ORIGINAL ARTICLE

PREVALENCE OF METABOLIC SYNDROME IN YOUNG V/S OLD APPARENTLY HEALTHY ASIAN INDIAN GUJARATI POPULATION

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ABSTRACT

Introduction: The metabolic syndrome (MetS) is an epidemiological construct of different permutations of risk factors. We aimed to compare and study the overall prevalence of MetS in healthy, asymptomatic young v/s old Gujarati population.

Methods: This population based- cross sectional study involved a total of 3329 healthy adults of 18-70 years of age. Clinical data such as body mass index (BMI), waist circumference (WC), blood pressure (BP) were measured along with the biochemical estimations of lipids and fasting blood glucose (FBS). The overall population was categorized in young (<40 years) and old (≥40 years) individuals.

Results: The overall prevalence of MetS was 34.3% where the incidence was found to be more than double in old(45.4%) as compared to young population (20.8%, $p<0.0001$). The level of FBS (99.82 ± 38.49 vs 87.65 ± 19.82), HDL-C (38.94 ± 7.35 vs 37 ± 6.42) and LDL-C (129.45 ± 33.88 vs 117.39 ± 30.38) were significantly ($p<0.05$) higher in older population as compared to younger population. In both the age groups the prevalence of MetS was higher in males as compared to females and was majorly contributed by increased FBS level. However in old (95.6% vs 84.2) and young (84% vs 96%) females, the abnormalities of WC were significantly higher than their male counterparts.

Conclusion: In summary we conclude that MetS is prevalent in Gujarati population and is subjected to age and gender. This results reinforces the need of early life style intervention and awareness programs in this ethnic group.

Keywords: Metabolic syndrome, Asymptomatic Gujarati population, Age, Gender

INTRODUCTION

High fasting glucose, elevated triglyceride (TG) and arterial pressure levels, increased waist circumference (WC) and decreased high density cholesterol (HDL-C) levels conjointly form Metabolic Syndrome (MetS). Three abnormal findings out of 5 would qualify a person for the MetS.[1] South Asian population has a propensity for MetS.[2] Degree and prevalence varied on basis of ethnicity, genetic susceptibility and geographic location.[3,4,5] Furthermore it is possible that the prevalence remains underestimated in Asian populations due in part to variations in the definition of the syndrome and to selection biases in sample populations.[6]Metabolic syndrome confers a 5- fold increase in the risk of type 2 diabetes mellitus (T2DM) and 2-fold the risk of developing cardiovascular disease (CVD) over the next 5 to 10 years.[1]

There have been several definitions of MetS, but the most commonly used criteria for definition at present are from the World Health Organization (WHO),[7] the European Group for the study of Insulin Resistance (EGIR),[8] the National Cholesterol Education Programme Adult Treatment Panel III (NCEP ATP III),[9] American Association of Clinical Endocrinologists (AACE),[10] and the International Diabetes Federation (IDF).[11]Worldwide prevalence of MetS ranges from <10% to as much as 84%, depending on the region, urban or rural environment, composition (sex, age, race, and ethnicity) of the population

studied, and the definition of the syndrome used.[4,5] An European study for the MetS prevalence showed that the most frequent MetS component present in obese individuals was elevated blood pressure (BP). In previous studies, obesity coincided with hypertension (HTN) in 60% to 85% cases. It was also observed that there were considerable variations in the prevalence of other components of MetS, especially blood glucose and HDL-C. A BP exceeding the strict criterion for a high BP can be accounted as a main contributor promoting unhealthy obesity and MetS in the Finnish cohorts in this study indicating the highest prevalence of MetS among obese subjects and the lowest percentage of metabolically healthy obese.[12]

A study in Central India reported (as per ATP III criteria) the MetS prevalence was found to be 9.3% with 8.2% in males and 10.7% in females.[13] There has till date been no or less evidence about MetS prevalence in Gujarati Indian Asian population. The Prevalence of different risk factors of MetS has been reported individually and comparatively in young versus old Gujarati population.

METHODOLOGY

Study design: The current study has been conducted on a cohort enrolled for World Heart Day health check-up camp 2013 which was held at U. N. Mehta institute of cardiology and research centre, Ahmedabad, Gujarat. Detailed anthropometric (height, weight, waist circumference (WC), physical activity, BMI, family history of CAD, smoking, any medical history) and clinical parameters (blood pressure (BP), ECG, ECHO, lipid profile) were evaluated and filed in the participant record form. Only individuals with no major history of any past illness were enrolled. Total 3329 individuals (1830 males & 1499 females), who were apparently healthy, asymptomatic, disease free who were 18 years and above (1490 were <40 years of age and 1839 were ≥40 years of age) were included. Young population was defined as individuals of <40 years of age and old population as ≥40 years of age. The protocol was approved and cleared by institutional ethics committee. The subjects taking any medications and with abnormal stress test were excluded from the investigation.

Risk factors assessment: Venous blood samples were collected in an overnight fasting state of 12-14 hours for laboratory assessments for the determination of lipid components (total cholesterol, HDL-C, LDL-C and TG, total lipid) and blood glucose. Serum glucose and lipids were measured by International Federation of Clinical Chemistry (IFCC) approved enzymatic methods using commercially available kit on auto analyzer (ARCHITECH PLUS ci4100, Germany). Blood pressure (BP) was measured using a sphygmomanometer and HTN was diagnosed if the systolic blood pressure (SBP) was higher than 140mm Hg or the diastolic blood pressure (DBP) was above 90mm Hg. A calibrated weighing machine was used for the measurement of weight. Height of the subjects was measured on a calibrated fixed scale with bare feet and no head gears. Waist circumference was evaluated as maximum diameter midway between the iliac crest and the last rib.

Definition and Preferred Cut-off Values: NCEP-ATPIII guidelines were used for classification of MetS. Participants were confirmed having MetS when they had at least any three of the following five criteria:

1. Elevated WC ≥90 cm in men and ≥80 cm in women
2. Elevated TGs ≥150 mg/dl (1.7 mmol/L) or drug treatment for elevated TG (drug treatment for elevated TGs is an alternate indicator)
3. Reduced HDL-C<40 mg/dl (1.0 mmol/L) in males and <50 mg/dl (1.3 mmol/L) in females (drug treatment for reduced HDL-C is an alternate indicator)
4. Elevated BP (SBP≥130mmHg and/or DBP ≥85mmHg) (antihypertensive drug treatment in a patient with a history of HTN is an alternate indicator)
5. Elevated fasting glucose ≥100 mg/dl or drug treatment for elevated glucose.[1]

Statistical analysis: Statistical analysis was performed using SPSS, Version 22.0 (Chicago, IL, USA). Mean, standard deviation (SD), independent t-test were calculated and as the data follows Gaussian distribution. Level of significance was accepted at $p<0.05$. Quantitative data variables were expressed as mean ± SD whereas qualitative data variables as proportions.

RESULTS

Table 1 shows the baseline characteristics of young, healthy and asymptomatic Asian Indian Gujarati individuals. Total sample population of 3329 individuals of heterogonous Asian Indian Gujarati origin between 18-80 years of age with no past history of any major illness were included in the study. Study population consisted of 1490 males and 1839 females. Total population along with the old group was male prominent (55%,

Table 1: Demographic details of study Subjects

	Total Population	Young (<40 years age)	Old (≥40 years age)
Total	**3329**	1490 (44.6%)	1839 (55.4%)
Male	1830 (55%)	720 (48.3%)	1110 (60.4%)
Female	1499 (45%)	770 (51.7%)	729 (39.6%)
Age (year)	41.31 ± 13.4	28.74 ± 5.69	51.49 ± 8.34
MetS	1272 (38.2%)	436 (29.3%)	836 (45.5%)
FBS	86.18 ± 24.08	79.49 ± 13.64	91.59 ± 28.87
TC	184.91 ± 39.19	169.66 ± 34.27	197.27 ± 38.57
TG	115.5 ± 63.46	101.58 ± 59.1	126.83 ± 64.63
HDL-C	43.67 ± 9.89	43.89 ± 9.99	43.49 ± 9.81
LDL-C	118.13 ± 33.4	105.45 ± 29.05	128.41 ± 33.22
VLDL	23.10 ± 12.69	20.31 ± 11.82	25.36 ± 12.92
Total lipid	644.12 ± 87.90	615.13 ± 81.21	667.61 ± 86.10
LDL-C/HDL-C	2.84 ± 1.08	2.55 ± 1.12	3.07 ± 0.99
TC/HDL-C	4.43 ± 1.49	4.07 ± 1.5	4.71 ± 1.42
Pre mature CAD	424 (12.7%)	146 (9.8%)	278 (15.1%)
Tobacco Consumption	309 (9.3%)	117 (7.9%)	192 (10.4%)
SBP (mm/Hg)	130.79 ± 28.92	124.32 ± 36.78	136.02 ± 18.98
DBP (mm/Hg)	82.39 ± 10.16	79.21 ± 9.78	84.96 ± 9.73
BMI (kg/m^2)	24.36 ± 5.25	23.03 ± 5.37	25.43 ± 4.90
Increased WC	2087 (62.7%)	733 (49.2%)	1354 (73.6%)

(MetS-Metabolic Syndrome, FBS-Fasting Blood Sugar, TC- Total Cholesterol, TG- Triglyceride, HDL-C- High Density Lipoprotein Cholesterol, LDL-C- Low Density Lipoprotein Cholesterol, VLDL- Very Low Density Lipoprotein, Premature CAD- Positive family history for Coronary Artery Disease, SBP- Systolic Blood Pressure, DBP- Diastolic Blood Pressure, BMI- Body Mass Index, WC- Waist Circumference**)**

Table 2: Compared profile of clinical characteristics of MetSaffected Asian Indian Gujaratis

Variable	Total Population	Young Population (<40 years age)	Old Population (≥40 yrs age)	p Value
MetS	1146 (34.3%)	310 (20.8%)	836 (45.4%)	**<0.0001**
Male	678 (59.2%)	196 (63.2%)	482 (57.7%)	0.101
Female	468 (40.8%)	114 (36.8%)	354 (42.3%)	0.101
Age (years)	46.34 ± 11.57	31.66 ± 5.02	51.78 ± 8.05	**0.000**
FBS	96.53 ± 34.86	87.65 ± 19.82	99.82 ± 38.49	**0.000**
TC	195.51 ± 39.66	184.31 ± 36.72	199.67 ± 39.92	0.263
TG	154.53 ± 80.00	149.58 ± 88.52	156.36 ± 76.57	0.233
HDL-C	38.42 ± 7.16	37.00 ± 6.42	38.94 ± 7.35	**0.010**
LDL-C	126.19 ± 33.39	117.39 ± 30.38	129.45 ± 33.88	**0.049**
VLDL	30.90 ± 16.00	29.91 ± 17.70	31.27 ± 15.31	0.233
Total lipid	688.47 ± 103.18	670.90 ± 110.57	694.98 ± 99.59	0.285
LDL-C/HDL-C	3.36 ± 1.00	3.24 ± 0.92	3.40 ± 1.03	0.670
TC/HDL-C	5.23 ± 1.53	5.09 ± 1.19	5.28 ± 1.64	0.877
Pre mature CAD	160 (14.0%)	44 (14.2%)	116 (13.9%)	0.966
Tobacco Consumption	119 (10.4%)	38 (12.3%)	81 (9.7%)	0.247
SBP	141.64 ± 41.16	139.12 ± 73.54	142.57 ± 17.85	0.378
DBP	87.43 ± 9.73	85.95 ± 10.50	87.98 ± 9.38	0.710
BMI	26.47 ± 4.56	25.98 ± 3.91	26.65 ± 4.76	0.052
Increased WC	1019 (88.9%)	274 (88.4%)	745 (89.1%)	0.808

(MetS- Metabolic Syndrome, FBS-Fasting Blood Sugar, TC- Total Cholesterol, TG- Triglyceride, HDL-C- High Density Lipoprotein Cholesterol, LDL-C- Low Density Lipoprotein Cholesterol, VLDL- Very Low Density Lipoprotein, Premature CAD- Positive family history for Coronary Artery Disease, SBP- Systolic Blood Pressure, DBP- Diastolic Blood Pressure, BMI- Body Mass Index, WC- Waist Circumference**)**

Table 3: Risk factor analysis in males and females in MetS population

Variable	Young Population (<40 years age)			Old Population (≥40 yrs age)		
	Male	Female	p Value	Male	Female	pValue
Affected	196 (63.2%)	114 (36.8%)	<0.0001	482 (57.7%)	354 (42.3%)	**<0.0001**
Age	31.66 ± 4.95	31.66 ± 5.16	0.456	52.51 ± 8.33	50.79 ± 7.55	0.054
FBS	89.45 ± 21.62	84.55 ± 15.87	0.185	102.29 ± 40.18	96.46 ± 35.83	**0.011**
TC	189.74 ± 37.06	174.98 ± 34.32	0.254	198.26 ± 39.56	201.58 ± 40.39	0.858
TG	167.62 ± 96.95	118.57 ± 60.62	0.094	169.51 ± 84.88	138.45 ± 59.12	**0.000**
HDL-C	35.09 ± 5.76	40.28 ± 6.20	0.149	36.59 ± 7.12	42.14 ± 6.41	0.944
LDL-C	121.12 ± 31.20	110.97 ± 27.91	0.106	127.76 ± 32.76	131.74 ± 35.27	0.317
VLDL	33.52 ± 19.39	23.71 ± 12.12	0.094	33.90 ± 16.97	27.69 ± 11.82	**0.000**
Total lipid	692.45 ± 118.21	633.84 ± 84.42	0.105	704.38 ± 108.34	682.18 ± 84.75	**0.000**
LDL-C/HDL-C	3.49 ± 0.91	2.80 ± 0.74	0.026	3.57 ± 1.09	3.17 ± 0.90	0.156
TC/HDL-C	5.49 ± 1.15	4.41 ± 0.94	0.037	5.59 ± 1.90	4.85 ± 1.06	**0.037**
Pre mature CAD	25 (12.8%)	19 (16.7%)	0.433	69 (14.3%)	47 (13.3%)	0.743
Tobacco Consumption	29 (14.8%)	9 (7.9%)	0.108	65 (13.5%)	16 (4.5%)	**<0.0001**
SBP	143.57 ± 91.61	131.47 ± 14.53	0.244	142.80 ± 17.51	142.26 ± 18.33	0.222
DBP	86.65 ± 11.43	84.75 ± 8.58	0.228	88.14 ± 9.53	87.77 ± 9.18	0.333
BMI	25.92 ± 3.50	26.08 ± 4.55	0.001	26.23 ± 4.23	27.21 ± 5.36	**0.017**
Increased WC	95.03 ± 8.87,	92.91 ± 12.60,	0.011	96.58 ± 11.09,	95.51 ± 10.54,	**0.042**
(Mean, Number/%)	165 (84.2%)	109 (95.6%)		405 (84.0%)	340 (96%)	

(MetS- Metabolic Syndrome, FBS-Fasting Blood Sugar, TC- Total Cholesterol, TG- Triglyceride, HDL-C- High Density Lipoprotein Cholesterol, LDL-C- Low Density Lipoprotein Cholesterol, VLDL- Very Low Density Lipoprotein, Premature CAD- Positive family history for Coronary Artery Disease, SBP- Systolic Blood Pressure, DBP- Diastolic Blood Pressure, BMI- Body Mass Index, WC- Waist Circumference**)**

Results in Table 2 showed the comparison population having MetS which were further categorised into young and oldpopulations. The levels of FBS (99.82 ± 38.49 vs 87.65 ± 19.82 mg/dl), and LDL-C (129.45 ± 33.88 vs 117.39 ± 30.38) was higher in older individuals as compared to the younger population. Statistically significant (p<0.049) difference was observed in the levels of HDL-C of young (37 ± 6.42) and old (38.94 ± 7.35) individuals. Table 3 provides the description of varied risk factors of MetS affected male and females of both young and old populations. Irrespective of the age greater incidence of MetS was observed in females as compared to males. In younger males the contributing factors were some lipid ratios (LDL-C/HDL-C and TC/HDL-C) and increased WC. Similarly in young population along with lipid components (TG, VLDL, TL, TC/HDL-C), FBS, tobacco consumption and greater WC was significantly associated with male gender. However in both the age groups, females had higher BMI values as compared to males which was statistically significant (p<0.05).

DISCUSSION

The MetS is an epidemiological construct of different permutations of risk factors, each with unique clinical implications and treatment strategies.[14]The prevalence of MetS in Asian Indians varies according to the region, the extent of urbanization, lifestyle patterns, and socioeconomic/ cultural factors. Recent data show that about one third of the urban population in India's major cities have MetS.[15]In this cross-sectional study of young, healthy and asymptomatic Asian-Indian Gujarati population, we evaluated the prevalence of MetS risk factors in young versus old population.

Asian population has been proved more likely to be affected by MetS for varied reasons. Different studies from Eastern India (33.5%), Southern India (22.1% to 41%) and Northern India (22.37%) showed a prevalence ranging from 11 to 41%.[16-19]Our results too were in concordance. In National Health Statistics Reports 2003-2006 (published in 2009) by U.S. Department of Health And Human Services, Center for Disease Control and Prevention, approximately 34% of adults met the criteria for MetS. Males and females ≥40years of age were about three times as likely as those <40 years of age to meet the criteria for MetS.[20]Our study population had an overall prevalence of 38.2% which was in concordance with other studies reporting prevalence of MetS in varied ethnicity and cultures.[2,21-24] Except FBS and HDL-C all other the

risk factors of MetS were equally distributed in both the populations, whereas high DBP did not show any contribution in development of MetS in any of the categorised population.

The main risk factors responsible for MetS in old population in our study were increased WC followed by elevated BP and decreased HDL-C. The most prevalent risk factors in National Health Statistics Reports 2003-2006 (published in2009) were abdominal obesity (53%), HTN (40%) and hyperglycemia (39%). According to Prasad *et al.,* Obese individuals were five times more likely to have MetS compared with those having normal weight. Studies suggest that both hyperglycemia and hyperinsulinemia activate the Renin angiotensin system (RAS) by increasing the expression of angiotensinogen, Angiotensin II (AT II), and the AT1 receptor, which, in concert, may contribute to the development of HTN in patients with insulin resistance,[25]which leads to strong possibility of increased FBS and BP as the main miscreant in the causing of MetS. Abdominal obesity, hypertriglyceridemia, HTN, hyperglycemia and decreased HDL-C were differently prevalent in male and females of both young and old population. For both males and females hyperglycemia, hypertriglyceridemia and abdominal obesity factors affected significantly with succeeding age. For young individuals this was only applicable for increased WC/ central obesity. Males <40 years of age more likely had MetS than the old males. In contrast, females ≥40 years were more prone to have MetS. There were no significant associations between any of risk factors of MetS except for increased WC in young population differentiated on basis of gender; whereas in old population FBS and TG were found associated.

In different studies till date relation between tobacco addiction and a positive family history with MetS have not been explained. Our study showed tobacco addiction significantly increased the risk of MetS by varying degree in young population ($p=0.012$) and had no compelling effect in the other group. The same also can be concluded for genetic background, it was an important risk predicting factor in the terms of a positive family history for premature CAD raised the chances of MetS significantly with $p<0.05$.

Many studies also indicated that the prevalence of MetS was double in males as compared to females.[25] However, in many of the studies worldwide and in Indian subcontinent, women had a higher prevalence of MetS.[21] Although MetS was more prevalent in Gujarati males than females, the difference was less than double in the young population as compared to the old population.

CONCLUSION

This cross-sectional study of Asian Indian Gujarati population showed the prevalence of MetS more than double in old population. Females in both young and old population were less prone to be MetS affected. The study population males had low HDL-C concentration whereas females had most increased waist circumference. If abdominal obesity or increased waist circumference is kept at check, MetS incidence can be controlled by and large in the young population, which inturn lowers the chances of MetS incidence with increasing age.

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