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PREVALENCE, PATIENT AWARENESS AND CONTROL RATES OF HIGH BLOOD PRESSURE IN THE ADULT POPULATION OF TEHRAN: A REPORT FROM THE TEHRAN BLOOD PRESSURE STUDY, 1990-1991[1]

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ABSTRACT

The "Tehran Blood Pressure Study" (TBPS) is an observational cross-sectional study performed on men and women aged 15 years or more during the years 1990-1991. The study has been designed and performed by the Tehran University of Medical Sciences' Cardiovascular Research Center, with the primary objective of determining the prevalence and distribution of high blood pressure in Tehrani adults. In addition, awareness levels, control rates, and the prevalence of other cardiovascular risk factors among those with high blood pressure, as well as associations between blood pressure (BP) levels and certain epidemiologic and anthropometric factors have been studied. The study population comprised 10180 male and female inhabitants of Tehran aged above 15, selected by random sampling in 50 districts of the city.

The mean and the 95% confidence interval for systolic blood pressure (SBP) and diastolic blood pressure (DBP) were 123 (122.8-123.4) and 75.4 (75.2-75.6), respectively. The prevalence of high blood pressure (SBP≥ 140 mmHg or DBP> 90 mmHg or drug consumption) was 17.6% in males, 17.9% in females, and 17.7% in general.

About 47% of the patients with high DBP readings were aware of their condition. In 20% of these, control of hypertension had been achieved by drug therapy; in 11%, drug therapy had failed to control hypertension, and 16% were not receiving treatment despite their awareness. High body mass index and a history of diabetes were more frequent in those with high BP readings than the general population. Of those with high BP readings, most had only mild elevations of BP (90≤ DBP≤99 or 140≤SBP≤159). Isolated high systolic blood pressure (SBP ≥140 mm Hg and DBP< 90 mmHg) was found in 36% of females and 30% of males aged above 64.

The noticeable prevalence of high BP, the remarkable prevalence of isolated high systolic blood pressure in the elderly, the very low level of patient awareness and low control rates all necessitate the adoption of appropriate personal and community health policies.

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INTRODUCTION

Hypertension is a very important risk factor for cardiovascular disease. A large body of evidence indicates that the risk of ischemic heart disease, atherosclerosis, stroke, and mortality in general is increased in patients with high systolic or diastolic blood pressure.[1] Appropriate treatment and control of high BP reduce the risk of ischemic heart disease and stroke.[2] Non-pharmacological treatments such as weight reduction, low-salt diet, regular exercise and abstinence from alcohol have an important role in the control of high BP and reduction of the risks thereof.[3]

This report reflects the results of the Tehran Blood Pressure Study, 1990-91 (TBPS) on the prevalence and distribution of high BP, level of awareness, control and treatment rates and the frequency of other cardiovascular risk factors in 10180 adult citizens of Tehran.

PATIENTS AND METHODS

The study population

The Tehran Blood Pressure Study (TBPS) is a cross-sectional study performed in Tehran from autumn 1990 to autumn 1991. The study population included men and women aged above 15, who had been permanent inhabitants of Tehran since at least 10 years prior to the study. Permanent inmates of prisons, hospitals, old people's homes and military barracks were not included.

Methods

A special type of cluster random sampling (area sampling) was employed in this study. After dividing the whole of the 20 municipality divisions of Tehran into 500 districts, 50 districts were randomly selected. A letter was sent to all families living in the selected districts to provide information and prepare the subjects. All of the residents of selected houses who met the inclusion criteria (except for guests) were admitted.[3]

All measurements were taken by specially trained fourth-year medical students, on weekends. After sampling (by the above-mentioned method), teams consisting of two medical students were sent to the subjects' homes. First, a special standardized questionnaire asking for information regarding epidemiological factors and other cardiovascular risk factors was filled in, then necessary anthropometric measurements were taken, and subsequently BP was measured 5 times (twice from the right and once from the left arm in the sitting position, once in the recumbent and once in the erect position from the right arm).

Measurements

BP readings were taken after making sure that the subjects had not consumed tea, coffee, cigarettes, or medications in the past hour, and after at least 5 minutes of rest. A standard technique[4,5] and table mercury sphygmomanometers with conventional-sized (12 × 23cm) cuffs were employed for BP measurements. BP was first measured on the right arm in the sitting position, then on the left arm, and again on the right arm with the subject still seated. Then, the subject was requested to lie on a firm, flat surface and BP was measured on the right arm. Readings were also taken after 2 minutes of standing upright. SBP and DBP were determined by the first and the fifth Korotkoff sounds, respectively. Pulse rates were recorded in the sitting, recumbent, and erect positions. In this report, BP is considered as the average of the two sitting-position readings (on the right arm) and the recumbent reading (right arm). The subjects were informed of their readings, and were advised to seek medical consultation (from a physician) if DBP values were above or equal to 90 mmHg.[4]

Linen measuring tapes and standardized spring scales were used for the anthropometric measurements.

Data analysis

The SPSS/PC+ statistical software was employed for data analysis and presentation.[6,7] All data have been included after passage through necessary filters, and unreasonable readings have been excluded. Throughout this report the age and sex distributions of the study population have been weighed with regard to the results of the 1986 census.[8] To eliminate the error in BP measurement due to variations in arm circumference, all BP readings have been corrected for this factor.[9]

RESULTS

In this article, the 99.999% level of confidence has been used for all comparisons. Thus, for all significant differences, P is <0.001.

The mean, standard deviation (SD) and the 95% confidence interval for SBP and DBP are shown in Table I. Men in the 15-24 year age group had a slightly higher SBP mean than the next two age groups. After the age of 25, SBP increased parallel to age in both sexes. This increase was gradual in men, from 123 mmHg in the 15-24 year age group to 142 mmHg in the above 64 age group. In the below 44 age groups, women had lower SBP means than men, but there was an abrupt rise in SBP in the 45-54 year age group among women, causing the SBP mean for women to be higher than that for men in the above 45 age groups. This difference was maximal for those above 64 (149.6 mmHg for women versus 142.4 mmHg for men) (Table I).

There was a rise in DBP parallel to age in both sexes, except for the above 64 age group where the DBP mean decreased as compared with the previous group (from 83 to 81 mmHg in women and from 81 to 78 mmHg in men). The

Table I. Mean, standard deviation and the 95% confidence intervals* for SBP and DBP (mmHg) by age and sex.

Age group (years)	Sample size		SBP		DBP	
	Women	Men	Women	Men	Women	Men
15-24	1559	1555	115.2(12) [114.6-115.8]	122.7(12) [122.1-123.3]	70.8(9) [70.4-71.3]	72(10) [71.5-72.5]
25-34	1256	1329	115.7(12) [115.1-116.4]	120.1(12) [119.5-120.8]	73.1(9) [72.6-73.6]	74.7(10) [74.2-75.3]
35-44	738	789	119.5(15) [118.4-120.6]	121.8(13) [120.9-122.8]	75.9(10) [75.2-76.6]	78(10) [77.2-78.7]
45-54	520	612	130.9(19) [129.2-132.5]	125.2(16) [124.1-126.4]	81.3(11) [80.4-82.3]	79.9(10) [79-80.7]
55-64	393	426	141.5(22) [139.4-143.7]	135.2(20) [133.3-137.1]	83.2(12) [82.1-84.3]	81.5(12) [80.3-82.6]
> 64	276	239	149.6(22) [147-152.2]	142.4(22) [139.7-145.1]	81.4(12) [79.9-82.8]	78.2(12) [76.7-79.7]
Total	4742	4950	121.9(18) [121.4-122.4]	124.2(15) [123.8-124.6]	75(11) [74.7-75.3]	75.8(11) [75.5-76.1]
	9692		123.09(17) [122.8-123.4]		75.4(11) [75.2-75.6]	

* The figures inside parentheses and brackets indicate standard deviation and 95% confidence intervals, respectively.

DBP mean was 72 mmHg for males in the first age group, reaching a maximum of 81.4 mmHg in the 55-64 year group, and then decreasing to 78 mmHg. In general, after the age of 54, DBP was higher in women than in men (Table I). An abrupt rise in DBP from 76 to 81 mmHg was observed between the 35-44 and 45-54 year age groups. The peak for DBP mean was in the 55-64 year age group in both sexes, with decrements thereafter.

Distributions of SBP and DBP in the study population are depicted in Tables II and III. It must be clarified that antihypertensive drug therapy has not been considered in these data; therefore, these distributions show the percentage of the population who are at risk due to above-normal blood pressure levels.

In men, the frequency of an SBP above 130 mmHg gradually increased after the age of 25, and in those over 64, 49.4% of men had SBP readings above or equal to 140 mmHg. The frequency of an SBP below 130 mmHg decreased with advancing age (with the exception that an SBP below 120 mmHg was less frequent in the 15-24 year age group than the next age group). On the whole, in 13% of the men, SBP was above 140 mmHg. Similarly, an increase in the frequency of high SBP with advancing age was demonstrable in women, starting from SBPs in the range of 130mmHg onwards (Table II). In the above 64 year age group, 63% of women (cf. 49% of men) had SBP readings above or equal to 140 mmHg. On the whole, an SBP above or equal to 140 mmHg was found in 14% of women. 13.2% of the whole study population (men plus women) had an SBP above or equal to 140 mmHg (Table II).

Table III depicts the distribution of DBP in men and women. The frequency of a DBP above or equal to 80 mmHg increased with age. The percentage of patients with DBP above or equal to 90 mmHg was small in the 15-24 year age group (3% of women and 5.5% of men) compared to the above 64 age group (22% of women and 16% of men). In general, in 8.8% of women and 9% of men, DBP was above 90 mmHg. A DBP above 90 mmHg was detected in 9% and a DBP above or equal to 120 mmHg in 0.1% of the whole study population.

Before presenting the results on the prevalence of "high blood pressure" in the study population, it must be mentioned that the diagnosis of "hypertension" can be made only after demonstrating that the average of at least three BP readings of a subject, taken at 3 different visits, is above normal. All further classifications are simply based on the above mentioned average. Since in the Tehran Blood Pressure Study only one BP reading was taken from each patient, the

Table II. Distribution of SBP (mmHg, percent) by age and sex.

Age group (years)		Sample size	SBP									
			<90	90-99	100-109	110-119	120-129	130-139	140-159	160-179	180-209	≥ 210
Women	15-24	1606	0.7	7.3	23.2	35.5	23.8	7.1	2.2	0.2	0.0	0.0
	25-34	1294	0.6	5.1	27.0	32.9	22.5	8.7	3.1	0.2	0.0	0.0
	35-44	755	0.6	4.4	20.3	29.7	24.9	11.6	7.1	0.9	0.4	0.1
	45-54	539	0.1	2.0	7.9	20.2	23.2	18.8	19.1	7.1	1.4	0.1
	55-64	408	0.0	0.8	3.4	9.4	19.5	19.3	28.1	13.6	5.2	0.7
	> 64	286	0.0	0.0	2.0	4.8	11.5	18.8	32.2	22.7	7.0	1.1
	Total	4888	0.5	4.7	19.2	28.3	22.5	11.2	9.0	3.5	1.1	0.1
Men	15-24	1620	0.0	2.0	12.8	26.8	32.3	17.5	8.1	0.5	0.0	0.0
	25-34	1366	0.2	2.9	13.2	35.1	31.2	11.9	5.1	0.1	0.0	0.1
	35-44	819	0.0	2.5	13.2	31.3	31.0	13.8	6.7	1.1	0.5	0.0
	45-54	629	0.1	1.5	11.7	26.5	29.2	15.8	12.3	2.1	0.8	0.0
	55-64	445	0.0	1.4	6.9	13.5	23.9	17.6	25.5	7.9	3.1	0.2
	> 64	249	0.0	0.5	3.7	8.1	16.9	21.8	29.7	11.8	6.9	0.7
	Total	5128	0.1	2.1	11.9	27.6	30.0	15.4	10.1	1.9	0.8	0.1
Grand total		10016	0.3	3.4	15.4	28.0	26.3	13.4	9.6	2.6	0.9	0.1

Table III. Distribution of DBP (mmHg, percent) by age and sex.

Age group (years)		Sample size	DBP							
			<60	60-69	70-79	80-89	90-99	100-109	110-119	≥ 120
Women	15-24	1606	9.2	35.2	40.5	13.4	1.6	0.1	0.0	0.0
	25-34	1294	6.3	28.9	43.2	17.4	3.7	0.5	0.0	0.0
	35-44	755	4.5	21.5	41.7	23.6	7.0	1.3	0.2	0.2
	45-54	539	1.3	10.7	36.5	31.4	13.6	4.8	1.4	0.3
	55-64	408	0.5	9.2	31.9	32.0	18.1	6.0	1.8	0.3
	> 64	286	3.1	14.3	28.9	32.0	14.9	4.6	1.4	0.9
	Total	4888	5.8	25.3	39.5	20.7	6.5	1.7	0.4	0.2
Men	15-24	1620	11.0	30.8	34.4	20.1	3.5	0.2	0.0	0.0
	25-34	1366	7.0	22.7	40.0	24.4	5.0	0.7	0.0	0.1
	35-44	819	2.6	19.4	36.0	30.8	8.4	2.3	0.3	0.3
	45-54	629	1.1	14.0	37.7	33.1	9.3	3.7	0.8	0.1
	55-64	445	1.9	12.4	33.5	30.3	14.8	4.7	1.8	0.5
	> 64	249	5.5	16.4	34.8	26.9	12.7	2.5	1.0	0.1
	Total	5128	6.3	22.4	36.5	25.8	6.9	1.6	0.3	0.1
Grand total		10016	6.1	23.8	38.0	23.3	6.7	1.6	0.4	0.1

word "hypertension" has been avoided in this report, and "high blood pressure" has been used instead.

Table IV depicts the prevalence of high BP by age and sex (*see* the legend for the classification of high BP). Readings in the upper range of normal blood pressure and mildly elevated BP readings were more frequent in men than women (18% and 12% in men versus 12% and 9% in women, respectively), but the two sexes had equal frequencies of the more severe categories of high BP. On the whole, 15.1% of all subjects fell in the upper range of normal;

Table IV. Distribution of BP status (percent) by age and sex.

Age group (years)		Sample size	BP status					
			Normal*	Upper range of normal**	Mild***	Moderate†	Severe*	Very severe*
Women	15-24	1555	88.1	8.4	3.3	0.2	0.0	0.0
	25-34	1248	83.2	11.2	5.2	0.4	0.0	0.0
	35-44	707	77.2	12.2	9.3	1.0	0.2	0.1
	45-54	451	54.3	18.9	19.0	6.5	1.1	0.3
	55-64	280	39.7	22.0	24.2	10.8	2.6	0.7
	> 64	164	24.5	24.5	31.2	16.3	2.9	0.5
	Total	4407	76.1	12.3	8.8	2.3	0.4	0.1
Men	15-24	1554	70.5	18.8	10.0	0.7	0.0	0.0
	25-34	1323	76.7	14.9	7.5	0.8	0.0	0.1
	35-44	776	68.0	19.2	9.5	2.6	0.4	0.3
	45-54	579	64.1	16.2	14.9	4.0	0.6	0.1
	55-64	368	46.0	18.8	26.1	6.2	2.4	0.6
	> 64	178	32.3	25.3	27.9	9.1	5.1	0.3
	Total	4777	67.7	17.7	11.7	2.2	0.5	0.1
Grand total		9184	71.7	15.1	10.3	2.2	0.5	0.1

* SBP < 130 mmHg or DBP < 85 mmHg; ** 130 mmHg < SBP < 139 mmHg or 85 mm Hg < DBP < 89 mmHg; *** 140 mmHg < SBP < 159 mmHg or 90 mmHg < DBP < 99 mmHg; † 160 mmHg <SBP < 179 mmHg or 100 mmHg < DBP < 109 mmHg; ‡ 180 mmHg < SBP < 209 mmHg or 110 mmHg < DBP < 119 mmHg; ‡ SBP ≥ 210 mmHg or DBP ≥ 120 mmHg.

Table V. The prevalence of high BP (percent) by age and sex, by the 1st* and 2nd criteria.**

Age group (years)	Sample size		1st criterion		2nd criterion	
	Women	Men	Women	Men	Women	Men
15-24	1543	1469	2.5	8.8	2.0	3.8
25-34	1232	1283	3.8	5.6	4.5	6.1
35-44	668	734	10.7	9.3	11.2	12.0
45-54	355	511	33.0	18.3	27.1	17.6
55-64	183	260	53.9	40.7	42.8	29.4
> 64	85	106	70.0	56.6	49.7	34.3
Total	4065	4364	15.6	14.2	13.0	11.1
	9692		14.9		12.0	

* SBP ≥ 140 mmHg or drug use; ** DBP ≥ 90 mmHg or drug use.

10.3% had mild; 2.2%, moderate; 0.5%, severe; and 0.1%, very severe elevations of BP.

Tables V and VI demonstrate the prevalence of high BP as obtained by using different criteria. These are: (1) an SBP above or equal to 140 mmHg or antihypertensive drug use, (2) a DBP above or equal to 90 mmHg or drug use, (3) SBP above or equal to 140 mmHg or a DBP above or equal to 140 mmHg or drug use,[10] and (4) an SBP above or equal to 160 mmHg or a DBP above or equal to 95 mmHg or drug use.[11] By all these criteria, the prevalence of high BP was shown to increase with age. This trend was steeper in women. On the whole, 15% of all subjects had high SBP and 12%, high DBP.

By the third criterion, 17.9% of women, 17.6% of men

Table VI. The prevalence of high BP (percent) by age and sex, by the 3rd* and 4th criteria.**

Age group (years)	Sample size		3rd criterion		4th criterion	
	Women	Men	Women	Men	Women	Men
15-24	1559	1555	3.7	10.8	0.9	1.3
25-34	1256	1329	6.2	8.9	2.1	2.5
35-44	738	789	14.3	14.2	6.9	7.0
45-54	520	612	36.5	24.0	21.2	11.7
55-64	393	426	56.0	44.2	40.5	24.6
> 64	276	239	70.8	57.0	53.6	37.2
Total	4742	4950	17.9	17.6	10.7	7.5
	9692		17.7		9.1	

* SBP ≥ 140 mmHg or DBP ≥ 90 mmHg or drug use; ** SBP ≥ 160 mmHg or DBP ≥ 95 mmHg or drug use.

Table VII. The prevalence of isolated high SBP (percent) by age and sex, by the 1st* and 2nd criteria.**

Age group (years)	Sample size		1st criterion		2nd criterion	
	Women	Men	Women	Men	Women	Men
15-24	1555	1554	1.7	7.0	0.1	0.3
25-34	1248	1323	1.6	2.8	0.0	0.1
35-44	707	776	3.3	2.2	0.1	0.4
45-54	451	579	10.9	6.9	1.6	0.6
55-64	280	368	18.7	17.3	4.1	2.3
> 64	164	178	35.6	30.3	11.1	7.1
Total	4407	4777	5.2	6.7	0.9	0.7
	9184		6.0		0.8	

* SBP ≥ 140 mmHg and DBP < 90 mmHg; ** SBP ≥ 160 mmHg and DBP < 95 mmHg.

and 17.7% of all subjects had high BP. Using the fourth one, 10.7% of women, 7.5% of men and 9.1% of all subjects would be regarded as having high BP (Table VI).

Isolated high systolic blood pressure was infrequent in the younger (25-44) age groups (Table VII); for example, in the 25-34 year age group, approximately 3% of men and 2% of women had an SBP above or equal to 140 mmHg and a DBP less than 90 mmHg. The frequency rose from 11% in women and 7% in men aged 45-54, to 19% and 17% in the 55-64 year age group and 36% and 30% in the above 64 year age group, respectively. The same pattern is demonstrable if isolated high SBP is defined as an SBP above or equal to 160 mmHg and a DBP less than 90 mmHg; the frequency would rise from ≅ 1% in those less than 55 to 7% in women and 11% in men above 64. Overall, the prevalence of isolated high SBP would be 5.2% in women, 6.7% in men and 6% in all, if one used the first criterion (SBP ≥ 140 and DBP < 90mmHg), and 0.9% in women, 0.7% in men, and 0.8% in both sexes by the second criterion (SBP ≥ 160 mmHg and DBP < 90mmHg).

Level of awareness, as well as treatment and control rates in those with high DBP are reflected in Table VIII.

Considering the fact that at the time of the study, the diagnosis of high BP and the definition of "control" were based on DBP, DBP has been adopted to determine awareness and control. The relevant population comprises those already diagnosed (by a physician) to be hypertensive, and those with DBP readings (as taken in our study) above or equal to 90 mmHg. The level of awareness, treatment rates, and control rates all increased with age, and were all greater in women than in men. Of the study population, 64% of men, 42% of women, and 53% of all subjects were unaware of their high BP.

In this report, those who had achieved a DBP of less than 90 mmHg after regular treatment were considered "controlled". Control rates were better in women than in

Table VIII. Awareness and control rates in those with high DBP (percent) by age and sex.

Age group (years)	Sample size		Treated regularly and controlled		Treated but uncontrolled		Untreated		Unaware	
	Women	Men	Women	Men	Women	Men	Women	Men	Women	Men
15-24	1606	1620	4.8	2.7	0.0	0.0	4.8	2.7	90.5	94.6
25-34	1294	1366	6.0	0.0	2.9	2.1	14.0	8.3	78.0	89.6
35-44	755	819	14.5	3.4	9.4	3.4	20.5	17.0	55.6	76.1
45-54	539	629	20.5	12.4	13.0	8.0	24.9	17.7	41.6	61.9
55-64	408	445	33.5	18.5	21.8	14.4	16.0	21.2	28.7	45.9
> 64	286	249	50.0	42.0	22.5	21.0	13.3	22.0	14.2	15.0
Total	4888	5128	26.3	12.5	14.6	8.2	17.3	15.5	41.8	63.8
	10016		19.5		11.4		16.4		52.7	

Table IX. Treatment status (percent) by age and sex.

Age group (years)	Treatment status							
	Sample size		Regular*		Irregular**		At times of discomfort or high BP	
	Women	Men	Women	Men	Women	Men	Women	Men
15-24	4	2	100.0	100.0	0.0	0.0	0.0	0.0
25-34	8	6	80.0	33.3	20.0	66.7	0.0	0.0
35-44	31	13	62.5	53.8	22.9	0.0	14.6	46.2
45-54	68	33	60.6	63.2	11.0	18.4	28.4	18.4
55-64	113	59	67.3	71.1	16.0	12.0	16.7	16.9
> 64	111	61	71.4	71.6	11.3	16.7	17.3	11.8
Total	335	173	67.2	67.7	14.0	15.4	18.8	16.9
	509		67.4		14.5		18.1	

* Drugs used regularly as prescribed by the physician; ** Continual but irregular drug use.

men (26% versus 12.5%), albeit very unfavorable in both sexes. For both sexes, control rates increased with age (from 5% in women and 3% in men in the 15-24 year age group to 50% in women and 42% in men above 64).

The percentage of patients who had not achieved control despite drug treatment was high, but decreased with age in both sexes. On the whole, 64% of women, 60% of men, and 63% of all subjects with high DBP who were under regular antihypertensive drug treatment had achieved control.

Table VIII also shows the distribution of regular treatment by age and sex. The percentage of men and women with high BP who did not use drugs (non-users) decreased with advancing age, from 95% in women and 97% in men in the 15-24 year age group to 27% in women and 37% in men aged above 64. In both sexes there was an increase in treatment rates with age. To sum up, 59% of women, 79% of men and 69% of all patients with high BP were not receiving any drugs.

Table IX shows how the patients used their medications. It can be observed that apart from the first age group (which comprises a very small fraction of the patients), there was no particular change in the regularity of drug use with age in women; conversely, the rate of regular drug use increased from 33% in the 25-34 year age group to 72% in the above 64 year age group in men.

On the whole, 67.2% of women, 67.7% of men and 67.4% of all treated patients used their drugs regularly. It is intriguing that 18.1% of all drug users (who were mostly 35-54 years of age) used their drugs only "when they felt their pressure had gone up".

Table X compares the quantity of salt intake in the diet of all subjects with that of patients with high BP. As shown, approximately 23% of women, 18% of men and 20% of all subjects had low-salt or salt-free diets. Among patients with high BP, 46% of women, 36% of men and 41% of all complied with low-salt or salt-free diets. Although low-salt

Table X. Salt content in the diet of all subjects versus subjects with high BP (percent) by age and sex.

Diet	All subjects			Subjects with high BP		
	Women	Men	All	Women	Men	All
No. of subjects	4742	4950	9692	847	870	1716
Salt-free	3.9	2.6	3.2	11.5	6.5	9.0
Low-salt	18.7	15.7	17.2	34.5	29.3	31.9
Normal	61.9	61.4	61.6	46.2	49.1	47.7
High-salt	15.5	20.3	18.0	7.8	15.0	11.4

Table XI. Prevalence of some cardiovascular risk factors in subjects with high or normal BP (percent) by sex.

Risk factor	Women		Men		All	
	High BP	Normal BP	High BP	Normal BP	High BP	Normal BP
Smoking	10.0	8.1	29.0	29.0	19.0	20.0
BMI ≥ 25	72.0	38.0	57.0	31.0	64.0	34.0
BMI ≥ 27	56.0	25.0	37.0	17.0	46.0	21.0
No regular exercise	82.0	80.0	62.0	60.0	70.0	69.0
Diabetes	9.8	1.3	7.3	1.9	8.5	1.6

dicts were twice more frequent in patients with high BP than in the general population, it should be noted that 59% of these patients had not restricted their salt intake, and even in 11% of them salt intake was high.

To sum up, most (69%) of the patients with high BP were not receiving treatment, 33% of the treated patients used their drugs irregularly, and 59% had not restricted their salt intake.

Table XI summarizes the prevalences of other cardiovascular risk factors by BP status (normal versus high) after age and sex distributions were weighed with regard to the 1986 census. Risk factors were more prevalent in patients with high BP than in those with normal BP. The most noticeable difference was in body mass index (BMI), especially in women. Almost 20% of men and women with high BP were regular smokers. Among those with high BP, body mass index was higher in women than in men. Of these, 72% of women and 57% of men had a BMI above or equal to 25, and 56% of women and 37% of men had a BMI above or equal to 27. Of those with high BP, women were more likely not to perform regular exercise or to have diabetes than men.

DISCUSSION

To determine the mean of BP and the prevalence of high BP, another study in the province of Tehran[12] and numerous studies in the world have been performed, which are, to some extent, comparable to our study regarding methods and results.[13-17] Finding the distribution of BP and the prevalence of high BP has been one of the objectives of the "Health and Disease in Iran: The province of Tehran" study. The criteria used in this study are similar to ours, although there are differences in sampling methods, measurements, and the study population. For example, it included subjects from both urban and rural areas in the province of Tehran. DBP means obtained in the two studies were equal, while the SBP mean obtained in our study was slightly (4mmHg) higher. In their study, the prevalence of high BP was calculated without including patients who had achieved control with therapy; therefore, their results are comparable with the data shown in Table IV of this report. The prevalence of high BP in their study was 1.5% higher than ours. Both studies showed the prevalence to be higher in men, regardless of treatment. The greater prevalence of high BP in their study can be partly explained by the fact that it included rural areas, where awareness and treatment rates are presumed to be lower.

In a Canadian study on the prevalence, awareness and control rates of high BP,[13] the average of two readings was used to detect high BP. The prevalence of high BP in Canada as obtained by this study was 2.5% higher than what we found in Tehran, despite the fact that age-specific prevalences were equal in the two studies. The Minnesota Heart Survey[14] has also used two BP readings; however, the SBP mean, DBP mean, and the prevalence of high BP were all

significantly greater than what we found. BP was higher in men than women in all age groups in their study. Similar to our study, they showed that in men awareness and control rates were lower, and the frequency of active smoking was higher. Despite close resemblance to our study in terms of methods, measurements and criteria, the results of the National Health and Nutrition Examination Survey I (NHANES-I) in the USA were more similar to those of the Minnesota Survey.

It is of importance to bear in mind while comparing these studies that the population of Tehran is younger compared to western populations. The age distribution of our study population is such that more subjects fall in the lower age groups, where high BP prevalence and BP means are lower and risk factors for ischemic heart disease are less frequent. This underscores the importance of weighing and adjusting the results of our study and the western studies with a standardized population[18] before drawing comparisons between them.

The importance of high BP as a major risk factor for ischemic cardiovascular disease has been proved in numerous studies.[1] Recent research in western societies has disclosed the merits of treating hypertension, though mild,[19] emphasizing the proper management of those with mildly elevated BP, who constitute nearly 80% of all "high BPs" in our study.

Although the prevalence of isolated high SBP is extremely low in younger subjects (less than 1% in the below 45 age group), about 9% of those above 64 have an SBP above or equal to 160 and a DBP below 90. The results of the Systolic Hypertension in the Elderly Program (SHEP)[20-22] which was a long-term clinical trial, demonstrated the desirable effects of treating isolated systolic hypertension in the elderly on reducing mortality from ischemic heart disease. This study can prompt physicians to pay more attention to diagnosing and treating this rather prevalent condition in the elderly.

We have calculated the prevalence of high BP according to two important criteria. The prevalence was nearly 18% using the protocol of JNC-V[10] and nearly 9% using that of WHO.[11] It is evident that the decision to select one or the other of these two criteria as the national criteria to be adopted by the health and treatment system of Iran (while awaiting the results of a long-term clinical trial on the treatment of hypertension in the country) will have a substantial influence on the number of patients to be treated and the costs of diagnosis and treatment.

The considerably low percentage of younger patients who were aware of their high BP (Table VIII), reflects that both the society and the physicians have been neglectful of screening for high blood pressure in young individuals.[10] Uncontrolled high BP gradually worsens itself; therefore, prompt diagnosis and control of high BP in young patients is critical for preventing further BP increases and reducing the prevalence of hypertension (especially its severe forms) in the future society.

The lower rates of awareness and treatment in men reflect their relative ignorance concerning the significance of preventive health. In spite of the increase in awareness and treatment rates with advancing age, a large number of regularly treated patients fail to achieve control. Possible explanations include: failure to individualize the choice of antihypertensive drugs, failure to increase the dose when necessary, failure to switch to an alternative drug or to add a second drug when appropriate, and most important of all, poor patient compliance. This underscores the need for controlled clinical trials to compare the efficacy of different antihypertensive treatments in controlling hypertension and ensuring better compliance, taking into consideration the racial, cultural, and demographic differences between Iranian and western populations.[23,24] A large number of treated patients (mostly middle-aged) took their drugs irregularly or only at times of discomfort or "a feeling of high blood pressure."

Non-pharmacological measures to improve life-style are considered essential in the treatment of hypertension.[10] Although we have not comprehensively studied these measures, a consideration of the dietary habits of Tehrani subjects shows poor compliance with low-salt diets and even consumption of salt-rich foods in a large number of patients with high BP.

Considering the numerous side-effects of antihypertensive drugs, especially in the elderly,[25] and considering the fact that approximately 96% of Tehrani patients had only mild to moderately elevated BP, the importance of non-pharmacological methods of treatment becomes more and more obvious. Clinical studies to determine the efficacy and long-term results of such treatments in reducing BP and mortality due to hypertension in Iranian patients must be designed and conducted.

There was at least one major cardiovascular risk factor present in most subjects with high BP (Table XI). This necessitates due care and appropriate diagnostic studies for finding such risk factors in patients with high BP. Taking into account the synergistic effects of these risk factors in inducing coronary disease and stroke,[26] current classifications and treatment strategies for hypertension consider the presence and effect of other risk factors.[10]

Smoking is a major risk factor which can be eliminated rapidly and without any major complications; therefore, appropriate attention must be paid to the rather frequent problem of smoking in patients with high BP.

A major non-pharmacological method to reduce blood pressure in obese hypertensives is weight reduction.[10,27] The risk of ischemic heart disease in obese hypertensives is no less, if not more, than non-obese hypertensives.[28] The fact that almost half of our patients with high BP were obese (Table XI) underlines the importance of weight reduction in these patients through general health instructions and the

cooperation of practitioners and dieticians.

In our study, diabetes was 5.3 times more prevalent in those with high BP than the general population; therefore, one should always bear diabetes in mind at the time of ordering preliminary diagnostic tests in those with high BP. The risk of myocardial infarction in those with diabetes and high BP is several times greater than those with diabetes alone,[20] hence the need for aggressive treatment of hypertension in diabetics.[30] To compare the different methods, and to determine the effects of antihypertensive therapy on mortality in Iranian hypertensive diabetics, long-term clinical studies are required. Currently the results of a short-term clinical trial are available, comparing the efficacy of different pharmacological treatments in reducing BP in Iranian diabetics.[31]

The "Tehran Blood Pressure Study" is the first observational, cross-sectional study to examine the distribution of BP and its association with other risk factors of ischemic heart disease in Iran. A favorable sample size, and sampling based on the distribution of the Tehrani urban population make the results appliable to all Tehrani's. It must be mentioned that our criteria for high BP were identical to the most widely accepted international criteria.[10,11]

The probability of high BP in a woman above 64 in a single measurement was nearly 71% (Table VI), hence emphasizing the importance of measuring BP in the elderly by physicians and health workers, especially in those whose BPs have not been regularly monitored.

High SBP and isolated high SBP are particularly prevalent in the elderly; therefore, once more we emphasize the need for appropriate strategies for the classification and treatment of high BP with due attention to SBP according to recent recommendations[10] and encouraging physicians to adopt them.

Awareness and control rates of high BP have significantly increased in western countries in the last two decades; currently, nearly 84% of American (from NHANES-III) and 74% of Canadian patients are aware of their condition.[10,13] These figures differ strikingly from the 47% level of awareness in Tehrani patients. We hope that the results of our study can provide an acceptable data base, and elicit more attention and activity in the country in order to improve the current status of the diagnosis and treatment of hypertension.

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