

## Why are We Missing the Target in Hypertension?

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### ABSTRACT

**Introduction and objectives:** Blood pressure control plays a key role in the reduction of cardiovascular mortality. Control of hypertension becomes even more difficult when other risk factors accompany. The aim of the present study was to identify the parameters that effect the achievement of target blood pressure levels in hypertensive patients.

**Methods:** 536 patients (376 female, 160 male) diagnosed more than 3 months ago and receiving antihypertensive treatment with good compliance were eligible for the study. Patients achieving and not achieving target blood pressure levels were compared with regard to factors that may effect the achievement of systolic and diastolic targets.

**Results:** When the two groups were compared, age caused a significant difference for achieving target systolic blood pressure ( $p < 0.001$ ), however such a relation was not found for diastolic blood pressure targets. Obtained blood pressure values were 136.6/88.5 mm/Hg and 144.6/90.9 mm/Hg for male and female patients, respectively. Male patients were more successful in achieving diastolic blood pressure targets ( $p = 0.014$ ). When subgroup analysis was made for sex, age maintained its significance for the achievement of systolic blood pressure targets in both groups ( $p = 0.001$  for males and  $P = 0.024$  for females), however it was not significant in terms of achieving diastolic targets in either group ( $p = 0.076$  and  $0.333$ , respectively). Comorbidities such as obesity, hyperlipidemia and diabetes were not significantly effecting achievement of systolic or diastolic targets ( $p = 0.150$  and  $0.169$  for systolic and diastolic targets, respectively).

**Conclusion:** Present study found age as the most important factor in achieving target blood pressure levels.

**Key words:** Blood pressure control, obesity, hyperlipidemia, diabetes

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### Introduction

Our knowledge on the pathophysiology of hypertension has been increased, particularly during recent years. Despite the development of effective drug treatments, control of hypertension still is far from being satisfactory. High blood pressure, particularly when accompanied by other risk factors, is associated with an increased risk for cardiovascular disease. Hyperlipidemia, presence of diabetes and advanced age are associated with increased prevalence of hypertension [1-4]. Besides accompanying risk factors making the control of diabetes more difficult such as obesity, hyperlipidemia and DM, gender has also been identified as a factor [5-8]. The present study investigated the factors effecting systolic

and diastolic blood pressure control in patients admitting to our outpatient clinics with a diagnosis of hypertension.

### Material and Methods

Among 2400 patients (age range: 18 to 65 y) admitted to our general medicine outpatient clinics between September 2004 and September 2005, a total 846 patients previously diagnosed with hypertension by a physician were recruited for this cross-sectional study. Patients not receiving any antihypertensive drug treatment, not receiving their antihypertensive medication regularly or not adapting themselves to dietary recommendations and

patients diagnosed less than 3 months ago were excluded and the remaining 536 patients (376 female, 160 male) were considered eligible and included in the study. Patients with controlled and uncontrolled hypertension were compared in terms of factors that may potentially effect the achievement of systolic or diastolic blood pressure targets.

Across the country, physicians use the criteria defined by JNC-VII and WHO for the diagnosis of hypertension: a systolic BP >140 mm Hg and/or a diastolic BP >90 mm Hg in those not taking antihypertensive medications [9, 10]. Patients with a systolic blood pressure >140 mmHg or a diastolic blood pressure >90 mmHg were considered as not achieving target blood pressure level. Age, sex, height, weight, body mass index (BMI), systolic and diastolic blood pressure values of the patients were recorded. Patients were instructed not to smoke, not to drink tea or coffee and not to perform exercise within the 30 minutes before systolic and diastolic pressure measurements. If any of these activities had occurred, measurements were delayed for 30 minutes. Blood pressure measurements were done twice by using a mercury column sphygmomanometer in accordance with the standard protocol. Both BP readings were obtained on the left arm of the seated subject using a cuff of an appropriate size, with the arm supported and the sphygmomanometer at the level of the heart [11].

The Body Mass Index (BMI) was calculated as the weight in kilograms divided by the height in meters squared. Serum samples for fasting blood glucose (FBG), total cholesterol, low density lipoprotein (LDL), high density lipoprotein (HDL) and triglyceride (TG) measurements were obtained in the morning following 8 to 12 hours fasting. Plasma lipids were determined at the university hospital laboratory of clinical chemistry, using routine enzymatic methods. In order to identify subjects with pathological values the following cut off points were used according to the laboratory's recommendation: total cholesterol >200mg/dl, LDL cholesterol >130 mg/dl, HDL cholesterol <35 mg/dl and triglycerides > 200 mg/dl. Diagnosis of diabetes mellitus was established if fasting serum plasma glucose level was >7 mmol/L or if the patient was using antidiabetic medication (12). Patients included in the study were assigned to two groups: controlled and uncontrolled patients. Groups were compared in terms of factors that have the potential to differ among groups (age, gender, BMI, cholesterol, LDL,

HDL, TG) and comorbid conditions (hyperlipidemia, DM). Subgroup analyses were also done for two sexes. Study protocol was in accordance with Declaration of Helsinki and approved by local ethics committee of the institution. All subjects and controls gave informed consent prior to study entry.

## Statistics

Descriptive statistics were generated for all study variables, including mean±SD for continuous variables and relative frequencies for categorical variables. Pearson's  $\chi^2$  method for categorical and ANOVA for continuous data were performed for univariate analysis. Two-sided values of  $p<0.05$  were considered as statistically significant. For inter-group and intra-group comparisons, independent sample t test was used. The statistical analyses were performed with the statistical package SPSS, Version 10.0 for Windows

## Results

Mean ages of male and female patients included in the study were 50.8±9.2 and 49.6±10.0, respectively. Mean systolic/diastolic blood pressure was 144.6±23.9/90.9±13.3 mmHg for female patients and 136.6±17.7/88.5±12.5 mm/Hg for male patients (Table 1).

Among all hypertensive patients, 376 (70%) were female and 160 (30%) were male. When systolic blood pressure values are considered, predefined target could not be achieved in 244 (64.9%) of 376 female patients and it was achieved in 132 (35.1%). Target systolic blood pressure levels could be achieved in 86 (53.8%) out of 160 male hypertensive patients, whereas it could not be achieved in the remaining 74 (46.3%). Two sexes were comparable in terms of ratio of patients achieving the target ( $p=0.086$ ). Target diastolic blood pressure could be achieved in 128 (34%) female patients, but could not be achieved in 248 (66%); however diastolic targets could be achieved in half of the male patients. There was a statistically significant difference between two sexes in terms of achieving diastolic targets, which was in favor of male patients ( $p=0.014$ ).

When comparisons were made considering the factors that may effect achieving systolic blood pressure target regardless of sex, only age had a significant effect on the achievement of systolic blood pressure target ( $p<0.001$ ) (Table 2).

There was no difference between parameters in terms of achieving target blood pressure level, when

**Table 1.** Demographic data of study patients

	Female Mean $\pm$ SD	Male Mean $\pm$ SD	P value
Age	49.6 $\pm$ 10.0	50.88 $\pm$ 9.2	0.359
Weight	76.0 $\pm$ 14.4	78.9 $\pm$ 12.9	<0.001
Height	156.7 $\pm$ 7.1	169.5 $\pm$ 7.5	0.125
Body Mass Index (BMI)	30.8 $\pm$ 5.2	27.4 $\pm$ 4.1	<0.001
Total cholesterol (mg/dl)	208.1 $\pm$ 48.9	198.5 $\pm$ 58.5	0.167
LDL (mg/dl)	121.8 $\pm$ 41.4	119.2 $\pm$ 42.1	0.641
HDL (mg/dl)	58.4 $\pm$ 19.3	48.0 $\pm$ 18.7	<0.001
TG (mg/dl)	150.1 $\pm$ 75.4	168.3 $\pm$ 122.6	0.141
FBG (mg/dl)	102.0 $\pm$ 26.7	101.2 $\pm$ 39.2	0.228
Mean blood pressure Systolic (mm/hg)	144.6 $\pm$ 23.9	136.6 $\pm$ 17.7	0.008
Diastolic (mm/hg)	90.9 $\pm$ 13.3	88.5 $\pm$ 12.5	0.156

p<0.05: Significant

LDL: Low Density Lipoprotein; HDL: High Density Lipoprotein; FBG: Fasting Blood Glucose; TG: Triglycerides

comparisons were made in terms of achieving diastolic blood pressure target (p>0.05, Table 3).

Male and female patients were compared in terms of achieving targeted systolic and diastolic blood pressure level. For female patients, none of the parameters other than age had statistical significance for achieving systolic blood pressure target (p=0.024). For diastolic pressure, none of the parameters including age had a statistical significance (p>0.05, Table 4).

When factors that may effect the achievement of systolic and diastolic blood pressure targets are taken into account for male patients, achievement of systolic blood pressure target was only effected by age (p=0.001), on the other hand none of the factors

caused a difference in terms of achieving diastolic blood pressure target (p>0.05) (Table 5).

Among female patients with uncontrolled blood pressure, accompanied comorbid conditions were as follows in decreasing order of frequency: hyperlipidemia (35.6%) and diabetes (12.8%). In 8.5% of patients, both conditions were present. Among male patients with uncontrolled hypertension, hyperlipidemia was again the most frequent comorbid condition (25.3%) followed by diabetes (15.2%), and 6.3% of them had both conditions. In both male and female patients, achievement of target systolic and diastolic blood pressure levels was not affected by comorbid conditions (p=0.169 and 0.150, respectively).

**Table 2.** Comparison of two groups in terms of achievement of target systolic blood pressure, regardless of sex.

	Successful (n=206) Mean $\pm$ SD	Unsuccessful (n=330) Mean $\pm$ SD	P value
Body Mass Index (BMI)	29.3 $\pm$ 4.9	30.1 $\pm$ 5.2	0.208
Age	47.3 $\pm$ 10.5	51.7 $\pm$ 9.0	<0.001
Height	162.0 $\pm$ 8.8	160.6 $\pm$ 9.5	0.062
Weight	76.6 $\pm$ 12.3	77.0 $\pm$ 15.0	0.787
Cholesterol (mg/dl)	201.4 $\pm$ 54.7	207.6 $\pm$ 50.2	0.208
LDL (mg/dl)	116.1 $\pm$ 48.2	124.1 $\pm$ 36.7	0.126
HDL (mg/dl)	55.3 $\pm$ 22.6	55.3 $\pm$ 17.7	0.977
TG (mg/dl)	157.1 $\pm$ 112.3	154.4 $\pm$ 77.3	0.818

P<0.05: significant

LDL: Low Density Lipoprotein; HDL: High Density Lipoprotein; FBG: Fasting Blood Glucose; TG: Triglycerides

**Table 3.** Comparison of two groups in terms of achievement of target diastolic blood pressure, regardless of sex

	Successful (n=208) Mean ± SD	Unsuccessful (n=328) Mean ± SD	P value
BMI	29.0 ± 5.1	30.2 ± 5.1	0.066
Age	48.8 ± 10.7	50.7 ± 9.3	0.110
Height	162.0 ± 9.1	159.6 ± 9.3	0.056
Weight	76.0 ± 12.6	77.4 ± 14.8	0.412
Cholesterol (mg/dl)	201.4 ± 54.4	207.7 ± 50.5	0.336
LDL (mg/dl)	117.5 ± 47.3	123.2 ± 37.5	0.275
HDL (mg/dl)	55.0 ± 20.0	55.5 ± 19.5	0.835
TG (mg/dl)	151.1 ± 111.3	158.3 ± 77.6	0.533

P<0.05: significant

LDL: Low Density Lipoprotein; HDL: High Density Lipoprotein; FBG: Fasting Blood Glucose; TG: Triglycerides

## Discussion

Despite improvements in the detection and treatment of hypertension since the 1970s, recent survey results illustrate that the condition continues to contribute, significantly, to mortality and morbidity in adults and that it is often poorly controlled in clinical practice.

In our study, age was the only parameter reaching statistical significance for patients achieving or not achieving systolic and diastolic blood pressure targets, regardless of age. With the advancing age, prevalence of hypertension increases and its control becomes more challenging [13 -18]. The patients

in the group that could not reach systolic blood pressure target was significantly older in our study (**p=0.001**), however age did not effect achieving diastolic target (p>0.05).

In contrast with the studies demonstrating poorer hypertensive control and patient compliance among male hypertensives [5,15, 19 -22, 26], in our study no difference was found between two sexes in terms of achieving systolic blood pressure targets when adjustments were made for other factors and male patients showed better achievement of diastolic blood pressure targets (**p=0.014**). Smaller number of male patients, study design based on patient's

**Table 4.** Comparison of patients successful vs. unsuccessful in achieving systolic and diastolic blood pressure targets (female patients)

	Systolic			Diastolic		
	Successful (n=208) Mean ± SD	Unsuccessful (n=328) Mean ± SD	P value	Successful (n=208) Mean ± SD	Unsuccessful (n=328) Mean ± SD	P value
BMI	30.2 ± 5.3	31.1 ± 5.1	0.256	29,8±5.5	31.3 ± 5.0	0.059
Age	47.3 ± 10.8	50.8 ± 9.6	*0.024	48.6±10.6	50.1 ± 9.9	0.333
Height	157.6 ± 6.6	156.2 ± 7.3	0.197	157.1±6.8	156.5 ± 7.2	0.548
Weght	74.6 ± 12.1	76.7 ± 15.4	0.344	73.1±12.2	77.5 ± 15.2	0.051
Cholesterol (mg/dl)	202.5 ± 47.6	211.2 ± 49.5	0.248	202.7±46.3	210.9 ± 50.1	0.277
LDL (mg/dl)	115.7 ± 48.9	125.1 ± 36.5	0.138	115.0±48.1	125.3 ± 37.2	0.109
HDL (mg/dl)	60.9 ± 25.3	57.1 ± 15.1	0.198	61.0±22.2	57.1 ± 17.6	0.190
TG (mg/dl)	141.5 ± 79.5	154.7 ± 73.1	0.253	139.9±78.4	155.4 ± 73.6	0.184

P<0.05: significant

LDL: Low Density Lipoprotein; HDL: High Density Lipoprotein; FBG: Fasting Blood Glucose; TG: Triglycerides

**Table 5.** Comparison of patients successful vs. unsuccessful in achieving systolic and diastolic blood pressure targets (male patients)

	Systolic			Diastolic		
	Successful (n=208) Mean $\pm$ SD	Unsuccessful (n=328) Mean $\pm$ SD	P value	Successful (n=208) Mean $\pm$ SD	Unsuccessful (n=328) Mean $\pm$ SD	P value
BMI	27.6 $\pm$ 3.4	27.2 $\pm$ 4.6	0.656	27.9 $\pm$ 4.2	26,9 $\pm$ 3,9	0.310
Age	47.1 $\pm$ 10.3	54.0 $\pm$ 6.7	0.001	49.0 $\pm$ 10.9	52,7 $\pm$ 6,6	0.076
Height	169.8 $\pm$ 6.7	169.3 $\pm$ 8.2	0.766	169.8 $\pm$ 6.6	169,2 $\pm$ 8,4	0.692
Weight	80.0 $\pm$ 11.9	77.9 $\pm$ 13.8	0.480	80.5 $\pm$ 12.2	77,3 $\pm$ 13,6	0.270
Cholesterol (mg/dl)	199.5 $\pm$ 66.2	197.7 $\pm$ 51.7	0.888	199.3 $\pm$ 65.9	197,7 $\pm$ 50,9	0.902
LDL (mg/dl)	116.8 $\pm$ 47.5	121.2 $\pm$ 37.3	0.644	121.5 $\pm$ 46.3	116,9 $\pm$ 37,9	0.627
HDL (mg/dl)	45.2 $\pm$ 11.3	50.4 $\pm$ 23.1	0.220	45.4 $\pm$ 10.5	50,6 $\pm$ 24,1	0.212
TG (mg/dl)	185.7 $\pm$ 152.9	153.7 $\pm$ 89.2	0.249	168.9 $\pm$ 149.2	167,6 $\pm$ 89,4	0.962

P<0.05: significant

LDL: Low Density Lipoprotein; HDL: High Density Lipoprotein; FBG: Fasting Blood Glucose; TG: Triglycerides

own declaration and exclusion of other factors that may have a role in the control of hypertension in the present design (smoking and alcohol) may account for this result.

Overweight and obesity are closely associated with hypertension [7, 16, 23, 24]. Prevalence of hypertension increases in the presence of comorbidities such as hypertension and diabetes and its control becomes more difficult [3, 4, 25-27].

BMI was significantly higher among female hypertensives compared to males in our study (<0.001). In the controlled and uncontrolled group, BMI, hyperlipidemia and accompanying diabetes did not cause significant changes on systolic and diastolic blood pressures. This result was maintained when subgroup analysis for two sexes were done (for males p=0.169 and for females p=0.150). BMI, hyperlipidemia and associated diabetes did not cause any difference in terms of achievement of systolic and diastolic

blood pressure targets for both male and female patients. Exclusion of other factors that may effect the achievement of blood pressure targets might have prevented the identification of possible differences.

Our study has certain limitations. First, we accepted the own statements of patients on diet and medication compliance as true. Second, most of the ambulatory patients admitting general internal medicine outpatient clinics are female. Therefore, most of the study patients were female (70%), whereas male patients constituted a smaller portion (30%). This might have affected statistical significance. Third, we did not examine habits such as smoking and alcohol consumption.

In conclusion, our study demonstrates that age is the most important factor in terms of achieving systolic and diastolic blood pressure targets, and BMI and associated conditions such as hyperlipidemia and diabetes do not effect the achievement of target levels.

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