Prevalence, Awareness, Treatment, and Risk Factors Associated With Hypertension in the Iranian Population: The National Survey of Risk Factors for Noncommunicable Diseases of Iran

Alireza Esteghamati[1], Mehrshad Abbasi[1], Siamak Alikhani[2], Mohamad M. Gouya[2], Alireza Delavari[2], Mehdi H. Shishehbor[3], Mehrdad Forouzanfar[4,5], Alieh Hodjatzadeh[2] and Rashid D. Ramezani[2]

BACKGROUND
The prevalence of hypertension in the Middle East is not well defined. We examined the prevalence, awareness, treatment, and control of hypertension in Iran.

METHODS
The Survey of Risk Factors of Noncommunicable Diseases was conducted in 2005 and contains a representative sample of the Iranian adult population. Of 70,981 participants, the data of 68,250 adults aged 25–64 years who had two valid blood pressure (BP) readings were analyzed to estimate the total prevalence of hypertension (systolic BP ≥ 140 mm Hg, diastolic BP ≥ 90 mm Hg, or the concurrent use of antihypertensive agents) in the Iranian adult population.

RESULTS
Approximately 25% or 6.6 million Iranians aged 25–64 years had hypertension; additionally 46% or 12 million Iranians aged 25-64 years had prehypertension. Among hypertensive patients, 34% were aware of their elevated BP; 25% were taking antihypertensive medications; and of these treated subjects, only 24% had BP values <140/90 mm Hg. Hypertension and prehypertension were associated with age, male gender, obesity, central obesity, hypercholesterolemia, and diabetes.

CONCLUSIONS
The prevalence of hypertension and prehypertension is high, and the rates of awareness, treatment, and control are unacceptably low. These results underscore the urgent need to develop national strategies to improve prevention, detection, and treatment of hypertension in Iran.

Am J Hypertens 2008; **21**:620-626 © 2008 American Journal of Hypertension, Ltd.

Hypertension is a leading risk factor for coronary, cerebral, and renal disease. While the prevalence of hypertension in developed countries has been established, little data are available in developing countries.[1–9] In developing countries, the economic growth and associated sociodemographic changes have brought a significant change that may be associated with increased prevalence of noncommunicable diseases such as hypertension.[10–12]

The prevalence of hypertension increases with advancing age to the point where more than half of people aged 60–69 years old, and approximately three-fourth of those aged ≥70 years, are affected in the United States.[13] However the burden of the disease among younger populations in developing countries is unknown and may be considerable.[14]

To date, national estimates of hypertension in Iran are not available; however, some recent subnational studies reported high prevalence of hypertension in the highly urbanized population of Tehran, Iran's capital city (22% of those aged 20–69 years)[15] and in three other cities (17% of those >19 years).[16] The first Survey of Risk Factors of Noncommunicable Disease was conducted in 2005 to assess the prevalence and profile of noncommunicable disease–related risk factors in the Iranian population. This article reports the results of this national survey which pertains to the prevalence of hypertension, its treatment and control, and the associated risk factors including obesity, central obesity, diabetes mellitus, hypercholesterolemia, and sociodemographic factors.

MATERIALS AND METHODS

Study population. The Survey of Risk Factors of Noncommunicable Disease 2005 was a nationwide household survey of the noninstitutionalized civilian population. The protocol of the survey is described in detail elsewhere.[17] In brief, on the

[1]Endocrine Research Center, Valiasr Hospital, Tehran University of Medical Sciences, Tehran, Iran; [2]Division of Surveillance of Risk Factors of Noncommunicable Disease, Center for Disease Control, Tehran, Iran; [3]Department of Cardiovascular Medicine, Cleveland Clinic, Cleveland, Ohio, USA; [4]Endocrine Research Center, Shariati Hospital, Tehran University of Medical Sciences, Tehran, Iran; [5]Department of Epidemiology and Biostatistics, School of Public Health, Tehran University of Medical Sciences, Tehran, Iran. Correspondence: Alireza Esteghamati (Estegamati@tums.ac.ir)

basis of recommendations of the World Health Organization,[18] a random multistage cluster sampling method was conducted, and a sociodemographically representative sample of the Iranian population aged 15–64 years was selected. The data set contains the information of 89,440 individuals from and proportional to the population size of all 28 provinces of Iran. The study received ethics approval of the Center for Disease Management and Control of Iran and all participants gave verbal informed consent.

Clinical characteristics. Clinical characteristics were recorded in the course of home visits by trained interviewers using a standardized questionnaire that recorded health characteristics and demographic information and measured blood pressure (BP), height, weight, and waist circumference. In addition to other data, history of hypertension and diabetes, and current use of prescribed medicines for hypertension were recorded in the questionnaires. Blood samples were collected after a 12-h fast in the selected local facilities. Blood glucose and lipid levels were measured in specific reference laboratories.

BP and anthropometric measurement. BP was measured using a standardized calibrated sphygmomanometer with an appropriately sized cuff, and the readings were recorded to the nearest integer digit. First and fifth Korotkoff sounds were regarded as systolic (SBP) and diastolic (DBP) blood pressure, respectively. Two sitting BP readings were taken on the right arm after 10 min sitting rest period. The average of two BP readings was used to define the stage of hypertension. Height and weight were measured in light clothing without shoes using analog scales. The scales were calibrated daily with standard triple beam scales to 100 g for weights between 50 and 70 kg. Standard constant tension tape and portable height measuring inflexible bar were used to measure waist and height, respectively. The body mass index was calculated as weight (in kilograms) divided by height (in meters) squared. Waist circumference was measured at the midpoint level of midaxillary line between the 12th rib head and the superior anterior iliac spine.

Definition of variables. On the basis of the *Seventh Report of the Joint National Committee on Prevention, Detection, Evaluation, and Treatment of High Blood Pressure*, subjects with SBP ≥140 mm Hg, DBP ≥90 mm Hg or subjects currently using any medications for hypertension were considered to have hypertension. Those nonhypertensive individuals with SBP ≥120 mm Hg or DBP ≥80 mm Hg were defined as prehypertensive individuals.[19] Awareness was defined as answering "yes" to the question: "during the past year, has a doctor or other health worker told that you had high blood pressure?" treatment was defined as self-reported current use of antihypertensive medications. Those hypertensive subjects with SBP <140 and DBP <90 were regarded as controlled hypertensive individuals. Among hypertensive patients receiving antihypertensive drugs, those with SBP <140 and DBP <90 were regarded as "controlled treated hypertensive patients."

Type 2 diabetes was defined as fasting plasma glucose level ≥126 mg/dl or self-reported diabetes. We defined individuals with body mass index ≥25 as overweight and those with body mass index ≥30 as obese. Central obesity was defined as a waist circumference >94 cm in men and >80 cm in women. Blood cholesterol levels ≥200 mg/dl were regarded as hypercholesterolemia. Educational attainment was treated as a dichotomous variable (having or not having obtained high school diploma).

Statistical analysis. Considering the cluster design effects, complex sample survey analyses were employed using Stata 8 (StataCorp, College Station, TX). To extrapolate the results to the general population of Iran, data were standardized to the Iranian population of 2004 aged 25–64 years considering different age, sex, and urban/rural area strata. Design-based Pearson χ^2 tests were used to compare prevalence rates between categories. Multiple logistic regression models in surveys were used to examine the association of health characteristics with hypertension, prehypertension, and hypertension awareness. The following variables were included as independent variables: age (10-year strata), gender, residential area (urban vs. rural), educational attainment (not having vs. having obtained high school diploma), marital status (married vs. unmarried), obesity (normal weight, over weight, and obese), diabetes, and hypercholesterolemia. The same regression model was repeated with central obesity substituting obesity. A *P* value of <0.05 was considered significant.

RESULTS

Of the 89,440 individuals who were interviewed, 70,981 were between the 25 and 64 years of age and 18,459 were under 25 years. An additional 652 pregnant adults were excluded from the analyses. Of the remaining 70,329 nonpregnant adults, 68,250 provided two valid BP measurements (97%).

Table 1 | Health characteristics of participants

	Normal	Prehypertension	Hypertension	All
	$N = 16896$	$N = 29,788$	$N = 21,566$	$N = 68,250$
Age (years)	39 (0.1)	43 (0.1)	50 (0.1)	44 (0.0)
BMI (kg/m^2)	24.8 (0.0)	26.1 (0.0)	27.8 (0.0)	26.3 (0.0)
Waist (cm)				
Men	83.9 (0.1)	88.2 (0.1)	93.3 (0.1)	88.8 (0.1)
Women	87.3 (0.1)	92.2 (0.1)	97.6 (0.1)	92.6 (0.1)
Systolic blood pressure (mm Hg)	105.5 (0.1)	121.6 (0.0)	144.5 (0.1)	124.9 (0.1)
Diastolic blood pressure (mm Hg)	66 (0.1)	77.8 (0.0)	90.7 (0.1)	78.9 (0.1)
Fasting plasma glucose (mg/dl)	91.6 (0.2)	96 (0.2)	104 (0.3)	97.6 (0.2)
Cholesterol (mg/dl)	191.3 (0.4)	200.4 (0.3)	211.8 (0.4)	201.9 (0.2)

Table 2 | National estimate of prevalence and burden of hypertension and prehypertension in Iran 2005

	Prehypertension			Hypertension		
	Burden	% (CL)		Burden	% (CL)	
Age[a]						
25–34	4,825,324	47.0	(46.2, 47.8)	1,282,446	12.5	(12.0, 13.0)
35–44	3,758,959	48.7	(47.9, 49.5)	1,681,626	21.8	(21.1, 22.5)
45–54	2,208,067	44.2	(43.4, 44.9)	1,889,928	37.8	(37.1, 38.6)
55–64	1,153,057	35.3	(34.6, 36.1)	1,748,974	53.6	(52.8, 54.4)
Sex[b]						
Males	6,811,634	50.9	(50.3, 51.5)	3,412,521	25.5	(25.0, 26.0)
Females	5,135,181	39.9	(39.3, 40.5)	3,190,453	24.8	(24.3, 25.3)
Residential Area[c]						
Rural	3,452,673	44.0	(43.3, 44.7)	1,952,023	24.9	(24.3, 25.4)
Urban	8,492,733	46.2	(45.7, 46.7)	4,650,951	25.3	(24.9, 25.7)
National Estimate[d]	11,945,406	45.5	(45.1, 45.9)	6,602,974	25.2	(24.8, 25.5)

%(CL) are prevalence and 95% confidence limits; data are standardized based on the weights of the 2004 Iranian population. Pregnant women and those without two blood pressure readings are excluded.
[a]Sex and residential area standardized. [b]Age and residential area standardized. [c]Age and sex standardized. [d]Weighted and age-sex-residential area standardized.

Table 3 | Percentage of individuals with hypertension who are aware, treated, and controlled and percentage of treated individuals with hypertension who are controlled

	Men				Women				Total			
	Hypertensive			Hypertension control in treated hypertensives	Hypertensive			Hypertension control in treated hypertensives	Hypertensive			Hypertension control in treated hypertensives
Age	Aware	Treated	Controlled		Aware	Treated	Controlled		Aware	Treated	Controlled	
25–34	6.9	5.0	2.8	57.1	16.8	9.4	5.6	59.2	10.7	6.7	3.9	58.3
35–44	11.4	7.7	2.6	34.5	28.4	19.4	7.3	37.7	19.8	13.4	4.9	36.8
45–54	23.1	16.0	4.5	28.5	45.4	32.2	8.0	25.1	34.9	24.6	6.4	26.1
55–64	31.7	23.3	4.9	21.1	54.7	42.7	8.0	18.9	44.1	33.7	6.6	19.6
Total	22.5	16.1	4.1	25.7	44.7	33.1	7.7	23.5	33.9	24.8	6.0	24.2

Pregnant women and those without two blood pressure readings are excluded.

Of the total study population, 21,566 (32%) were hypertensive, 29,788 (44%) were prehypertensive, and 5,355 (8%) reported taking medication. Overall, individuals with hypertension and prehypertension were more likely to be older, have higher body mass index, and have elevated glucose levels compared with those with normal BP (**Table 1**).

After extrapolation to the Iranian adult population aged 25–64 years, the prevalence of hypertension was 25.2% (95% confidence interval (CI): 24.8–25.5). The overall prevalence of hypertension was 25.5% in men and 24.8% in women (**Table 2**). The absolute number of 25- to 64-year-old Iranian civilians with hypertension was estimated to be 6.6 million individuals (~3.4 million men and 3.2 million women). Moreover, 45.5% (95% CI: 45.1–45.9) were defined to have prehypertension which comprised more than 11.9 million individuals (**Table 2**). Among hypertensive individuals, 66% were previously undiagnosed (55% women and 77% men). Overall, 6% of individuals diagnosed with hypertension had their BP controlled (**Table 3**).

Of those hypertensive individuals receiving medication for their hypertension, only 24.2% had their BP controlled. Out of all, 17.5% (95% CI: 17.2–17.8) had stage 1 and 7.7% (95% CI: 7.5–7.8) had stage 2 hypertension (**Table 4**).

BP in different age and sex strata

The prevalence rates and estimated absolute number of 25- to 64-year-old Iranians with hypertension and prehypertension in different age and sex strata are depicted in **Figure 1**. The prevalence of hypertension increased with increasing age both for men and women (**Figure 1a**). In women, the prevalence of hypertension increased by a greater magnitude compared with men (likelihood ratio test for interaction: $P < 0.0001$). Age specific prevalence of hypertension was higher among men in the youngest age group ($P < 0.0001$), whereas it was higher in women in two oldest age groups ($P < 0.0001$); the interaction of sex and age on prevalent hypertension was significant ($P < 0.0001$). Prehypertension was considerably more

Table 4 | Prevalence of hypertension according to blood pressure stages

	Normotension		Prehypertension		Hypertension			
					Stage I		Stage II	
Male								
25–34	31.2	(30.3, 32.2)	53.8	(52.7, 54.8)	12.3	(11.6, 13.0)	2.7	(2.3, 3.0)
35–44	24.6	(23.7, 25.5)	53.5	(52.5, 54.6)	17.1	(16.3, 17.9)	4.8	(4.3, 5.2)
45–54	16.3	(15.5, 17.1)	48.4	(47.3, 49.4)	24.4	(23.5, 25.4)	10.9	(10.2, 11.5)
55–64	11.2	(10.5, 11.8)	39.3	(38.3, 40.4)	31.3	(30.3, 32.3)	18.2	(17.4, 19.0)
Female								
25–34	50.4	(49.3, 51.5)	39.7	(38.7, 40.8)	7.9	(7.3, 8.5)	2.0	(1.7, 2.3)
35–44	34.9	(33.9, 35.9)	43.4	(42.3, 44.5)	15.7	(14.9, 16.5)	6.0	(5.5, 6.5)
45–54	19.9	(19.1, 20.8)	40.1	(39.1, 41.1)	25.4	(24.5, 26.3)	14.5	(13.8, 15.3)
55–64	10.9	(10.3, 11.6)	30.4	(29.4, 31.4)	33.7	(32.7, 34.7)	25.0	(24.0, 25.9)
Total								
25–34	40.6	(39.8, 41.3)	46.9	(46.2, 47.7)	10.2	(9.7, 10.6)	2.3	(2.1, 2.6)
35–44	29.7	(29.0, 30.4)	48.5	(47.8, 49.3)	16.4	(15.9, 17.0)	5.4	(5.0, 5.7)
45–54	18.1	(17.6, 18.7)	44.2	(43.5, 45.0)	24.9	(24.3, 25.6)	12.7	(12.2, 13.2)
55–64	11.0	(10.6, 11.5)	34.9	(34.2, 35.6)	32.5	(31.8, 33.2)	21.5	(20.9, 22.2)
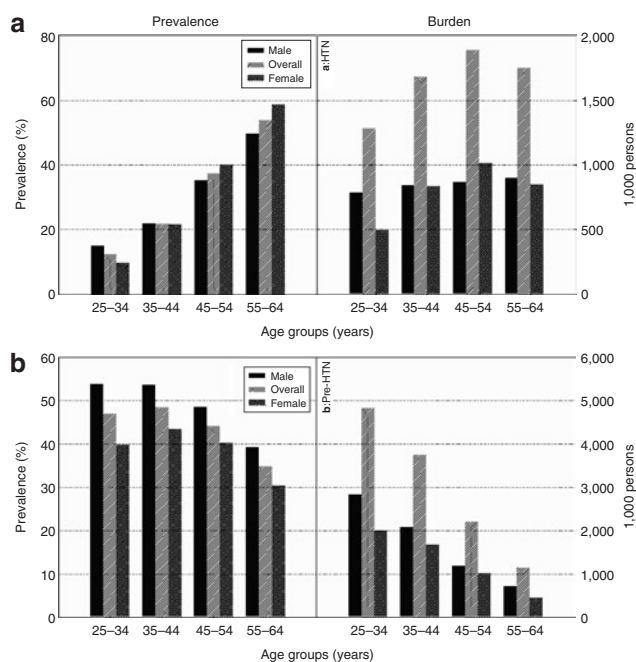
Figure 1 | Prevalence and absolute number of subjects with hypertension (**a**, HTN) and prehypertension (**b** Pre-HTN) according to age and gender, 2005.

common in men (51% vs. 40%) which comprises 1.7 million more prehypertensive men compared with women ($P < 0.0001$; **Figure 1b**).

Association of cardiovascular risk factors with hypertension, prehypertension, and awareness

Older age, male gender, being unmarried, being overweight or obese, hypercholesterolemia, lower education, and diabetes but not living in urban areas were associated with prevalence

Table 5 | Association of cardiovascular risk factors with hypertension, prehypertension, and unawareness

	Hypertension[a]		Prehypertension[b]		Unawareness[c]	
Age[d]						
35–44	1.7	(1.6–1.8)	1.3	(1.2–1.4)	0.6	(0.5–0.7)
45–54	3.6	(3.3–3.8)	1.9	(1.8–2.1)	0.3	(0.2–0.3)
55–64	6.8	(6.4–7.4)	2.5	(2.3–2.7)	0.2	(0.1–0.2)
Sex (referent: females)	1.3	(1.2–1.4)	2.1	(2.0–2.2)	2.6	(2.4–2.8)
BMI[e]						
Overweight	1.8	(1.7–1.9)	1.5	(1.5–1.6)	0.8	(0.7–0.9)
Obesity	2.8	(2.6–3.0)	2.2	(2.1–2.4)	0.7	(0.6–0.7)
Urbanization	1.0	(1.0–1.1)[NS]	1.0	(0.9–1.0)[NS]	1.0	(1.0–1.1)[NS]
History of diabetes[f]	1.6	(1.5–1.8)	1.2	(1.1–1.3)	0.6	(0.5–0.6)
Education level[g]	1.2	(1.1–1.3)	1.0	(1.0–1.1)[NS]	1.2	(1.0–1.3)
Marriage (referent: marriage)	1.2	(1.1–1.3)	1.0	(1.0–1.1)[NS]	1.0	(0.9–1.1)[NS]
Hypercholesterolemia[h]	1.2	(1.2–1.3)	1.2	(1.1–1.3)	1.0	(1.0–1.1)[NS]

Data are exp(β) and 95% confidence limits in parentheses. All predictors were forced to enter into a binary multivariate logistic regression model. Those with missing data on all dependent variables and pregnant women were excluded.
BMI, body mass index; NS, nonsignificant correlations.
[a]Compared with nonhypertensive individuals; data of 50,316 subjects were analyzed. [b]Compared with normotensive individuals; data of 33,677 subjects were analyzed. [c]Compared with aware hypertensive individuals; data of 16,639 subjects were analyzed. [d]Each category is compared with 25–34 years age group. [e]Each category is compared with normal weight individuals (BMI < 25). [f]Includes both self-reported diabetes and newly diagnosed diabetes based on fasting blood sugar ≥126 mg/dl. [g]Diploma of high school (not obtained is compared with obtained; referent diploma holders). [h]Cholesterol level ≥200 mg/dl is compared with that below this cutoff level.

Table 6 | Comparison of age- and sex-specific prevalence rates of hypertension among selected recent studies and the present study

Age group (years)	Canada[a]	USA[b]	China	Australia[c]	Germany[d,§]	UK[e]	Japan[f,§]	India[g,§,‡]	Isfahan[h,§,†]	Tehran[i,§,†]	Iran 2005
Males											
30	3	11	—	7.9	16.8	21.2	20.7	27.4	7.4	8.5	15 (0.41)
40	6.6	11.5	17.4	16.2	28	27.1	34.8	39.3	21.8	15.5	22 (0.48)
50	13.7	20.3	28.2	30.5	44.9	40.6	43.7	54	27.9	26	35.5 (0.56)
60	24.3	23.5	40.7	46.5	56	54.5	55.6	—	40.3	35.6	49.7 (0.57)
Females											
30	2.8	—	—	4.1	8.4	6.2	4.4	23.8	9.7	6.6	9.8 (0.35)
40	5.2	9.4	10.7	7.9	20.4	10.5	17.5	40.9	26.4	17.1	21.6 (0.47)
50	14.7	19	26.8	22.8	28.6	31	36.9	54.9	46.4	30	40 (0.55)
60	27.7	33.5	38.9	42.3	57.6	51.8	51.7	—	61.3	40.4	58.6 (0.56)

Data are prevalence rates (%). Iran data represents prevalence and s.e. in parentheses.
—Age groups are 25–34, 35–44, 45–54, and 55–64 years; §Exceptions that are categorized to 30–39, 40–49, 50–59, and 60–69 years according to original reports.
—The Studies are National surveys on both urban and rural populations. †Exceptions that are subnational urban population.
—Definition of hypertension: previous physician diagnosis for data of Canada; ≥SBP 140 mm Hg and/or DBP 90 mm Hg for data of USA, Japan, and Australia; ≥SBP 140/DBP 90 mm Hg or known hypertension for data of India, UK, China, and Iran; and ≥SBP 160/DBP 95 mm Hg or on current antihypertensive medication for data of Germany.
—Sources are as follows and available from links in http://www.who.int/ncd_surveillance/infobase/en/
[a]Statistics Canada. Canadian Community Health Survey 2000/2001. 2002. Additional data. [b]Centers for Disease Control and Prevention. National Health and Nutrition Examination Survey 1999–2000. [c]Australian Institute of Health and Welfare. Heart, stroke and vascular diseases—Australian facts 2001. Survey year: 1999–2000. [d]From ref. 41. [e]Department of Health. Health Survey for England. 2002. Available from http://www.doh.gov.uk/stats. [f]Ministry of Health, Labour and Welfare. Heisei 12-nen Junkanki-shikkan kiso cyousa houkoku (The Fifth National Survey of Cardiovascular Diseases, 2000), 2001. [g]From ref. 42. [h]From ref. 43. [i]Azizi F, Endocrine Research Center; Tehran Lipid and Glucose Study. National Research Project Tehran Lipid and Glucose Study; 2001.

of hypertension (**Table 5**). Similarly, all these variables were associated with prehypertension except educational level, marriage, and dwelling in an urban or rural residential area. Unawareness was found to be associated with male gender, younger age, and lower education. More obese, centrally obese, and diabetic patients were aware of their hypertension compared with normal subjects. Central obesity was also independently associated with hypertension (odds ratio: 2.1, 95% CI: 1.9–2.2), prehypertension (odds ratio: 1.7, 95% CI: 1.6–1.8), and unawareness (odds ratio: 0.7, 95% CI: 0.6–0.7).

DISCUSSION

In this first nationally representative report of the burden and prevalence of hypertension, its treatment, and awareness, we found that 25% or 6.6 million Iranian adults aged 25–64 years have hypertension and 11.9 million (45.5%) have prehypertension. Only 34% of those with hypertension were aware of their diagnosis; only 25% were taking prescribed medication to lower their BP; and only ~6% of all hypertensive patients had a BP <140/90 mm Hg. Of the pharmacologically treated hypertensive individuals, only 24% were adequately controlled. The prevalence rates in this study exceed those of many developing countries,[20–22] and are similar to those in industrialized countries[4,23,24] and recent estimate of global prevalence of hypertension.[25] However, reported rates of detection, treatment, and control are significantly lower compared with those of developed countries.[4,14,26–31]

The age-specific prevalence rates of recent national reports are shown in **Table 6**; however, comparisons should be considered with caution between studies as the definition of hypertension, year of the survey, and age categorization differ substantially between studies. Noticeably, age-specific prevalence of hypertension is considerably higher than the previous subnational reports from Iran in particular among men. The prevalence rates of hypertension are lower in North America, China and Australia compared with those in European countries and India; BP measurements of Iranian men are placed halfway between these extremes and the BP measurements of Iranian women exceed that of European countries.[32] Economic development and changes in lifestyle and diet may explain the high prevalence of hypertension, whereas, urbanization was not found to be correlated with hypertension in contrast to data from other developing countries.[33]

Wolf-Maier et al.[26] summarized that among 35- to –64-year-old hypertensive individuals 29% in the United States (1994–1998), 17% in Canada, and ≤10% in European countries (Germany, Sweden, England, Spain, and Italy) had controlled hypertension at 140/90 mm Hg. Among those hypertensive subjects taking antihypertensive medications, 55% in the United States, 47% in Canada, and ≥18% in European countries had controlled hypertension. In United States the BP control rate increased from 29% in 1999–2000 to 37% in 2003–2004.[4] In this study, the rate of controlled hypertension among Iranian adults were comparable with that of European countries and in particular was better than that of Spain,[34] but was much lower than that of the United States, Canada, and England (**Table 3**). The differences in control achievements follow strictly the pattern of different rates of awareness and treatment which may reflect the inefficient screening strategies and defective clinical guidelines for treatment.

There are 12 million Iranians aged 25–64 years with prehypertension. The high prevalence of prehypertension in

Iranian adults is higher than that of other populations.[8,35–37] Prehypertension is a risk factor for myocardial infarction and coronary artery disease[38] and may warrant interventions to prevent cardiovascular disease.[39] However, until prospective studies document the role of pharmacotherapy in prehypertension, lifestyle modification may be advocated.[40] Nevertheless at the public health level, effective strategies to screen and treat the patients with hypertension will be the first priority in the population of this study.

Older age is associated with a higher prevalence of hypertension, which indicates that the aging, younger population of Iran would likely encounter an even further increase in the absolute number of individuals with hypertension in proceeding decades. Obesity and central obesity were found to be the most modifiable, unyielding correlates of hypertension, indicating the direction of preventive measures. Obesity may associate with BP independently; nevertheless, it may be mediated through physical inactivity and unhealthy diet. Although such conclusions are beyond the scope of this report, the need to reduce the risk of hypertension through change of risk factors such as lifestyle modification should be reinforced. Our results highlight the concordance of multiple risk factors with both hypertension and prehypertension as was shown previously.[27] This finding, particularly in prehypertensive individuals, suggests the need to aggressively pursue preventive and screening programs in individuals with prehypertension.

The overall prevalence of hypertension is relatively equal in men and women. However, men are more likely to be unaware of their disease compared with women (odds ratio: 2.6; 95% CI: 2.4–2.8), adjusting for other relevant variables as is observed in other populations.[28] Interestingly, the awareness rate of hypertension was better in older people and in obese, centrally obese, diabetic, and hypercholesterolemic individuals indicating their greater concern of their health status. Lower education was related with higher odds of both hypertension and unawareness, consistent with previous reports (Table 5).[29,30]

In summary, this report provides a precise estimate of a pattern of hypertension in Iran and may facilitate assessment of the societal impact and appraisal of health policy and public health strategic planning. These results revealed that 25.2 and 45.5% of Iranians aged 25–64 years had hypertension and prehypertension, respectively. Among hypertensive individuals, 66% were previously undiagnosed, 75% were untreated, and 94% had uncontrolled high BP. These rates are relatively high compared with other communities. Further improvement in the control of hypertension with more aggressive policies to prevent, detect, and treat hypertension successfully through training and awareness of health professionals, and increasing public awareness is necessary. Furthermore, current data support the paradigm of epidemic chronic diseases in developing countries.

Disclosure: The authors declared no conflict of interest.

1. De Macedo ME, Lima MJ, Silva AO, Alcantara P, Ramalhinho V, Carmona J. Prevalence, awareness, treatment and control of hypertension in Portugal. The PAP study. Rev Port Cardiol 2007; 26:21–39.
2. Perez-Fernandez R, Marino AF, Cadarso-Suarez C, Botana MA, Tome MA, Solache I, Rego-Iraeta A, Mato AJ. Prevalence, awareness, treatment and control of hypertension in Galicia (Spain) and association with related diseases. J Hum Hypertens 2007; 21:366–373.
3. Petrella RJ, Merikle EP, Jones J. Prevalence, treatment, and control of hypertension in primary care: gaps, trends, and opportunities. J Clin Hypertens (Greenwich) 2007; 9:28–35.
4. Ong KL, Cheung BM, Man YB, Lau CP, Lam KS. Prevalence, awareness, treatment, and control of hypertension among United States adults 1999–2004. Hypertension 2007; 49:69–75.
5. Hajjar I, Kotchen JM, Kotchen TA. Hypertension: trends in prevalence, incidence, and control. Annu Rev Public Health 2006; 27:465–490.
6. Agyemang C, Ujcic-Voortman J, Uitenbroek D, Foets M, Droomers M. Prevalence and management of hypertension among Turkish, Moroccan and native Dutch ethnic groups in Amsterdam, the Netherlands: the Amsterdam Health Monitor Survey. J Hypertens 2006; 24:2169–2176.
7. Pitsavos C, Milias GA, Panagiotakos DB, Xenaki D, Panagopoulos G, Stefanadis C. Prevalence of self-reported hypertension and its relation to dietary habits, in adults; a nutrition & health survey in Greece. BMC Public Health 2006; 6:206.
8. Choi KM, Park HS, Han JH, Lee JS, Lee J, Ryu OH, Lee KW, Cho KH, Yoon D, Baik SH, Choi DS, Kim SM. Prevalence of prehypertension and hypertension in a Korean population: Korean National Health and Nutrition Survey 2001. J Hypertens 2006; 24:1515–1521.
9. Mancia G, Parati G, Borghi C, Ghironzi G, Andriani E, Marinelli L, Valentini M, Tessari F, Ambrosioni E. SMOOTH investigators. Hypertension prevalence, awareness, control and association with metabolic abnormalities in the San Marino population: the SMOOTH study. J Hypertens 2006; 24:837–843.
10. He J, Whelton PK. Elevated systolic blood pressure and risk of cardiovascular and renal disease: overview of evidence from observational epidemiologic studies and randomized controlled trials. Am Heart J 1999; 138:211–219.
11. Lopez AD. Assessing the burden of mortality from cardiovascular diseases. World Health Stat Q 1993; 46: 91–96.
12. He J, Klag MJ, Wu Z, Whelton PK. Stroke in the People's Republic of China. II. Meta-analysis of hypertension and risk of stroke. Stroke 1995; 26: 2228–2232.
13. Burt VL, Whelton P, Roccella EJ, Brown C, Cutler JA, Higgins M, Horan MJ, Labarthe D. Prevalence of hypertension in the US adult population. Results from the Third National Health and Nutrition Examination Survey, 1988–1991. Hypertension 1995; 25:305–313.
14. Gu D, Reynolds K, Wu X, Chen J, Duan X, Muntner P, Huang G, Reynolds RF, Su S, Whelton PK, He J. InterASIA Collaborative Group. The International Collaborative Study of Cardiovascular Disease in ASIA. Prevalence, awareness, treatment, and control of hypertension in china. Hypertension 2002;40:920–927.
15. Azizi F, Ghanbarian A, Madjid M, Rahmani M. Distribution of blood pressure and prevalence of hypertension in Tehran adult population: Tehran Lipid and Glucose Study (TLGS), 1999–2000. J Human Hypertens 2002; 16:305–312.
16. Sadeghi M, Roohafza HR, Kelishadi R. Blood pressure and associated cardiovascular risk factors in Iran: Isfahan Healthy Heart Programme. Med J Malaysia. 2004; 59:460–467.
17. Delavari AR, Alikhani S, Alaedini F. A National Profile of Non-Communicable Disease Risk Factors in the I.R.of Iran. Center for Disease Control, Ministry of Health & Medical Education, Tehran 2005.
18. STEPwise approach to chronic disease risk factor surveillance (STEPS) <http://www.who.int/chp/steps/manual/en/index.html> (2003). Accessed 3 January 2008.
19. Chobanian AV, Bakris GL, Black HR, Cushman WC, Green LA, Izzo JL, Jones DW, Materson BJ, Oparil S, Wright JT, Roccella EJ, the National High Blood Pressure Education Program Coordinating Committee. The Seventh report of the Joint National Committee on Prevention, Detection, Evaluation, and Treatment of High Blood Pressure. JAMA 2003; 289:2560–2572.
20. Kim JS, Jones DW, Kim SJ, Hong YP. Hypertension in Korea: a national survey. Am J Prev Med 1994; 10: 200–204.
21. Tatsanavivat P, Klungboonkrong V, Chirawatkul A, Bhuripanyo K, Manmontri A, Chitanondh H, Yipintsoi T. Prevalence of coronary heart disease and major cardiovascular risk factors in Thailand. Int J Epidemiol 1998; 27: 405–409.
22. Pan W, Chang H, Yeh W, Hsiao S, Hung Y. Prevalence, awareness, treatment and control of hypertension in Taiwan: results of nutrition and health survey in Taiwan (NAHSIT), 1993–1996. J Hum Hypertens 2001; 15:793–798.
23. Primatesta P, Brookes M, Poulter NR. Improved hypertension management and control: results from the health survey for England 1998. Hypertension 2001; 38:827–832.

24. Joffres MR, Ghadirian P, Fodor JG, Petrasovits A, Chockalingam A, Hamet P. Awareness, treatment, and control of hypertension in Canada. *Am J Hypertens* 1997; 10:1097–1102.

25. Kearney PM, Whelton M, Reynolds K, Muntner P, Whelton PK, He J. Global burden of hypertension: analysis of worldwide data. *Lancet* 2005; 365:217–223.

26. Wolf-Maier K, Cooper RS, Kramer H, Banegas JR, Giampaoli S, Joffres MR, Poulter N, Primatesta P, Stegmayr B, Thamm M. Hypertension treatment and control in five European countries, Canada, and the United States. *Hypertension* 2004; 43:10–17.

27. Lloyd-Jones DM, Evans JC, Levy D. Hypertension in adults across the age spectrum: current outcomes and control in the community. *JAMA* 2005; 294:466–472.

28. Whelton PK, He J, Muntner P. Prevalence, awareness, treatment and control of hypertension in North America, North Africa and Asia. *J Hum Hypertens* 2004; 18:545–551.

29. Gupta R, Gupta VP, Ahluwalia NS. Educational status, coronary heart disease, and coronary risk factor prevalencein a rural population of India. *BMJ* 1994; 309:1332–1336.

30. Jaddou1 HY, Bateiha1 AM, Ajlouni KM. Prevalence, awareness and management of hypertension in a recently urbanised community, eastern Jordan. *J Hum Hypertens* 2000; 14:497–501.

31. Hajjar I, Kotchen TA. Trends in prevalence, awareness, treatment, and control of hypertension in the United States, 1988–2000. *JAMA* 2003; 290:199–206.

32. Wolf-Maier K, Cooper RS, Banegas JR, Giampaoli S, Hense HW, Joffres M, Kastarinen M, Poulter N, Primatesta P, Rodríguez-Artalejo F, Stegmayr B, Thamm M, Tuomilehto J, Vanuzzo D, Vescio F. Hypertension prevalence and blood pressure levels in 6 European countries, Canada, and the United States. *JAMA* 2003; 289:2363–2369.

33. Cappuccio FP, Micah FB, Emmett L, Kerry SM, Antwi S, Martin-Peprah R, Phillips RO, Plange-Rhule J, Eastwood JB. Prevalence, Detection, Management, and Control of Hypertension in Ashanti, West Africa. *Hypertension* 2004; 43:1017–1022.

34. Banegas JR, Rodríguez-Artalejo F, de la Cruz Troca JJ, Guallar-Castillón P, del Rey Calero J. Blood pressure in Spain: distribution, awareness, control, and benefits of a reduction in average pressure. *Hypertension*. 1998; 32:998–1002.

35. Tsai PS, Ke TL, Huang CJ, Tsai JC, Chen PL, Wang SY, Shyu YK. Prevalence and determinants of prehypertension status in the Taiwanese general population. *J Hypertens* 2005; 23:1355–1360.

36. Brown DJ, Metiko EB. Prevalence of hypertension in a sample of Black American adults using JNC 7 classifications. *J Natl Black Nurses Assoc* 2005; 16:1–5.

37. Qureshi AI, Suri MF, Kirmani JF, Divani AA. Prevalence and trends of prehypertension and hypertension in United States: National Health and Nutrition Examination Surveys 1976 to 2000. *Med Sci Monit* 2005; 11: CR403–CR409.

38. Qureshi AI, Suri MF, Kirmani JF, Divani AA, Mohammad Y. Is prehypertension a risk factor for cardiovascular diseases? *Stroke* 2005; 36:1859–1863.

39. Zhang Y, Lee ET, Devereux RB, Yeh J, Best LG, Fabsitz RR, Howard BV. Prehypertension, diabetes, and cardiovascular disease risk in a population-based sample: the Strong Heart Study. *Hypertension* 2006; 47:410–414.

40. Grotto I, Grossman E, Huerta M, Sharabi Y. Prevalence of prehypertension and associated cardiovascular risk profiles among young Israeli adults. *Hypertension* 2006; 48:254–259.

41. Thefeld W. Verbreitung der herz-kreislauf-risikofaktoren hypercholesterinämie, übergewicht, hypertonie und rauchen in der Bevölkerung. *Bundesgesundheitsbl-Gesundheitsforsch-Gesundheitsschutz* 2000; 43:415–423.

42. Gupta R, Gupta VP, Sarna M, Bhatnagar S, Thanvi J, Sharma V, Singh AK, Gupta JB, Kaul V. Prevalence of coronary heart disease and risk factors in an urban Indian population: Jaipur heart watch-2. *Indian Heart J* 2002; 54:59–66.

43. Sarraf-Zadegan N, Boshtam M, Mostafavi S, Rafiei M. Prevalence of hypertension and associated risk factors in Isfahan, Islamic Republic of Iran. *East Mediterr Health J* 1999; 5: 992–1001.