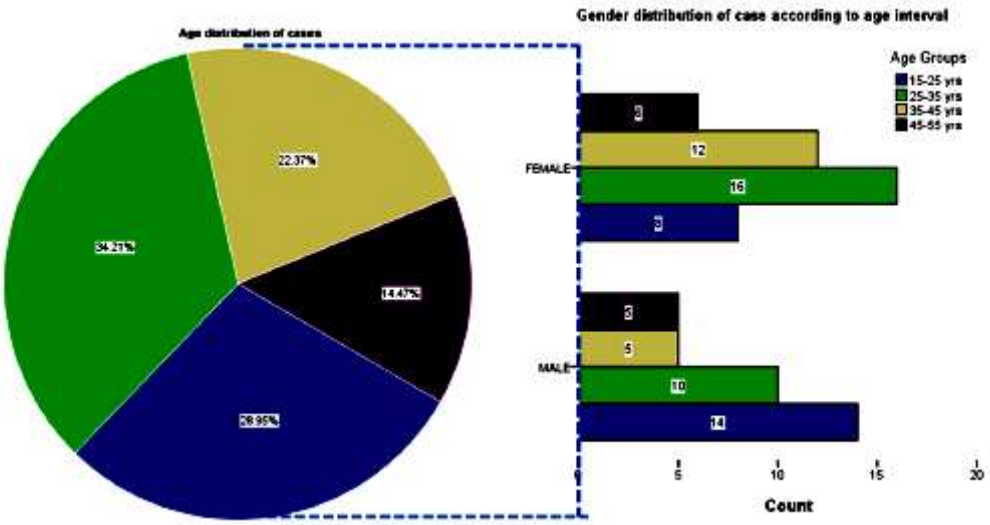

Figure 1: Age and sex distributions in the group diagnosed as Metabolic Syndrome

Patient of Metabolic Syndrome are now becoming more prevalent in younger age groups. In our study males with MetS were 34 subjects out of 76 (44.7%) with mean age of 30.29 ±11.01 years whereas the females were 42 subjects out of 76 (55.3%) with mean age of 35.24 ±10.11 years. More number of female patients with MetS is also seen in other studies like Pathania D *et al* (2013) 66.36% as compared to males with 33.63% which is in accordance with our study. Prasad *et al* (2012) found similar gender preponderance of females (52.2%) over males (34.2%) in subjects with MetS.

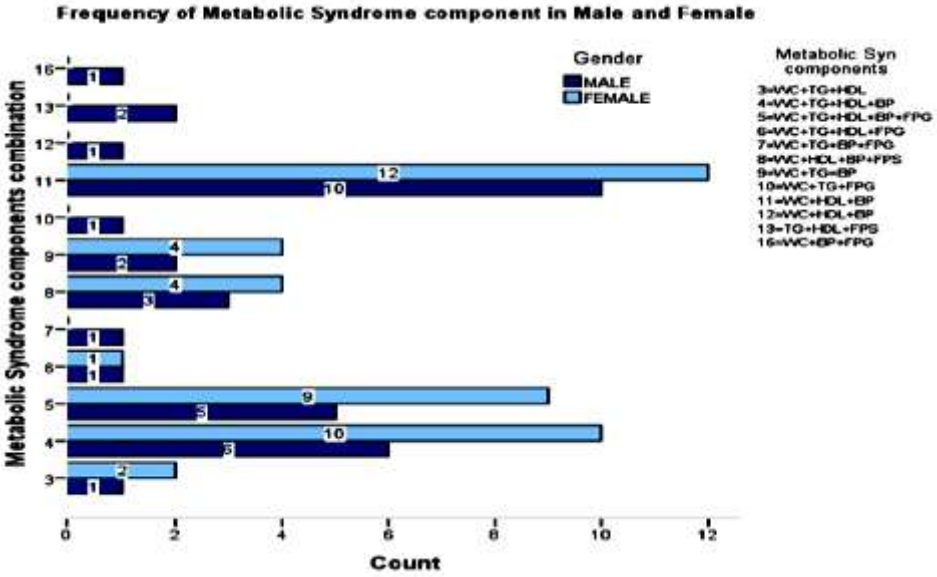

Figure 2: Frequency of Metabolic Syndrome components in study subjects define by IDF 2005 criteria.

In the frequency distribution of MetS components, we observed 14 (18.4%) subjects which includes 5 males and 6 females presented themselves with all the five components of MetS; five cases had associated abnormal thyroid profile and one case had associated raised fasting and postprandial Insulin levels. 16 (21.1%) subjects (6 Males and 10 Females) had a combination of increased Waist Circumference (WC) with elevated Fasting Triglyceride (TG), low High Density Lipoprotein cholesterol (HDL-C) and elevated Blood Pressure (BP); another 7 (9.2%) subjects (3 males and 4 females) had increased WC, low HDL-C, elevated BP and elevated Fasting Plasma Glucose (FPG); 2 (2.6%) subjects (one male, one female) had a four component combination of increased WC, elevated TG, low HDL and elevated FPG levels; one male (1.3%) subject had a above combination with low HDL-C replaced by elevated BP.

In the three components combination, 22 (28.9%) subjects which includes 10 males and 12 females were the highest frequency group of this study with a combination of increased WC, low HDL and elevated

BP. Another three combination in this study was increased WC, elevated TG and elevated BP in 6 (2 males, 4 females) constituting 7.9% of the cases. Three subjects (3.9%, one male, two female) had increased WC, elevated TG and low HDL-C, another three subjects had combination of elevated TG or low HDL-C or elevated BP with fixed two combination of increased WC and elevated FPG. Two (2.6%) subjects had an exception with a combination of elevated TG, low HDL-C and elevated TG levels without including mandatory Waist circumference criteria of IDF but fulfils ATP III criteria.

In the present study, 59.2% subjects with Metabolic Syndrome had raised TG levels (M<F) which is in accordance with the finding of Prasad *et al* with 63.4% prevalence in Subjects with MetS. However other study have report low; Kamble P *et al* 30.2% in Wardha, Peixoto C *et al* 16.3% in Goa, 30.3% by Kotokey RK *et al* in Dibrugarh.

Table 3: Comparative table on different Studies on Metabolic Syndrome Components

Parameter		Prasad *et al* (2012) (JIS)	Mangat *et al* (2010) IDF (ATPIII)	Present Study (2012-14) IDF	Kamble P *et al* (2007-08) ATP III	Peixoto C *et al* (2014) ATP III	Kotokey RK *et al* (2010-11) IDF	Pemminati S *et al* (2009) IDF	Apurva S et al (2011) ATP III
Age (Mean)		-	49.46(±13.2)	33±10.74	-	-	48.06	52.2±13.2	-
Sex	M	34.2%	40.0% (31.7%)	44.7%	8.2%	33.6%	21.56%	26.5%	56.76%
	F	52.2%	54.3% (44.8%)	55.3%	10.7%	39.8%	45.92%	31.2%	46.71%
TG↑		63.4%	-	59.2%	30.2%	16.3%	30.3%	38.8%	-
HDL-C↓		65%	-	88.1%	58.8%	24%	24.8%	48.1%	35%
BP↑		89.2%	-	78.9%	53.8%	13.3%	37.6%	-	29.10%
WC↑		-	-	63.4%	21.6%	51.7%	-	60.7%	-
FPG ↑		59.6%	-	35.5%	12.3%	26.8%	-	29.4%	17.99%
BMI	≥25	-	100%	66.5%	-	-	39.1%,57.1%	38.3%	33.76%
	23-24.9	-	67.5%	16.1%	-	-	50.7%	-	45.26%
	≤22.9	-	19.2%	17.4%	-		31.8%	-	20.99%

In Present study, the prevalence of raised Fasting Plasma glucose was 35.5% subjects with MetS which is in accordance with Peixoto C *et al* 26.8% in Goa, and Pemminati S *et al* 29.4% manglore; whereas other study have found both higher and lower prevalence. Kotokey RK *et al* reported a prevalence 71.5%; Prasad *et al* reported 59.6%. Kamble P *et al* 12.3% in Wardha,

In the present study, 88.1% subjects with metabolic syndrome had low HDL-C levels similar to the finding of 65% by Prasad *et al* in Orissa, Pemminati S *et al* reported 48.1% in boloor diabetic study in 2010; other studies have reported low prevalence as; 24.85% by Kotokey *et al* in Dibrugarh and 24% Peixoto C *et al* in Goa.

In the Present study, elevated Blood Pressure was found in 78.9% (overall 37.3% of study subjects) which is similar with the finding of Prasad *et al* as 89.2% in Orissa, Pemminati S *et al* found 54.9% in Mangalore, Kotokey *et al* found 37.57% with male preponderance, Peixoto C *et al* found 13.3% in Goa, Kamble et al reported 53.8% in Wardha.

In the present study, the average mean of all the components of Metabolic Syndrome was similar with the boloor diabetic study of 2010 by Pemminati S *et al*. The mean WC in case group was 106.88 (±14.60), Fasting TG was 151.18 (±64.09), HDL-C was 36.15(±8.42), Systolic BP was 137.39 (±8.70), Diastolic BP was 91 (±7.69) and Fasting PG was 86.55 (±16.63). However BMI was much higher with mean as 32.87 (±6.12) compared to 26.2 (±3.98) in the Boloor diabetic study.

In the Boloor diabetic study (mangalore, 2010) by Pemminati S *et al*, the mean value of the variable in subjects with metabolic syndrome was; Age (years) was 52.2 ±13.2; WC (MetS category) was 92.3 ±8.1; BMI ≥ 25 kg/sq.m was 26.2 ±3.98; SBP ≥ 130 mmHg was 138.8 ±17.8, DBP ≥ 85 mmHg was 85.1 ±9.2; FPG ≥ 100 mg/dl was 122.9 ±54.6, TG ≥ 150 mg/dl was 153.2 ±112, HDL-C (MetS category) 46.64 ±14.02 which was found to be non-significant whereas all the other parameters was statistically significant with p value <0.0001 between case and the control.

In the present study, similar statistical significance was found between the case and the control groups as; Between WC case and control WC (t=8.336, df=93, p=.000 (95% CI 15.56-25.30), between TG of case and control TG (t=7.318, df=93, p=.000 (95% CI 60.72-105.94); between the HDL-C of case and control which is inversely related represented by minus sign of 't' HDL-C (t=-4.808, df=93, p=.000 (95% CI -11.59--4.82); between the Systolic BP of case and control SBP (t=4.323, df=93, p=.000 (95% CI 4.49-12.11); between the Diastolic BP of case and control DBP (t=4.841, df=93, p=.000 (95% CI 4.42-10.56); between the Fasting Plasma Glucose of case and control FPG (t=5.451, df=93, p=.000 (95% CI 10.18-21.86); between the BMI

of case and control BMI (t=6.707, df=93, p=.000 (95% CI 4.49-8.27).

The present study shows no Gender difference between male and female in relation to the Metabolic syndrome defining variables with P value >.05 except for BMI where P value is .008 (<0.01) similar to Mangat *et al* which has reported BMI 27.95 ± 4.15 in the case subjects with Metabolic syndrome and BMI of control subjects as 23.81 ± 3.23 with P <.001. the variables mean value between gender are; Male subjects (Cases); WC 106.66 (±13.81), TG 161 (±75.43), HDL-C 36.21 (±6.77), Systolic BP 137.41 (±8.55), Diastolic BP 91.29 (±7.80), FPG 88.26 (±17.00) and BMI 31.61 (±5.84) and female case WC 107.05 (±15.37), TG 143.22 (±52.81), HDL-C 36.10 (±9.64), Sys BP 137.38(±8.93), Diastolic BP 91.79 (±7.69) and BMI 33.02 (±6.21).

In the control group; the mean WC was 85.40 (±11.84), FTG was 77.62 (±33.81), HDL-C was 45.29 (±9.58), Systolic BP was 128.00 (±9.81), Diastolic BP was 80.32 (±7.68), FPG was 71.79 (±11.49) and BMI was 25.22 (±4.46). Control gender mean value for male was WC 86.23 (±9.92), TG 77.69 (±35.45), HDL-C 44.41 (±8.56), SysBP 129.11 (±9.19), DisBP 83.80 (±6.90), FPG 72.25 (±11.54) and BMI 25.23 (±3.44) and for female case WC 83.29 (±15.79), TG 77.46 (±29.91), HDL-C 47.54 (±11.68), Sys BP 122.58(±9.97), DisBP 78.54 (±8.43), FPG 70.62 (±11.52) and BMI 25.20 (±6.47).

CONCLUSION

Metabolic Syndrome screening is a simplest tool to bring awareness of prime importance of being healthy for a rapidly progressing nation like India. Development with healthy lifestyle is a central theme in preventing the increasing prevalence of MetS and Obesity in younger generation who will be the future pillar of the Nation yet caring for the elderly who has the highest incidence of MetS components. The present study shows high prevalence of Low HDL-c, increased TG and Elevated Blood Pressure suggesting underlying high risk of CVD related events in the region and necessitate effective planning of strategies for early prevention.

The present study has some limitations in relation to adequate selection of control subjects to extrapolate the beneficial of come unto the general population. Large scale analysis of the same study would yield a better outcome.

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CONFLICT OF INTEREST

The authors declare that they have no competing interests.

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