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PREVALENCE OF METABOLIC SYNDROME AND ITS RISK COMPONENTS: A COMMUNITY BASED STUDY IN A HILL STATE OF INDIA

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ABSTRACT

Aim: The aim of the study was to estimate the prevalence of Metabolic syndrome in a semiurban region of Uttarakhand. Methods: This was a community based cross-sectional study which included 274 participants. After getting written consent from the participants, detailed history was recorded. Physical examination was done and anthropometric measurements recorded as per protocol. Fasting blood samples were taken for estimation of fasting plasma glucose, HDL and triglycerides. Results: Out of 274 participants, according to harmonization criteria, the prevalence of MetS was 27% (n=74). Out of 212 males, 52 were MetS positive while 160 were MetS negative. Out of 62 female participants, 22 were MetS positive while 40 were MetS negative. Central obesity was the most common derangement both among males and females.

Conclusion: In conclusion, the study population has a high prevalence of MetS. Females and older populations were affected more than males and younger participants due to age and gender related metabolic changes.

Introduction

The metabolic syndrome (MetS) is a complex disorder having widespread socioeconomic impact due to increased morbidity and mortality. MetS consists of an inter-related cluster of several metabolic and physiological abnormalities including abdominal obesity, impaired glucose and lipid metabolism and arterial hypertension. [1] It is a premorbid condition that contributes to the development of cardiovascular disease (CVD) and type 2 diabetes mellitus (T2DM) in non-diabetic patients. Additionally, it increases the risk of premature death, renal disease, mental disorders and cancer. Thus MetS represents a serious public health problem. There are various criteria for the diagnosis of metabolic syndrome out of which the International Diabetes Federation (IDF) and Harmonization criterion for Asian Indians are widely accepted.[2-4] Increased prevalence of obesity due to physical inactivity, irregular diet and urbanization has led to an increase in cases of metabolic syndrome.[5] Prevalence of MetS also increases with age for individuals older than 50 years, new eating patterns, changes in the work environment, number of meals in a day, duration of sleep, low socioeconomic people and smokers. So prevention and treatment of MetS are based on changes in lifestyle along with the multifactorial approach based on education, regular physical exercise, healthy diet and pharmacological strategies. [1] Metabolic syndrome (MetS) is a major epidemic of 21st century. In 2015, out of 56.4million deaths globally, 39.5 million were due to non-communicable diseases among which MetS contributed a major portion globally.[6] It is prevalent across all ages from the adolescent to the elderly irrespective of gender, socioeconomic status, ethnicity and family history. In India, the prevalence of MetS ranges from 30%-45% according to various studies.[7-10] The objective of the current study was to estimate the prevalence of MetS and its components in a community of north India.

Material and methods

This was a community-based, observational cross-sectional study carried out from September 2015 to August 2016 at the Department of Biochemistry, of a tertiary care teaching hospital in North India. The study was approved by the Institutional Ethics Committee (Reference no. IEC/IM/05/RC/04). It was a convenient sampling method. Volunteers >18 years from hospital staff (doctors, nurses, and technical and clerical staff) banks and schools of Rishikesh were enrolled. After getting written consent from the participants, detailed history (age, gender & medical history) was taken and recorded in their respective proforma. Physical examination was done and anthropometric measurements recorded as per protocol. Blood pressure (BP) was measured in the sitting position. An average of three readings was taken and the mean was considered as a final reading. Waist circumference (WC) was measured midway between the lowest point of the rib cage and the superior border of the iliac crest at the

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end of normal expiration with a stretch-resistant measuring tape. The IDF criteria and harmonization criteria were used for the diagnosis of MetS [9] (table 1)

Exclusion criteria

1) Age less than 18years

2) History of Cushing syndrome, Hypothyroidism, Secondary hypertension, Type 1 diabetes, Hepatobiliary disease, Nephrotic syndrome and pregnancy.

Fasting blood samples were taken for estimation of fasting plasma glucose (FPG), HDL and triglycerides. Glucose was estimated by the hexokinase method while HDL and triglycerides were done by enzymatic colorimetric assays.[11,12] All analysis was performed on Beckman Coulter AU680 fully automated analyzer and two levels of quality control material (Beckman Coulter) were used.

Statistical analysis

Chi-square test was used to find out the difference between components of MetS in MetS positive and MetS negative population using the IBM SPSS trial version 20 statistical package. Data were considered to be significant if $p < 0.05$, highly significant if $p < 0.001$ and extremely significant if $p < 0.0001$.

Results

In our study, 300 participants were initially enrolled, however 26 were later excluded due to incomplete data and 274 were included. The general characteristics of study participants and MetS positive cases are given in the table 2. Out of 274 participants, 212 (77.4%) were males while 62 (22.6%) were females. The mean age of study participants was 34.4±9.4 years. Out of 274 participants, 113 (41.2%) were obese as well as hypertensive, 111 (40.5%) had decreased HDL levels, 67 (24.5%) had impaired FPG and 64 (23.4%) had increase TG levels. Participants were diagnosed as MetS as per harmonization criteria and their general characteristics are mentioned in Table 3. The prevalence of MetS was 27% (n=74) according to harmonization criteria. Out of these, 66.2% (n=49) were overweight while 21.6% (n=16) were obese. According to IDF criteria, prevalence of MetS was 21.1% (n=58), 69% (n=40) of these cases were overweight and 24.1 % (n=14) were obese. For further analysis, harmonization criteria were used. The older adults (41-60yrs) had a higher prevalence of MetS syndrome (37.7%) in comparison to young individuals (20-40 yrs, 23.3%) All the parameters were found to be significantly deranged (p value=0.001) in MetS positive cases in comparison to MetS negative participants. (Table 3) Amongst MetS cases, central obesity was the most common factor (78.4%) followed by HTN (74.3%), decreased HDL levels (67.6%), increased TG levels (54.1%) and impaired FPG levels (50%). (Table 4) The prevalence of MetS was more among females in comparison to males (35.5% and 24.5% respectively). Mean age of MetS positive males was 36.6 years while the mean age of MetS positive females was 38.6 years. Amongst MetS males, HTN (76.9%) and central obesity (69.2%) were the most common factors, while amongst MetS females, central obesity (100%) and decreased HDL levels (90.9%) were the most common derangements. (Table 5)

Table 1: Diagnostic criteria of metabolic syndrome according to Harmonization and IDF definitions

	International Diabetes Federation (IDF)	Harmonization criterion for Asian Indians (Harmonization)
Abdominal obesity (waist circumference)		
Men	≥ 90 cm	≥ 90 cm
Women	≥ 80 cm	≥ 80 cm
Hyperglycemia	≥ 100 mg/dL	≥ 100 mg/dL
Hypertriglyceridemia	≥ 150 mg/dL	≥ 150 mg/dL
Low HDL cholesterol		
Men	< 40 mg/dL	< 40 mg/dL
Women	< 50 mg/dL	< 50 mg/dL
Elevated blood pressure	≥ 130/ ≥ 85 mm Hg	≥ 130/ ≥ 85 mm Hg
Diagnostic criteria	Must have abdominal obesity + 2 other risk factors	3/5 risk factors

Table 2: General characteristics of study participants

Characteristics	Study participants (mean ± SD) n = 274	MetS positive cases (mean ± SD) n = 74
Age	34.4 ± 9.4	37.2 ± 10.4
FBS	94.9 ± 19.9	104.1 ± 28.2
TG	134.5 ± 91.6	198.4± 126.9
HDL	43.8 ± 8.6	40.4 ± 9.2
Systolic BP	123.3 ± 12.8	130.1 ± 13.2
Diastolic BP	80.9 ± 11.2	85.5 ± 9.3
Waist circumference	34.1 ± 6.1	36.8 ± 7.2
BMI	23.9 ± 3.2	25.6 ± 2.3

Table 3: Participant profile according to different components

	MetS positive (n = 74)	MetS negative (n = 200)	p value
Age (yrs)			
20 - 40	49 (23.3%)	161 (76.7%)	
41 - 60	23 (37.7%)	38 (62.3%)	0.02
Gender			
Male	52 (24.5%)	160 (75.5%)	0.094
Female	22 (35.5%)	40 (64.5%)	
FPG			
≥ 100	37 (55.2%)	30 (44.8%)	**0.001**
< 100	37 (17.9%)	170 (82.1%)	
HDL			
Decrease	50 (45%)	61 (55%)	**0.001**
Normal	24 (14.7%)	139 (85.3%)	
TG			
≥ 150	40 (62.5%)	24 (37.5%)	**0.001**
< 150	34 (16.2%)	176 (83.8%)	
HTN			
Present	55 (48.7%)	58 (51.3%)	**0.001**
Absent	19 (11.8%)	142 (88.2%)	
Central obesity			
Present	58 (51.3%)	55 (48.7%)	**0.001**
Absent	16 (9.9%)	145 (90.1%)	
BMI			
< 18.5	0	19 (100%)	
18.5-23	9 (10.6%)	76 (89.4%)	
23-27.5	49 (37.7%)	81 (62.3%)	
> 27.5	16 (40%)	24 (60%)	

*** Out of three participants of age more than 60 years, two were MetS positive.**

Table 4: Percentage of participants with MetS positive status

	% of MetS positive cases
FPG	
≥ 100	50%
< 100	50%
HDL	
Decrease	67.6%
Normal	32.4%
TG	
≥ 150	54.1%
< 150	45.9%
HTN	
Present	74.3%
Absent	25.7%
Central obesity	
Present	78.4%
Absent	21.6%

Table 5: Gender based MetS components profile

	MetS +ve males (n = 52)		MetS +ve females (n = 22)	
Parameters	**Abnormal**	**Normal**	**Abnormal**	**Normal**
FPG	31 (59.6%)	21 (40.4%)	6 (27.3%)	16 (72.7%)
TG	32 (61.5%)	20 (38.5%)	8 (36.4%)	14 (63.6%)
HDL	30 (57.7%)	22 (42.3%)	20 (90.9%)	2 (9.1%)
HTN	40 (76.9%)	12 (23.1%)	15 (68.2%)	7 (31.8%)
Central obesity	36 (69.2%)	16 (30.8%)	22 (100%)	0

Discussion

The prevalence of MetS in our study population was 27% (as per harmonization criteria), which is higher than the prevalence of 21%, reported by us earlier in a similar population of the same region.[7] This difference may be due to a general increase in the prevalence of MetS, facilitated by a sedentary lifestyle.[13] Several other studies from India have reported similar MetS prevalencein different states. Banerjee R et al.[8] observed 44.6% prevalence rate of MetS in West Bengal.Harikrishnan et al.[9] observed in a community-based study in Kerala that the prevalence of MetS was 29% according to IDF criteria and 33% according to Harmonization criteria. Singh et al.[10] found that prevalence of MetS was 26.6% by IDF criteria in Haryana. The prevalence of MetS in this study was higher with harmonization criteria than IDF criteria (27% and 21% respectively).This difference may be due to different criteria used by the these definitions with central obesity not being an essential component in Harmonization criteria. In our study also, several participants had metabolic derangements but did not have central obesity, excluding them from the diagnosis of MetS. Prevalence of MetS was higher among older participants (41-60 yrs) in comparison to young participants (20 40yrs).[14,15] Taking age as an example, from NHANES III in the US, a marked increase in the prevalence of the MetS from 20 years of age through the sixth decade of life was noted for men and through the seventh decade for women.[16] Birarra MK et al.[17] also observed increased prevalence rate of MetS with an increase in age. A gradual decrease in basal metabolic rate, stress-induced hypercortisolism, hypogonadism, decreased in growth hormone secretion, concomitant insulin resistance, and abdominal fat deposition are the changes that occur in the body with increasing age leading to increase chances for developing MetS.[18,19] In the present study, it was found that prevalence is more amongst females in comparison to males. These findings are corroborated by several other studies.[9,20-22] This difference can be explained by the fact that females have various physiological differences in contrast to males, including pregnancy-induced weight gain, gestational DM, use of hormonal oral contraceptives (which decrease insulin sensitivity, increase blood pressure and increase in weight gain with age), and menopause promoting change in body fat distribution leading to increase central adiposity.[23] The prevalence of MetS was higher amongst obese participants. These findings are well expected and shown by several other studies.[24.,25] Obesity and insulin resistance are the principal causative factors in the development of MetS.[26] TG and HDL were also the frequent deranged MetS components. Abnormal levels of TG and HDL have been implicated with adverse health effects. A low level of HDL is associated with an increased risk of CVD and death.[27] Thus we have to focus on interventions to improve HDL levels. The economic development over the past few decades have altered the lifestyle of several populations. Besides a reduction in overall physical activity, dietary habits have also changed, with a shift to decreased consumption of fruits and vegetables and higher consumption of processed foods. A healthier lifestyle needs to be promoted. Individuals should do regular exercise, eat foods with a little amount of saturated fats and cholesterol along with fiber-rich foods.[28]

Conclusion

In conclusion, the study population had a high prevalence of MetS. Females were affected more than males. Further, the older population were more susceptible to these metabolic derangements as compared to younger participants due to age-related metabolic changes. Central obesity along with arterial hypertension was the most significant indicator of MetS. Effective health programs are required for the prevention of MetS to decrease the prevalence of cardiovascular disease in the young population.

Conflicts of Interest

There is no potential conflict of interest relevant to the manuscript.

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