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ORIGINAL ARTICLE

Study of Metabolic Syndrome and Its Risk Components in Patients Attending Tertiary Care Center of Uttarakhand

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Abstract Metabolic syndrome is a complex of metabolic factors which includes central obesity, insulin-resistance, dyslipidemia and hypertension. Metabolic syndrome is associated with increased risk of cardiovascular disease. This study aimed to know the rate of metabolic syndrome in outpatients presenting to medicine department of our hospital and their profile. The metabolic syndrome was diagnosed using International Diabetes Federation criteria. The parameters analyzed included age, sex, blood pressure, BMI, fasting plasma glucose, HDL and triglycerides. The rate of metabolic syndrome was 21.1 % in our study. The younger population was most susceptible to metabolic derangements. Further, females were found to be affected more than males. The extremely significant parameters were deranged fasting plasma glucose, HDL, triglycerides while hypertension was found to be insignificant. Being overweight maybe a strong predictor for presence of metabolic syndrome in our region of study, and all overweight persons should be assessed and appropriately treated to prevent future cardiovascular events.

Keywords Metabolic syndrome · Parameters · Profile · Factor analysis

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Introduction

Metabolic syndrome (MS) is a complex of metabolic factors that are associated with increase in risk of cardiovascular disease (CVD), diabetes mellitus (DM) and fatty liver [1, 2]. Early detection of MS may lead to prevention of these conditions [3]. The components of MS include central obesity, insulin resistance, dyslipidemia [decreased high density lipid (HDL) and increased triglycerides] and hypertension. Individuals with MS, depending on the number of components present, have a 30–40 % probability of developing diabetes and/or CVD within 20 years [1].

International Diabetes Federation (IDF) has given a new definition for diagnosis of MS in which central obesity, with incorporation of ethnic variations, has been given primary importance (Table 1). Prevalence of the MS in Asian Indians varies according to region, extent of urbanization, lifestyle patterns, and socioeconomic/cultural factors [4]. The reported prevalence of MS varies from 20 to 30 % in different regions of Indian [5, 6]. There are very few reports on component analysis of MS and their impact in semi-urban populations of Uttarakhand, which is a hill state of India. This study aimed to analyze the profile and evaluate components of MS in patients visiting tertiary care center of Kumaon region of Uttarakhand. The study also

Table 1 IDF criteria for diagnosis of metabolic syndrome

Central obesity	BMI >30 kg/m^2
Plus any two of the following	
Raised triglycerides	≥150 mg/dl or specific treatment for this lipid abnormality
Reduced HDL cholesterol	<40 mg/dl in males, <50 mg/dl in females or specific treatment for this lipid abnormality
Raised blood pressure	Systolic BP ≥130 or diastolic BP ≥85 mmHg or treatment of previously diagnosed hypertension
Raised fasting plasma glucose	FPG ≥100 mg/dl or previously diagnosed type 2 diabetes

aimed to find out difference, if any, between components of MS in MS positive and MS negative population in a tertiary care hospital in Uttarakhand.

Materials and Methods

This was a cross-sectional study, including outpatients presenting to medicine department of Government Medical College and Sushila Tiwari Hospital, Haldwani, Uttarakhand. All patients aged <18 years or who had history of Cushing syndrome, Hypothyroidism, Secondary hypertension, Type 1 diabetes, Hepatobiliary disease, Nephrotic syndrome or pregnancy were excluded. The study was approved by institutional ethics committee. The IDF criteria for diagnosis of MS was used (Table 1). After recording history (age, gender, medical history), blood pressure (BP) was measured in sitting position. An average of three readings was taken. Height was measured with a non-stretchable wall mounted measuring tape and weight was recorded with a weighing machine. Body mass index (BMI), was calculated [weight (kg)/height (m)^2]. BMI of 18.5–24.9 were considered to be of optimal weight while BMI 25–29.9 was overweight and BMI >30 was obese [7]. Fasting blood samples were taken for estimation of fasting plasma glucose (FPG), HDL and triglycerides. Glucose was estimated by hexokinase method (Roche Diagnostics, Mannheim), while HDL and triglycerides were done by enzymatic colorimetric assays (Roche Diagnostics, Mannheim). All analysis were performed on Roche Cobas c501 fully automated analyzer and two levels of quality control material (Roche Diagnostics, Mannheim) were used.

Statistical Test

Chi square test was used to find out difference between components of MS in MS positive and MS negative population. $p < 0.05$ was considered significant $p < 0.001$ very significant and $p < 0.0001$ extremely significant.

Results

A total of 400 patients were initially enrolled in the study, however 20 were later excluded due to incomplete data and 380 were included. Participants were diagnosed as having metabolic syndrome as per IDF criteria and their general characteristics are mentioned in Table 2. 35.5 % participants (135/380) were found to be overweight while 21.1 % were obese (80/380). FPG was elevated in 44.7 % (170/380) of study participants. 22 % (85/380) participants were diabetic. Similarly, triglycerides (TG) were increased in 44.7 % (170/380) of participants while 65.8 % (250/380) had elevated BP. Surprisingly, a very large proportion (80.3 %) of participants (305/380) had reduced HDL.

The rate of MS was 21.1 % (n = 80). The profiling of patients with and without MS is shown in Table 3. The prevalence of MS in female (n = 140) and male participants (n = 240) was 39.2 and 10.4 % respectively; and difference was found extremely significant ($p = 0.0001$). On age-wise analysis, the maximum prevalence of MS was seen in age group 20–40 years (n = 105) followed by groups >60 years (n = 65) and 41–60 years (n = 210) (28.6 %, 23.1 % and 16.7 % respectively) with statistically significant difference ($p = 0.046$).

The percentage of participants with elevated TG was 75 % (60/80) and 36.7 % (110/300) amongst participants with and without MS ($p = 0.0001$). 75 % (60/80) of participants with MS and 36.7 % (110/300) of participants without MS had elevated FPG and the difference was extremely significant ($p = 0.0001$). 75 % (60/80) of participants with MS had elevated BP while 63.33 % (190/300) of MS negative participants had elevated BP although the difference was not significant ($p = 0.051$). 62.5 % (50/80) MS participants had reduced HDL levels while it was 85 % (255/300) for participants without MS ($p = 0.0001$).

Table 2 General characteristics of study participants

Characteristic	Value
Age	48.25 ± 12.39 years
Sex	
Male	240 (63.2)
Female	140 (30.8)
Weight	69.16 ± 14.92 kg
BMI	26.59 ± 5.77 kg/m^2
Triglycerides	151.45 ± 70.36 mg/dl
HDL	38.47 ± 5.27 mg/dl
FPG	103.86 ± 34.52 mg/dl
Blood pressure	
Systolic	137.49 ± 23.61 mmHg
Diastolic	87.3 ± 12.88 mmHg

Table 3 Profile of patients with and without MS

Factors	MS positive	MS negative	*p* value
Age (years)			
20–40	30	75	0.046
41–60	35	175	
>61	15	50	
Sex			
Males	25	215	0.0001
Females	55	85	
BMI (m^2/kg)			
>30	80	0	–
>25	0	135	
>23	0	165	
FPG (mg/dl)			
>100	60	110	0.0001
<100	20	190	
HDL (mg/dl)			
Decreased	50	255	0.0001
Normal	30	45	
Triglycerides (mg/dl)			
>150	60	110	0.0001
<150	20	190	
Hypertension			
Present	60	190	0.051
Absent	20	110	

Table 4 Number of parameters deranged in participants with and without MS

Number of parameters (BMI, FPG, BP, HDL, TG)	MS present (n = 80)	MS absent (n = 300)
One (n = 41)	0 % (0)	13.7 % (41)
Two (n = 53)	0 % (0)	17.7 % (53)
Three (n = 104)	31.3 % (25)	26.3 % (79)
Four (n = 67)	50 % (40)	9.0 % (27)
Five (n = 15)	18.8 % (15)	0 % (0)

The number of parameters deranged in participants with and without MS are shown in Table 4.

Discussion

Asian Indians are a high risk population with regards to cardiovascular disease and diabetes, and the number of those at-risk is increasing consistently [1]. Therefore this study was designed to assess the prevalence of MS and analyze the significance of various components of MS in patients visiting our medicine OPD. To the best of our knowledge this is first study on metabolic syndrome in Uttarakhand, which is a hilly state of India.

The results of the present study show that prevalence of MS was 21.1 %, which is similar to prevalence in other regions of India and Asia as shown by different studies [6, 8, 9]. Prevalence of MS has been reported 19.52 % in Maharashtra, 31.6 % in Rajasthan and 41 % in Tamil Nadu [6, 10, 11]. As different studies have used dissimilar criteria for diagnosis of MS, the comparison may be unsubstantial. This perhaps reinforces the requirement of an internationally acceptable and relevant definition. The rates of MS in our study population were higher in females compared to males. This gender difference is in concordance with other studies [6, 9, 10, 12] and is important to be clearly identified as certain conditions specific to females, such as pregnancy, menopause, polycystic ovarian syndrome, etc. may aggravate cardiovascular risk in association with MS [13].

A higher number of younger participants were found to be having MS, which is surprising, as traditionally, all metabolic parameters associated with MS are known to derange with increasing age [14–17]. This variation may probably be due to changing lifestyle of younger generation over the past decades, with increasing preference for junk food and reduced physical activity [18]. Moreover rigourous lifestyle behaviour of hilly people also have been shifted to moderate one in this millennium due to economic liberalization and market reforms in our state. Gupta et al. [19] have also shown that cardiovascular risk factors are escalating at a younger age group in Asian Indians. It has also been shown that DM and MS are associated with increased oxidative stress and inflammation therefore therapeutic life style along with antioxidant intake may be beneficial [20–22].

In this study, 36.8 % participants were overweight while 21.1 % were obese. The data from Integrated Disease Surveillance Project (IDSP) for Uttarakhand in 2008 showed that the prevalence of overweight and central obesity was 14 and 18 % respectively [23]. The prevalence of obesity ranged from 6 to 30 % in different parts of our country [24–26]. The National family Health Survey 3 (2005–2006) found that 9 and 13 % of males and females respectively were overweight/obese [27]. Thus the overweight and obesity patterns in Uttarakhand are slightly higher than countrywide trends. Although BMI as a marker of obesity was used in this study, it is established that BMI is not a good indicator of total adipose tissue concentration as well as fat distribution; the cut off for BMI >30 for obesity is controversial [28, 29]. Also, Asian populations have been shown to have a greater predisposition for atherosclerosis and diabetes at a lower level of BMI [30, 31]. Though some studies have used BMI >23 as cut off value, this is not yet accepted universally and a WHO expert consultation group has recommended that WHO cut offs for BMI (>30 kg/m^2) should be retained as such [32].

Better indicators, such as waist hip ratio can be used to for better assessment of population with MS but were not used in this study due to resource constraints.

The difference of TG levels in participants with and without MS was extremely significant inflicting it as an important contributor in MS. NHANES study further established higher TG levels is a significant parameter in MS [33].

We found that 31 % of diabetic patients were having MS. An earlier study had found that 62 % of newly diagnosed T2DM patients were having MS according to IDF criteria [34] and it has also been suggested that family history of T2DM can be useful predictor for diagnosis of MS [35]. It is known that impaired fasting glucose is a risk factor for diabetes and both are known to be associated closely with obesity, though the mechanism behind this is not confirmed yet [36].

Though a large number of MS participants had elevated BP, the difference was not significant. Prevalence of history of hypertension was not found significant in a study on metabolic syndrome in urban India reinforcing our findings [6].

Further, there was extremely significant difference in HDL levels of participants with or without MS, although overall HDL levels in our study population were found to be low. It has been reported earlier that only 4 % Asian men and 5 % Asian women had normal HDL levels. Similarly, studies conducted on a large group of Indian participants had low HDL levels [37, 38]. Epidemiological studies are needed to assess the baseline levels of HDL in healthy population, as population of this region may be having significant variations in HDL level from reference values.

To have further insight when we assessed number of parameters deranged in each participants we came across a dilemma. A large number of participants (35.3 %) had 3 or more parameters deranged, but were not classified as having MS because their BMI was <30, which is an essential criterion for diagnosis of MS according to IDF definition. It has been shown earlier that the prevalence of MS is lowest using IDF criteria [34]. Thus, it is important to note that as cut-off values for various parameters have been abridged in IDF criteria, the number of persons diagnosed as MS has reduced considerably.

Conclusions

Thus we conclude that in our study population, the prevalence of MS is 21.1 %, and females are affected more than males. Further, younger population is more susceptible to these metabolic derangements. Elevated TG and Reduced HDL are most significant indicator of MS. Being overweight is a strong predictor for presence of metabolic syndrome in our region of study, and all overweight persons should be assessed and appropriately treated to prevent future cardiovascular events. We also suggest a need to monitor those having >3 parameters deranged for future development of CVD.

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