# Brief Communication

# Prevalence of metabolic syndrome among newly diagnosed hypertensive patients in the hills of Himachal Pradesh, India

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## ABSTRACT

To study the prevalence of metabolic syndrome (MS) among newly diagnosed hypertensive patients in a tertiary care hospital in the northern hilly state of Himachal Pradesh, India, located in western Himalayas at a moderate altitude of 2200 m above mean sea level. One hundred and eighteen newly diagnosed hypertensive patients above the age of 20 years were studied in a hospital-based cross-sectional study. MS prevalence was estimated by International Diabetes Federation (IDF) criteria and modified National Cholesterol Education Program-Adult Treatment Panel III (NCEP-ATP III) criteria. Student's *t*-test was used to compare the mean of the continuous variables. Chi-square test was used to compare discrete variables. The prevalence of MS in hypertensive patients was 68.6% (modified NCEP-ATP III) and 63.6% (IDF criteria). The most common phenotype of MS with the component of hypertension was the coexistence of waist circumference (90.1%), low high-density lipoprotein (HDL; 70.4%), and high triglycerides (67.9%) as per the modified NCEP-ATP III criteria, and low HDL (76.2%) and high triglycerides (66.4%) as per the IDF criteria. Fasting blood glucose (33.2% as per the modified NCEP-ATP III criteria and 32.6% as per the IDF criteria) was the least significant factor having an association with MS. The prevalence of MS among hypertensive patients was high and indicates the need for metabolic screening in all hypertensive patients at the first diagnosis.

**Key words:** Hypertension, India, metabolic syndrome, moderate altitude, western Himalayas

## INTRODUCTION

An elevated arterial pressure is an important public health problem in developed countries, as well as in India.[1,2] Hypertension is the most common modifiable risk factor for coronary artery disease, stroke, congestive heart failure, end-stage renal disease, and peripheral vascular disease. Metabolic syndrome (MS) is the "fertile soil," and is strongly predictive of developing diabetes mellitus and cardiovascular diseases and subsequent mortality in future. No studies on estimation of MS in hypertensive patients from native population living either at moderate altitude or in plains of India have been done so far to the best of our knowledge. Higher altitude is an environment which provides natural experimental setting to study the series of adaptive changes like lower blood glucose, better utilization of glucose in peripheral tissue, higher insulin sensitivity, and greater caloric expense due to chronic hypobaric hypoxia. To assess the prevalence of MS among newly diagnosed hypertensive patients, the present study was designed and was conducted in a tertiary care hospital in the northern hilly state of Himachal Pradesh, India, located in western Himalayas at a moderate altitude of 2200 m above mean sea level.

## MATERIALS AND METHODS

A total of 118 patients of hypertension, above the age of 20 years, were included in the study. Patients with secondary

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hypertension, secondary cause of obesity, pregnant women, with any acute illness, on steroidal medications or any other medications likely to cause elevated plasma glucose and patients not willing to participate in the study were excluded from the study. Approval from the College Ethics Committee was obtained. Participants were subjected to detailed history, clinical examination, standard anthropometry measurements, and biochemical investigations on the day of presentation. Well-established definitions and criteria of MS, i.e., International Diabetes Federation (IDF) definition[3] and National Cholesterol Education Program-Adult Treatment Panel III (NCEP-ATP III) criteria modified for Asian subjects,[4] were used for estimating the prevalence. Student's *t*-test was used to compare the mean of the continuous variables. Chi-square test was used to compare discrete variables. All analyses were performed with SPSS version 10.

## RESULTS

The prevalence of MS was 68.6% (modified NCEP-ATP III criteria) and 63.6% (IDF criteria). The prevalence of MS in men, women, and both combined is shown in Table 1. The most common phenotype of MS with the component of hypertension was the coexistence of waist circumference (90.1%), low high-density lipoprotein (HDL; 70.4%), and high triglycerides (67.9%) as per the modified NCEP-ATP III criteria. As per IDF, the most common phenotype of MS with the component of hypertension in coexistence with obligatory waist circumference was low HDL (76.2%) and high triglycerides (66.4%). Fasting blood glucose (33.2% with modified NCEP-ATP III and 32.6% with IDF criteria) was the least significant factor having an association with MS [Figure 1]. IDF values were not significantly different from those of modified NCEP-ATP III criteria. The results of demographic profile and risk factors of hypertensive patients with or without MS are shown in Table 2.

## DISCUSSION

The findings of our study indicate that 68.6% and 63.6% of hypertensive patients had MS according to the modified NCEP-ATP III criteria and IDF criteria, respectively. The prevalence rates for the two sets of

criteria (modified NCEP-ATP III and IDF) used in our study were 58.1% and 50% in males and 86.3% by both criteria in females, respectively. The prevalence of MS in hypertensive patients was high and is consistent with previous reports from other parts of the world.[5-7] However, lower prevalence has been reported in other studies.[8-12] The increased prevalence found in our study may be the true reflection of the impact of changes in lifestyle, improvement in socioeconomic status, and urbanization of community living at this altitude. In addition, the IDF and modified NCEP-ATP III definition, the mean age of the study sample, and the fact that the data were obtained from an analysis of hypertensive patients in a reference hospital are also contributory. The prevalence is overwhelmingly predominant in women probably due to their lifestyle including sedentary habits and staying at home. Higher prevalence in women at high altitude has been reported in the past with similar explanation.[13] Older age was an independent risk factor associated with MS and is consistent with other studies.[14-17] In the present study, 72% of the patients had central obesity and 73.7% were overweight/obese. Impact of altitude on the prevalence of central obesity has been studied by one of the authors (PCN) and others also, and they have shown contradictory results in the past.[18,19] Higher body mass index (BMI) as a strong predictor of hypertension has been reported in various studies from India and abroad.[14,20-23] Reduced HDL was the commonest lipid abnormality recorded among the
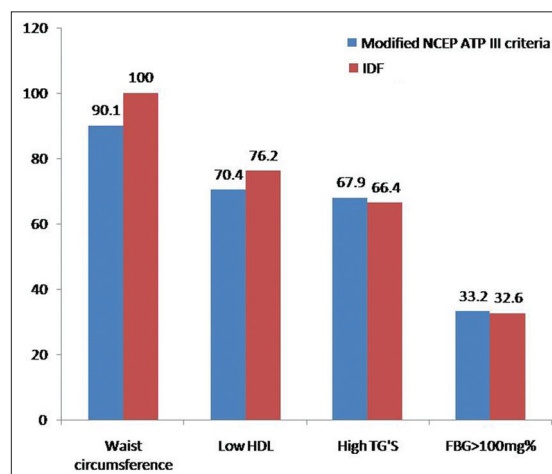


**Figure 1:** Frequency distribution of components of metabolic syndrome

| Table 1: Prevalence of metabolic syndrome by modified NCEP-ATP III and IDF criteria | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| Criteria | Prevalence | | | | | | | | |
| | Total (*N*=118) | | | Males (*n*=74) | | | Females (*n*=44) | | |
| | No. | % | 95% CI | No. | % | 95% CI | No. | % | 95% CI |
| Modified NCEP-ATP III | 81 | 68.6 | 59.9–76.4 | 43 | 58.1 | 56.6–74.4 | 38 | 86.3 | 55.4–75.8 |
| IDF | 75 | 63.6 | 54.2–72.2 | 37 | 50.0 | 55.2–76.6 | 38 | 86.3 | 54.3–76.7 |

NCEP-ATP III: National cholesterol education program-adult treatment panel III, CI: Confidence interval, IDF: International diabetes federation

## Table 2: Baseline characteristics of hypertensive patients with and without metabolic syndrome

| Characteristics | Study population (N=118) | | |
|---|---|---|---|
| | MS present value | MS absent (*n*=37) | *P* (*n*=81) |
| Demographic profile | | | |
| Age (years) | 50.9±9.7 | 50.8±15.7 | 0.02 |
| Sex | | | |
| Males | 43 (53.1) | 31 (83.8) | 0.70 |
| Females | 38 (46.9) | 6 (16.2) | |
| Rural/urban | | | |
| Rural | 36 (44.4) | 27 (73.0) | 0.30 |
| Urban | 45 (55.6) | 10 (27.0) | |
| Smokers | 27 (33.3) | 7 (18.9) | 0.23 |
| Systolic BP | 146.9±12.0 | 135.4±12.6 | <0.001 |
| Diastolic BP | 93.3±4.0 | 88.1±7.8 | 0.001 |
| Risk factors | | | |
| Central obesity | 76 (93.8) | 9 (24.3) | 0.001 |
| Overweight/obesity | 77 (95.0) | 10 (8.5) | 0.001 |
| Dyslipidemia | 81 (100) | 25 (67.6) | 0.07 |
| Fasting blood glucose (mg/dl) | 95.5±14.7 | 86.8±11.0 | 0.002 |
| TC (mg/dl) | 165.6±52.0 | 164.4±24.9 | 0.02 |
| HDL (mg/dl) | 40.4±3.8 | 45.3±6.3 | <0.001 |
| LDL (mg/dl) | 108.0±26.8 | 87.7±21.4 | <0.001 |
| TG (mg/dl) | 137.9±39.9 | 131.0±30.4 | 0.01 |

Values are given as mean±SD or number (%), BP: Blood pressure, TC: Total cholesterol, HDL: High-density lipoprotein, LDL: Low-density lipoprotein, TG: Triglycerides, MS: Metabolic syndrome

hypertensive patients (56.8%), followed by increased triglycerides (50%), increased total cholesterol (36.4%), and increased low-density lipoprotein (LDL; 20.3%). These results are consistent with previous observations from India and other parts of the world.[14,15,22-25] Lipid profile estimation in the natives at high altitude revealed that the total cholesterol decreased with increasing altitude, whereas HDL increased.[26] Another study revealed a high prevalence of hypercholesterolemia (34.3%), hypertriglyceridemia (53.9%), and low HDL (45.3%) in high-altitude natives.[19] In our study patients, the parameter that was found to be rather weak in hypertensive patients was that 23.7% had impaired fasting glucose, which is consistent with previous reports.[15,22,25] Mean systolic blood pressure and diastolic blood pressure of patients with MS were significantly higher than those without MS in our study. Mean blood pressure in patients with MS has been documented to be higher; however, it was not always the case.[17,25,27] Poor control of blood pressure has been established in hypertensive patients with the components of MS present.[23,28]

To summarize, the high prevalence of MS among hypertensive patients establishes the epidemiological transition experienced in this region of moderate altitude, and MS has emerged as a significant health concern and indicates the need for metabolic screening in all hypertensive patients at the first diagnosis.

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