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## Research Brief

# Factors responsible for Uncontrolled Hypertension in the Adults over 50 years of age: A pilot study from Northern India

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## ABSTRACT

Hypertension is the most common chronic disease of older adults and an important modifiable cause of mortality and morbidity. In this cross-sectional study, we gathered information about the demographic profile and biochemical parameters associated with hypertension in 897 study subjects above 50 years by structured questionnaires and various laboratory investigations. Higher body mass index, sedentary lifestyle, male sex, living alone, diabetes mellitus, alcohol consumption, medication non-compliance, and a higher serum cholesterol level were associated significantly with uncontrolled hypertension in our study. Hence, weight reduction, adopting an active lifestyle, improving social support, and strict compliance with anti-hypertensives are the cornerstones of blood pressure control.

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## 1. Introduction

Hypertension is the most common chronic disease of older adults and is a significant contributor to atherosclerosis.<sup>1</sup> It is a modifiable risk factor that leads to a two to three times higher risk of atherogenic events. Uncontrolled hypertension can increase the risk of cardiovascular events and stroke to double.<sup>2</sup> In this study, we looked at the various factors having a role in uncontrolled hypertension. This is very important in the scenario of India and other developing countries; simple lifestyle changes can help overcome the burden of uncontrolled hypertension without causing any economic implications to the society. We believe that this study will provide a baseline for future studies on hypertension in India. There is a need for primordial prevention through Behavioral Change Communication (BCC) strategies to prevent the emergence of modifiable risk factors for uncontrolled hypertension by

adopting healthy lifestyles, regular physical activity, ensuring drug compliance, and prudent dietary practices during early adulthood.

## 2. Material and methods

This cross-sectional study was carried out at a tertiary care center catering to north India's population, over a period of one year. The in-patients and out-patients above 50 years of age attending our hospital were screened for hypertension. As ours was a pilot study, a sample size of 897 participants was enrolled. We used structured questionnaires to gather the demographic characteristics (age, marital status, education, financial dependence, and relevant medical history of the participant) and lifestyle-related information (specifically addictions and physical activity levels). The subjects underwent routine blood investigations. The study conforms to the Declaration of Helsinki and is approved by the local ethics committee. The JNC VIII<sup>3</sup> criteria were used to diagnose new hypertensive patients, we also enrolled the previously diagnosed patients. Subjects were asked to rest for 15 min and sit quietly with their legs uncrossed, and then Blood Pressure (BP) was measured by the auscultatory method with a standardized aneroid sphygmomanometer. We took three BP measurements and calculated their mean. Uncontrolled hypertension was defined as systolic BP  $\geq$  140 mm Hg or diastolic BP  $\geq$  90 mm Hg for < 60 years of age.

*Abbreviations:* BMI, Body Mass Index; BP, Blood Pressure; TG, Triglyceride; HDL, High-Density Lipoprotein; LDL, Low-Density Lipoprotein; SBP, Systolic Blood Pressure; DBP, Diastolic Blood Pressure; WHR, Waist Hip Ratio; SD, Standard Deviation.

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For age  $\geq 60$ , a systolic BP of 150 mm Hg or diastolic BP of 90 mm Hg was taken as the cut-off. Statistical analysis was done using SPSS version 26. T-test was utilized for comparing means of parameters between groups, and the correlation between variables was assessed by utilizing odds ratios and analyzing the logistic regression. P-value  $<0.05$  was considered significant.

### 3. Results

The magnitude of uncontrolled hypertension was 46.15% (414) in our study. Factors associated with uncontrolled hypertension are as described in Tables 1 and 2.

### 4. Discussion

The high prevalence of uncontrolled BP (46.15% in our study) can be explained by the fact that India is a predominantly rural society, and rural residents generally are less health conscious and do not have easy access to healthcare facilities and the necessary resources for the appropriate drug therapy. The resulting cardiovascular and atherogenic events due to this uncontrolled hypertension put a significant burden on developing countries' economies. Higher Body Mass Index (BMI), Waist-Hip ratio (WHR), and sedentary lifestyle are associated with higher BP, the most substantial effect seen in patients  $\geq 50$  years of age. BMI increase leads to an increase in the BP of 0.8–1.7 mm Hg/(kg/m<sup>2</sup>) in patients not taking anti-hypertensive medications.<sup>4</sup> This suggests the importance of weight loss and regular exercise in the control of hypertension. Male sex was significantly associated with uncontrolled BP in our study. Proposed mechanisms include the lack of estrogen, which modulates vascular endothelial function leading to vasodilation and reduced blood pressure. Androgens may also be involved in the pathogenesis as castrated males show slower progression of hypertension.<sup>5</sup> Uncontrolled hypertension was seen more in patients whose spouses were dead and those who lived alone. This indicates the role of psychological stress in hypertension and the benefits of staying together with family, which acts as a stress buster. Stress stimulates the nervous system, producing vasoconstrictors which may lead to increased blood pressure.<sup>6</sup> Diabetics demonstrated higher risk of uncontrolled hypertension. The characteristic of hypertension in diabetes is increased peripheral vascular resistance. The cause of hypertension in majority of the diabetic population cannot be explained by the underlying renal disease and remains “essential” in nature.<sup>7</sup> Alcoholics also demonstrated a significantly increased risk of uncontrolled hypertension. Alcohol-induced endothelial stimulation leads to vasoconstrictor mediator release, which, along with lowered relaxation due to inflammatory response and oxidative stress-mediated injury, leads to inhibition of endothelial-dependent nitric oxide (NO).<sup>8</sup> The association of tobacco intake with hypertension could not be well established. There is inconsistent data that indicates chronic tobacco smoking leads to a rise in blood pressure.<sup>9</sup> Instead, habitual smokers have shown lower blood pressure than non-smokers, which may be explained by lower body weight in smokers<sup>10</sup> and cotinine's (primary metabolite of nicotine) vasodilator effect.<sup>11</sup> Patients non-compliant with medications had a whopping 12 times higher risk of having uncontrolled hypertension. This tells the importance of strict medication compliance in BP control. Higher cholesterol levels are associated with high BP, with studies showing that dietary fats lead to hypertension in healthy subjects.<sup>12</sup> Hypercholesterolemia-induced atherosclerosis maybe the

underlying mechanism for this. Surprisingly, high HDL levels, which have known cardio-protective effects, correlated with higher BP levels. In a Japanese study including 1803 healthy subjects, HDL cholesterol was independently associated with hypertension.<sup>13</sup> Similarly low TG levels were seen in uncontrolled hypertensives. The mechanism for such findings is obscure to date and thus are significant findings requiring further investigations.

### 5. Limitations

As we only included the patients coming to the hospital, hospital bias is a limiting factor. In addition, as this is a questionnaire-based study, the validity of respondents' reports can hardly be appraised.

### 6. Key messages

- Factors significantly associated with uncontrolled hypertension include high BMI, sedentary lifestyle, male sex, living alone, diabetes mellitus, alcohol consumption, medication non-compliance, and higher serum cholesterol levels.
- Weight reduction, adopting a healthy and active lifestyle, moral support of the family, strict compliance with anti-hypertensive medications, and dietary modifications are the cornerstone of BP control.
- The strange correlation of high HDL and low TG levels with higher BP values needs to be studied further.

### Declaration of competing interest

No conflict of interest.

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### Appendix

**Table 1**  
Association of Uncontrolled Hypertension with various factors: Applied independent t-test

Variable	Total Mean $\pm$ SD	Hypertension		P-Value
		Uncontrolled	Controlled	
		Mean $\pm$ SD	Mean $\pm$ SD	
Age (years)	62.5 $\pm$ 9.4	62 $\pm$ 10	63 $\pm$ 9	0.206
BMI (kg/m <sup>2</sup> )	24.4 $\pm$ 6.59	25.11 $\pm$ 7.74	23.81 $\pm$ 5.35	0.003
Waist (cm)	55 $\pm$ 29	78 $\pm$ 29	66 $\pm$ 25	0.1
Hip (cm)	57 $\pm$ 20	80 $\pm$ 30	68 $\pm$ 24	0.1
WHR	0.96 $\pm$ 0.12	0.98 $\pm$ 0.14	0.94 $\pm$ 0.20	0.1
Cholesterol (mg/dl)	195.2 $\pm$ 49.4	199.8 $\pm$ 52.9	191.3 $\pm$ 45.8	0.01
TG (mg/dl)	164.9 $\pm$ 80.3	149.9 $\pm$ 90.0	177.7 $\pm$ 68.5	0.001
HDL (mg/dl)	46.74 $\pm$ 13.06	47.6 $\pm$ 12.50	45.94 $\pm$ 13.47	0.046
LDL (mg/dl)	123.2 $\pm$ 46.7	123.5 $\pm$ 59.6	123.0 $\pm$ 31.7	0.86
SBP (mm Hg)	141 $\pm$ 25	162 $\pm$ 18	122 $\pm$ 14	0.001
DBP (mm Hg)	80 $\pm$ 14	87 $\pm$ 13	73 $\pm$ 11	0.001

BMI: Body Mass Index; TG: Triglyceride; HDL: High-Density Lipoprotein; LDL: Low-Density Lipoprotein; SBP: Systolic Blood Pressure; DBP: Diastolic Blood Pressure WHR: Waist Hip Ratio; SD: Standard Deviation.

**Table 2**  
Regression analysis for factors associated with uncontrolled hypertension

Variables	Sub-Group	Total Count (%age)	Hypertension		Odds Ratio (95% CI)	P-Value
			Uncontrolled	Controlled		
			Count (%age)	Count (%age)		
Sex	Male	381 (42.5%)	191 (50.1%)	190 (49.9%)	<b>1.3</b> (1.01–1.7)	0.04
	Female	516 (57.5%)	223 (43.2%)	293 (56.8%)	0.75 (0.58–0.98)	
Rural/urban	Urban	403 (44.9%)	177 (43.9%)	226 (56.1%)	0.84 (0.65–1.1)	0.226
	Rural	494 (55.1%)	237 (48.0%)	257 (52.0%)	1.17 (0.90–1.53)	
Spouse	Alive	757 (84.4%)	344 (45.4%)	413 (54.6%)	0.83 (0.58–1.19)	0.32
	Dead	140 (15.6%)	70 (50.0%)	70 (50.0%)	1.2 (0.83–1.72)	
Living with	Alone	38 (3.3%)	34 (89.4%)	4 (10.6%)	<b>9.5</b> (3.36–27.2)	<0.0001
	Family	408 (45.5%)	194 (47.5%)	214 (52.5%)	0.9 (0.69–1.18)	0.48
	Spouse	451 (50.2%)	210 (46.5%)	241 (53.5%)	0.83 (0.64–1.08)	0.17
Education status	Illiterate	351 (39.1%)	168 (47.9%)	183 (52.1%)	1.11 (0.85–1.16)	0.41
	Primary	230 (25.6%)	110 (47.8%)	120 (52.2%)	1.09 (0.81–1.47)	0.55
	High school	38 (4.2%)	28 (73.6%)	10 (26.4%)	3.5 (1.72–7.49)	0.0006
	Intermediate	130 (14.5%)	41 (31.5%)	89 (68.5%)	0.5 (0.34–0.76)	0.0009
Financial support	Graduate	148 (16.5%)	57 (38.5%)	91 (61.5%)	0.7 (0.43–0.94)	0.01
	Dependent	516 (57.5%)	238 (46.1%)	278 (53.9%)	0.99 (0.76–1.30)	0.98
	Independent	364 (40.6%)	167 (45.9%)	197 (54.1%)	0.98 (0.75–1.28)	0.89
Diabetes Mellitus	Partially dependent	17 (1.9%)	9 (52.9%)	8 (47.1%)	1.31 (0.50–3.45)	0.57
	Yes	126 (14%)	80 (19.3%)	46 (9.5%)	<b>2.28</b> (1.54–3.36)	<0.0001
	No	771 (86%)	334 (80.7%)	437 (90.5%)	0.44 (0.29–0.65)	
Alcohol	Yes	75 (8.4%)	48 (64.0%)	27 (36.0%)	<b>2.21</b> (1.3–3.6)	0.001
	No	822 (91.6%)	366 (44.6%)	456 (55.5%)	0.45 (0.27–0.73)	
Smoking	Yes	210 (23.4%)	102 (48.6%)	108 (51.4%)	1.135 (0.83–1.5)	0.422
	No	687 (76.6%)	312 (45.4%)	375 (54.6%)	0.88 (0.64–1.20)	
Impaired vision	Yes	411 (45.8%)	217 (52.8%)	194 (47.2%)	<b>1.6</b> (1.2–2.1)	0.0003
	No	486 (54.2%)	197 (40.5%)	289 (59.5%)	0.60 (0.46–0.79)	
Physical activity	Active	558 (62.2%)	235 (42.1%)	323 (57.9%)	0.65 (0.49–0.85)	0.002
	Sedentary	325 (36.2%)	173 (53.2%)	152 (46.8%)	<b>1.56</b> (1.18–2.05)	0.001
	Bed ridden	14 (1.6%)	6 (42.9%)	8 (57.1%)	0.87 (0.30–2.53)	0.8
No of drugs	0	162 (18%)	142 (87.6%)	20 (12.4%)	<b>12.08</b> (7.39–19.75)	0.0001
	1	430 (47.9%)	165 (38.3%)	265 (61.7%)	0.64 (0.49–0.84)	0.001
	2	227 (25.3%)	74 (32.5%)	153 (67.5%)	0.52 (0.38–0.72)	0.0001
	3	61 (6.8%)	12 (19.6%)	49 (80.4%)	0.29 (0.15–0.55)	0.0002
	4	17 (1.89%)	1 (5.8%)	16 (94.2%)	0.07 (0.01–0.58)	0.01

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