

Determinants of awareness, treatment and control of hypertension in Isfahan, Central Iran

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Abstract:

Introduction: Prevalence, awareness, treatment, and control rates of hypertension (HTN) are essential and considerable in health promotion and policy. The purpose of this study was to assess hypertension prevalence, awareness, treatment and control rates in the Iranian general population and determine their associated factors.

Material and methods: We selected samples from a national survey named Non-Communicable Disease Risk Factors Surveillance that was designed by the Health Ministry – Center of Disease Control – Iran. The evaluation was done based on the WHO stepwise approach for non-communicable disease (NCD) risk factors. Data were collected by survey and registered clinical assessment by health professionals in a special survey questionnaire in Isfahan district area. At the end data were analyzed by logistic regression.

Results: The overall prevalence of high BP was 20.7% (95% CI = 19.4-22). Of these, 59.7% were aware, 31.1% of hypertensives were receiving treatment, and 6.2% controlled. Multivariate analysis showed that old age (45-54 years OR = 7.5 (95% CI: 2.2-25.6), 55-64 years OR = 7.9 (95% CI: 2.3-26.7) compared with 15-24 years), female sex (OR = 2.3 [95% CI: 1.6-3.4] vs. male), urbanization (OR = 1.8 [95% CI: 1.02-2.2] compared with rural) and high waist circumference (WC) (OR = 1.8 [95% CI: 1.2-2.8] compared with low WC) were independently associated with higher BP awareness. No significant factor was associated with treatment of HTN. The only factor that affected HTN control was high WC (OR = 3.1 95% CI: 1.6-6).

Conclusions: The awareness of patients about HTN was high but the treatment and control of it was not adequate. Determination of factors associated with them is necessary for control of HTN.

Key words: hypertension, awareness, treatment, control, risk factor, Iran.

Introduction

Worldwide control of communicable diseases has caused an epidemiological transition, thus non-communicable diseases (NCDs) have increased. This reduction of infectious disease has resulted in a decline in infectious disease mortality. In addition, changes in lifestyle and diet, and an increase in life expectancy, have resulted in a greatly

increased burden of chronic diseases in countries [1]. The rise of NCDs is increasing much more rapidly in developing than industrialized countries [2, 3]. Meanwhile cardiovascular diseases contribute greatly to the burden of chronic disease. Hypertension is one of the most important and modifiable risk factors for cardiovascular and cerebrovascular morbidity and mortality [4, 5]. Epidemiological studies demonstrate that cardiovascular events are correlated linearly over a wide range of blood pressures (BP). This correlation is continuous and independent of other risk factors [6].

Kearney *et al.* in their study 'Global Burden of Hypertension' showed that more than 25% of the world's adult population (nearly 1 billion) were hypertensive in 2000 and this is projected to increase by about 60% (1.56 billion) in 2025, the population burden being greater in developing countries [7].

Prevention and control of hypertension has been the cornerstone of many public health programmes. The goal of concerted public health efforts is based on detecting, treating and controlling hypertension in the community, as shown by the experiences of many countries [7-13]. One strategy for achieving these objectives is to increase the awareness about blood pressure at the population level. Smith *et al.* have presented a rule named the 'rule of halves' which predicts that only half of all those with hypertension are detected; half of those detected are treated and half of those treated are adequately controlled [14]. It seems that the awareness of people about their hypertension results in adequate treatment and better control. Moreover, some studies indicated that many factors, such as sex, age, and body size are associated with hypertension awareness, treatment and control [15-17].

The previous study from Iran determined levels of the prevalence, awareness, treatment, and control of hypertension as 28.2, 62.3, 33.1, and 14%, respectively [18]. However in Iran, knowledge about the prevalence, awareness, treatment, and control of hypertension is inadequate and is limited to the aforementioned study [18]. Therefore the aim of the present study was to investigate the current status of hypertension in Iran and to estimate the current prevalence, awareness, treatment, and control of hypertension in the adult population of central Iran. Furthermore, we seek the factors associated with awareness, treatment, and control of hypertension that can be called determinants of awareness, treatment, and control of hypertension. This information is vitally important for health policy, medical care, and public health strategy as well as for resource allocation.

Material and methods

Setting

Isfahan is one of the important provinces of Iran that is located in the centre of the country. Isfahan covers an area of 107 044.3 km² and has approximately 4,072,501 urban and rural population covered by Isfahan Medical Sciences and Health Services University. It is a strategic area in Iran, 400 km south of Tehran, and many ethnic groups are resident in it [19].

Study population

Data were obtained from Non-Communicable Disease Risk Factors Surveillance that was designed, directed and supported by the Center of Disease Control (CDC) of the Health and Medical Education Ministry, Iran. It was a cross-sectional survey in all health district areas of Iran. The evaluation was done based on the WHO stepwise approach for NCD risk factors [20].

In Isfahan, the study was directed by Isfahan Medical Sciences University, deputy of health. The sample was made up of 3760 individuals from the adult population between 15 and 65 years old selected by means of multistage sampling from January to February 2006. At the first step, cluster random sampling was conducted. Clusters were selected randomly by the post office from the postal code. In each cluster individuals were divided into two strata, 50% men and 50% women. From any gender strata 10 participants as a sample unit were selected consecutively from any age group, until the sample size was completed.

Evaluation of subjects

After obtaining informed written consent from all participants, our team conducted a structured interview using a standardized questionnaire to obtain information on demographic and socioeconomic aspects. A trained team of health professionals performed anthropometric measurements. They measured height barefoot in standing position to the nearest 0.5 cm using a plastic ruler, and measured weight in light clothing using calibrated scales. In addition, they measured waist circumference (WC) at a level midway between the lower rib margin and the iliac crest to the nearest half centimetre. A figure of more than 102 cm for men and above 88 cm for women was considered a high WC level. Body mass index (BMI) was calculated as weight (kg) divided by height (m²). Overweight was defined as BMI \geq 25 kg/m² and obesity as BMI \geq 30 kg/m².

Each participant's BP was measured after 30 min of rest in a sitting position and repeated once more at least 10 min after by trained health professionals using calibrated mercury sphygmomanometers and

appropriate-sized adult cuffs. None of the participants had tea/coffee intake or had smoked within 30 min preceding the measurements. For quality control of data collection one from a sample of ten was re-evaluated by researchers.

Definitions

High BP was defined as a systolic blood pressure (SBP) \geq 140 mmHg, or diastolic blood pressure (DBP) \geq 90 mmHg (average of two measurements), or being on antihypertensive therapy. Awareness of hypertension/high BP was defined as self-reporting of any prior diagnosis of hypertension by a health-care professional. Treatment of hypertension was defined as the proportion of aware hypertensives who reported receiving prescribed antihypertensive medication for management of high BP at the time of the interview. Control rate was defined as the proportion on antihypertensive therapy with SBP $<$ 140 mmHg and DBP $<$ 90 mmHg [21].

The study protocol was evaluated and approved by the Ethics Committee of the Ministry of Health in Iran.

Data analysis

All data were summarized as mean and standard deviation for continuous variables and as frequency and percentage for categorical variables. We divided the subjects into five age groups: 15-24, 25-34, 35-44, 45-54, and 55-64 years. They were also divided into four education levels – illiterate, primary education, diploma and high school education, and university graduated – as well as two marital states: 1) married, 2) single, divorced or widow.

We used the χ^2 and Mantel-Haenszel tests for comparison of categorical data; and *t*-test and analysis of variance (ANOVA) for continuous variables. A multivariate analysis using stepwise logistic regression was conducted to identify independent factors associated with awareness, treatment, and control of hypertension. All analyses were performed in the sub-samples; analysis on awareness was done on all high BP persons, and analysis on treatment was done on aware subjects, whose control was done on the treated sub-sample. Only significant factors in the univariate analysis at first step were entered into the multivariate analysis. These were reported as odds ratios (ORs) with corresponding 95% confidence intervals (CIs).

All statistical analyses were performed with SPSS software package version 11.5 (SPSS Inc., Chicago, USA) for Windows. The significance level was set at $p < 0.05$.

Results

Of 3760 participants, the mean SBP and DBP were 122.3 ± 19.6 and 78.2 ± 12.3 mmHg respectively,

Table I. SBP and DBP in the population by age and HTN status in men

Age	Blood pressure	Mean	Standard deviation	
15-24	systolic	normotensive	113.6	10.3
		untreated	144.4	6.4
		treated	124.2	36.4
		total	114.9	12
	diastolic	normotensive	73.1	9
		untreated	85.3	11.3
		treated	76.7	5.8
25-34	systolic	normotensive	116.1	9.8
		untreated	143.6	7.2
		treated	105	35.3
		total	118	12.1
	diastolic	normotensive	76	9
		untreated	89.2	7.8
		treated	70	28.3
35-44	systolic	normotensive	116.5	9.8
		untreated	145.1	7.3
		treated	138.5	8.6
		total	119.8	13.2
	diastolic	normotensive	77	9.1
		untreated	92.5	8.2
		treated	85	12.2
45-54	systolic	normotensive	120.2	10.2
		untreated	152.1	15.3
		treated	142.2	22.2
		total	128.8	18.5
	diastolic	normotensive	78.7	8.9
		untreated	91.8	11.8
		treated	87.4	11
55-64	systolic	normotensive	122.7	9.5
		untreated	153.2	15.8
		treated	147.5	22.3
		total	136.3	20.2
	diastolic	normotensive	78.8	8.9
		untreated	90.5	10.3
		treated	89.1	11
total		84.1	11.2	

Table II. SBP and DBP in the population by age and HTN status in women

Age	Blood pressure	Mean	Standard deviation	
15-24	systolic	normotensive	106.5	10.8
		untreated	145	6.3
		treated	180	–
		total	107.8	12.9
	diastolic	normotensive	68.8	9.7
		untreated	89.8	11.8
		treated	80.	–
		total	69.5	10.3
25-34	systolic	normotensive	110	10.8
		untreated	146.1	8.7
		treated	138.7	13.6
		total	111.4	12.7
	diastolic	normotensive	71.1	9.9
		untreated	91.1	10.6
		treated	93.7	12.5
		total	72	10.7
35-44	systolic	normotensive	113.9	10.9
		untreated	148.3	8.7
		treated	148.3	25.1
		total	117.5	15.5
	diastolic	normotensive	75	9.4
		untreated	91.8	10.2
		treated	93.6	14.5
		total	76.8	11
45-54	systolic	normotensive	117.8	10.9
		untreated	151.2	13.9
		treated	153.9	24.9
		total	128.6	21.5
	diastolic	normotensive	76.2	9
		untreated	94.8	11.2
		treated	95.3	16
		total	82	13.7
55-64	systolic	normotensive	120.7	10
		untreated	156.4	17.6
		treated	157.8	21.1
		total	140.1	24.1
	diastolic	normotensive	77.8	8.7
		untreated	93.7	11.4
		treated	93.8	13.1
		total	86.3	13.4

as shown in Table I and II, by sex, age, and hypertension (HTN) status. The means of both SBP and DBP increase with age in both sexes. The mean BP showed that the control in treated cases was better in younger people than older ones.

Overall, 20.7% (95% CI = 19.4-22) of the current adult population aged 16 to 64 years had hypertension. Multivariate logistic regression analysis showed that risk of occurrence of HTN was higher in male, illiterate individuals, with urban residency, and older age (Table III). The health system in Iran is based on health houses and rural and urban health centres. Health houses are located in villages. The maximum distance of people to a health house is a 10-min walk. They are managed by rural health centres. In the cities, there are some urban health centres, but private health care is prominent. The management of health care in every province is undertaken by the health system network of the health ministry.

Multivariate logistic regression analysis determined the influence of gender, age, residential status, and waist circumference on awareness of people about HTN (Table V). Awareness in female subjects was 2.33-fold higher than males and participants in age groups 45-54 and 55-64 also had a significantly higher awareness. Urban residential status increased the awareness of HTN 1.83-fold compared with the rural population. Central obesity was a positive factor for awareness of people about

Table III. Multivariate logistic regression analysis of factors associated with prevalence of HTN in an Iranian adult population

Variable		Odds ratio (OR)	95% Confidence interval
Gender	Female	1	–
	Male	1.56	1.25-1.94
Age	15-24	1	–
	25-34	0.98	0.61-1.57
	35-44	1.57	1.01-2.42
	45-54	4.52	3-6.81
	55-64	10.07	6.65-15.24
Education	Illiterate	1.52	1.02-2.27
	primary	1.26	0.88-1.8
	high school	0.76	0.51-1.13
	university	1	–
Residential status	Rural	1	–
	Urban	1.35	1.05-1.7
BMI	Normal	1	–
	Obese	2	1.6-2.5
Waist circumference	Normal	1	–
	Obese	1.8	1.42-2.3

Table IV. Prevalence, awareness, treatment and control rate of HTN by sex and age in an adult population in Iran*

Sex	Age	Total number of people	Prevalence	Awareness	Treatment	Control
Male	15-24	373	19 (5.1%)	2 (10.5%)	2 (100%)	1 (50%)
	25-34	380	29 (7.6%)	3 (10.3%)	1 (33.3%)	0
	35-44	375	49 (13.1%)	6 (12.2%)	4 (66.7%)	1 (25%)
	45-54	376	110 (29.3%)	38 (34.5%)	25 (65.8%)	8 (32%)
	55-64	376	178 (47.3%)	58 (32.6%)	46 (79.3%)	14 (30.4%)
Female	15-24	375	14 (3.7%)	1 (7.1%)	1 (100%)	0
	25-34	375	19 (5.1%)	4 (21.1%)	3 (75%)	1 (33.3%)
	35-44	374	41 (11%)	14 (34.1%)	10 (71.4%)	2 (%)
	45-54	382	119 (31.2%)	67 (56.3%)	54 (80.6%)	8 (14.8%)
	55-64	374	201 (53.7%)	121 (60.2%)	96 (79.3%)	13 (13.5%)
Overall		3760	779 (20.7%) (95% CI = 19.4-22)	314 (40.3%) (95% CI = 37-43.8)	242 (77.1%) (95% CI = 72.4-81.7)	48 (19.8%) (95% CI = 14.8-25)

*The denominator of prevalence was the total number of people in each age group, the denominator for awareness was the hypertensive sub-sample, denominator for treatment was the aware sub-sample, and denominator for control was the treated sub-sample

HTN. Obese patients with high WC were more aware than those with normal WC (OR = 1.84 95% CI = 1.02-2.17). Unlike awareness, there were not any factors associated with treatment. Although the mean BP showed that the control in treated cases was better in younger people than older ones, multivariate logistic regression did not show any factor significantly associated with treatment of HTN. The unique factor that affected the control of HTN in multivariate analysis was WC. Individuals with normal WC were 3.13-fold better controlled than obese patients. Thus central obesity was a risk factor for uncontrolled HTN (OR = 3.13 95% CI = 1.62-6.02).

Discussion

Over the past decades, rapid economic growth and associated socioeconomic changes have resulted in the emergence of numerous NCDs including HTN. Hypertension as a cardiovascular risk factor has become an important public health problem not only in developed but also in developing countries. The Non-Communicable Disease Risk Factors study is the first national study designed to investigate NCD risk factors in the Iranian population. The prevalence, awareness, treatment, and control of HTN are the main subjects of interest in this study. We attempted to determine the rates and determinants of HTN in Isfahan, central Iran. The prevalence, awareness, treatment and control rates of HTN were demonstrated in our study as 20.7, 40.3, 77.1 and 19.8% respectively. We followed the other studies' methodology. However, like many studies, our findings did not follow the 'rule of halves', either [22-50]. Treatment rate was more than fifty percent of aware subjects. In contrast the control rate was less than 50% of treated patients. This rule predicts that only half of

Table V. Multivariate logistic regression analysis of factors associated with awareness of HTN in Iranian adults

Variable		Odds ratio (OR)	95% Confidence interval
Gender	Female	1	–
	Male	2.33	1.61-3.38
Age	15-24	1	–
	25-34	1.68	0.39-7.16
	35-44	2.59	0.7-9.55
	45-54	7.46	2.18-25.6
	55-64	7.88	2.32-26.74
Residential status	Rural	1	–
	Urban	1.83	1.02-2.17
Waist circumference	Normal	1	–
	Obese	1.84	1.21-2.8

all those with hypertension are detected; half of those detected are treated, and half of those treated are adequately controlled [14]. Table VI compares the prevalence, awareness, treatment, and control rates of HTN of the current study with the results of some previous works. As shown, prevalence of HTN was very low in Isfahan. It was even lower in Thailand, where prevalence was 17.8%. This low figure related to the studied population: the study was done in a rural area in Thailand [22]. Our data elucidated that urbanization was a risk factor for incidence of HTN. Hence there was a lower rate of HTN in rural areas. This study, like others, disclosed higher prevalence of HTN in males, aged over 35, illiterate people, those from urban areas, and obese patients [10, 12, 23-33].

The findings of this study provide important

Table VI. Prevalence, awareness, treatment and control rates of HTN in different studies

	Prevalence	Awareness	Treatment	Control
Our findings in Isfahan	20.7	40.3	77.1	19.8
IHHP [39]	17.3	40.3	87.7	25.8
USA [40]	52.3	68.1	46.4	13
USA [41]	58	82	79	39
Greece [27]	31.1	60.2	51.2	32.8
Thailand [22]	17.8	64.9	65.5	42.3
Ghana [24]	29.4	34	82.3	6.2
Turkey [25]	31.8	64.8	76.4	21
Portugal [31]	42.1	45.7	84.5	11.2
Brazil [28]	33.7	50.8	89.6	10.4
Greece [42]	~39	54.4	83.9	15.2
Malaysia [30]	33	33	69.7	6
China [15]	26.4	43	61.5	29.1
China [35]	46.5	23	56	33
India [26]	36.4	48.5	65.6	13.6
India [43]	54.5	39	74.3	30.6
China [34]	27.2	44.7	63.1	8.1
Spain [44]	50.3	62	–	8.6
Korea [29]	33.7	24.6	78.6	24.3
Greece [45]	28.4	60.8	54.5	27
Spain [46]	32.7	56.5	87	10.9
France and New Ireland [47]	$F = 28$ $I = 31$	70 58	60 60	31 12
Caribbean [48]	32.7	81	56	55
Egypt [49]	26.3	37.5	64	8
Canada [50]	25	~54	61.1	~29

information on factors associated with hypertension awareness, treatment, and control in a sub-sample of the Iranian population. In the multivariate analysis, some factors were related to awareness. Females, persons over 45 years old, the urban population, and obese patients were independently associated with higher HTN awareness. The association of female gender and older ages with HTN awareness is consistent with other studies [15, 24-26, 30-32, 34-36]. A possible explanation might be that women and older people may pay more attention to their health. Apart from age and sex, the present data have provided two independent factors associated with awareness – urbanization and high WC. Individuals with high WC are more apt to have a higher blood pressure [15, 37]. Muntner *et al.* demonstrated that overweight and obese people were more aware about their high blood pressure level [15]. It has been suggested that overweight and obesity positively influence BP

checking and prescription of medication for intervention; hence higher awareness and treatment [38].

In a survey in China and another in Ghana it was substantiated that obese patients have higher awareness about HTN; both of them were in agreement with our study [15, 24]. Perhaps it was due to more blood pressure checking in the obese. In contrast to other studies we did not find any significant factor associated with treatment of HTN. Findings of other reports were controversial about sex and age [15, 25, 29, 30, 34]. However, our study provided a significant effective factor for HTN control, which was normal waist circumference. This is in contrast to Muntner’s study in China. They demonstrated that obese patients had better blood pressure control [15].

On the whole, the present study and the other reports distinguish several factors worthy of note: first, “the rule of halves” is not true in every culture; second, in a recent Iranian sample, awareness of HTN helps individuals to treat their disease but it does not affect blood pressure control. Hence, it is necessary that health system managers design a special health intervention to promote knowledge, attitude and practice of patients to have better control of blood pressure level; third, awareness, treatment and control of HTN indirectly affect human cardiovascular and cerebrovascular diseases; thus they can be named determinants of HTN or HTN equivalent risk factors; fourth, rates of prevalence, awareness, treatment and control of HTN have a wide range in different studies, as shown in Table VI. It seems that a systematic review and meta-analysis are needed to determine the effective rates of these determinants; the authors will try to do it as soon as possible.

There were some limitations in our study; we measured blood pressure two times and got averages from them. It was not very accurate for subjects in whom HTN was detected the first time for them. According to JNC criteria, blood pressure is considered to be elevated when repeated measurements are greater than 140/90, for the systolic, diastolic, or both measurements. A diagnosis of hypertension is made when a person has had 2 or more elevated readings after the initial assessment. This limitation was observed in many studies.

We used some health professionals for measuring blood pressure; they were trained and used standardized measurement methods for minimizing intra-observer error. We did agreement analysis between them but inter-observer error was not eliminated. However, we tried to minimize it.

Reference

1. Yusuf S, Reddy S, Ounpuu S, Anand S. Global burden of cardiovascular diseases: part I: general considerations,

- the epidemiologic transition, risk factors, and impact of urbanization. *Circulation* 2001; 104: 2746-53.
2. Murray CJ, Lopez AD. Global mortality, disability, and the contribution of risk factors: Global Burden of Disease Study. *Lancet* 1997; 349: 1436-42.
 3. W.H.O. Reducing risks promoting healthy life. Geneva: World Health Organization; 2002. Report No.: World Health Report 2002.
 4. He J, Whelton PK. Epidemiology and prevention of hypertension. *Med Clin North Am* 1997; 81: 1077-97.
 5. Whelton PK. Epidemiology of hypertension. *Lancet* 1994; 344: 101-6.
 6. Ezzati M, Lopez AD, Rodgers A, Vander Hoorn S, Murray CJ. Comparative risk assessment collaborative group: selected major risk factors and global and regional burden of disease. *Lancet* 2002; 360: 1347-60.
 7. Kearney PM, Whelton M, Reynolds K, Whelton PK, He J. Worldwide prevalence of hypertension: a systematic review. *J Hypertens* 2004; 22: 11-9.
 8. Antikainen RL, Moltchanov VA, Chukwuma C Jr, et al. Trends in the prevalence, awareness, treatment and control of hypertension: the WHO MONICA Project. *Eur J Cardiovasc Prev Rehabil* 2006; 13: 13-29.
 9. Burt VL, Cutler JA, Higgins M, et al. Trends in the prevalence, awareness, treatment, and control of hypertension in the adult US population. Data from the health examination surveys, 1960 to 1991. *Hypertension* 1995; 26: 60-9.
 10. Cifkova R, Skodova Z, Lanska V, et al. Trends in blood pressure levels, prevalence, awareness, treatment, and control of hypertension in the Czech population from 1985 to 2000/01. *J Hypertens* 2004; 22: 1479-85.
 11. Hajjar I, Kotchen TA. Trends in prevalence, awareness, treatment, and control of hypertension in the United States, 1988-2000. *JAMA* 2003; 290: 199-206.
 12. Rywik SL, Davis CE, Pajak A, et al. Poland and U.S. collaborative study on cardiovascular epidemiology hypertension in the community: prevalence, awareness, treatment, and control of hypertension in the Pol-MONICA Project and the U.S. Atherosclerosis Risk in Communities Study. *Ann Epidemiol* 1998; 8: 3-13.
 13. Wang Z, Wu Y, Zhao L, Li Y, Yang J, Zhou B. Trends in prevalence, awareness, treatment and control of hypertension in the middle-aged population of China, 1992-1998. *Hypertens Res* 2004; 27: 703-9.
 14. Smith WC, Lee AJ, Crombie IK, Tunstall-Pedoe H. Control of blood pressure in Scotland: the rule of halves. *BMJ* 1990; 300: 983.
 15. Muntner P, Gu D, Wu X, et al. Factors associated with hypertension awareness, treatment, and control in a representative sample of the Chinese population. *Hypertension* 2004; 43: 578-85.
 16. Wang Y, Wang QJ. The prevalence of prehypertension and hypertension among US adults according to the new joint national committee guidelines: new challenges of the old problem. *Arch Intern Med* 2004; 164: 2126-34.
 17. Whelton PK, Beevers DG, Sonkodi S. Strategies for improvement of awareness, treatment and control of hypertension: results of a panel discussion. *J Hum Hypertens* 2004; 18: 563-5.
 18. Sarrafzadegan N, Sajady F. Hypertension and Diabetes situation in the Eastern Mediterranean region: with special reference to Iran. In: Dhalla NS, Chockalingam A, Berkowitz HI, Singal PK (eds.). *Frontiers in Cardiovascular health*. Kluwer academic Pub., Boston 2003; 451-72.
 19. Management and Planning Organization MPO. *Statistical year book of Isfahan province-2004*. First ed. Isfahan, Iran: Pooyandegan Toseea Co., 2005.
 20. Surveillance of risk factors for Non-communicable disease; The WHO stepwise approach. <http://www.who.int/ncd/surveillance/surveillance-publication.htm> 2001.
 21. JNC VI Joint National Committee on Prevention, Detection, Evaluation, and Treatment of High Blood Pressure: The sixth report of the Joint National Committee on Prevention, Detection, Evaluation and Treatment of High Blood Pressure (JNC VI). *Arch Intern Med* 1997; 157: 2413-46.
 22. Howteerakul N, Suwannapong N, Sittlerd R, Rawdaree P. Health risk behaviours, awareness, treatment and control of hypertension among rural community people in Thailand. *Asia Pac J Public Health* 2006; 18: 3-9.
 23. Agyemang C, Bindraban N, Mairuhu G, Montfrans G, Koopmans R, Stronks K. Prevalence, awareness, treatment, and control of hypertension among Black Surinamese, South Asian Surinamese and White Dutch in Amsterdam, The Netherlands: the SUNSET study. *J Hypertens* 2005; 23: 1971-7.
 24. Agyemang C, Bruijnzeels MA, Owusu-Dabo E. Factors associated with hypertension awareness, treatment, and control in Ghana, West Africa. *J Hum Hypertens* 2006; 20: 67-71.
 25. Altun B, Arici M, Nergizoglu G, et al. Prevalence, awareness, treatment and control of hypertension in Turkey (the PatenT study) in 2003. *J Hypertens* 2005; 23: 1817-23.
 26. Bharucha NE, Kuruvilla T. Hypertension in the Parsi community of Bombay: a study on prevalence, awareness and compliance to treatment. *BMC Public Health* 2003; 3: 1.
 27. Efstratopoulos AD, Voyaki SM, Baltas AA, et al. Prevalence, awareness, treatment and control of hypertension in Hellas, Greece: the Hypertension Study in General Practice in Hellas (HYPERTENSHELL) national study. *Am J Hypertens* 2006; 19: 53-60.
 28. Gus I, Harzheim E, Zaslavsky C, Medina C, Gus M. Prevalence, awareness, and control of systemic arterial hypertension in the state of Rio Grande do Sul. *Arq Bras Cardiol* 2004; 83: 429-33.
 29. Jo I, Ahn Y, Lee J, Shin KR, Lee HK, Shin C. Prevalence, awareness, treatment, control and risk factors of hypertension in Korea: the Ansan study. *J Hypertens* 2001; 19: 1523-32.
 30. Lim TO, Morad Z. Prevalence, awareness, treatment and control of hypertension in the Malaysian adult population: results from the national health and morbidity survey 1996. *Singapore Med J* 2004; 45: 20-7.
 31. Macedo ME, Lima MJ, Silva AO, Alcantara P, Ramalhinho V, Carmona J. Prevalence, awareness, treatment and control of hypertension in Portugal: the PAP study. *J Hypertens* 2005; 23: 1661-6.
 32. Marques-Vidal P, Arveiler D, Amouyel P, Bingham A, Ferrieres J. Sex differences in awareness and control of hypertension in France. *J Hypertens* 1997; 15: 1205-10.
 33. Oliveria SA, Chen RS, McCarthy BD, Davis CC, Hill MN. Hypertension knowledge, awareness, and attitudes in a hypertensive population. *J Gen Intern Med* 2005; 20: 219-25.
 34. Gu D, Reynolds K, Wu X, et al. Prevalence, awareness, treatment, and control of hypertension in china. *Hypertension* 2002; 40: 920-7.
 35. Li W, Jiang X, Ma H, et al. Awareness, treatment and control of hypertension in patients attending hospital clinics in China. *J Hypertens* 2003; 21: 1191-7.
 36. Reynolds K, Gu D, Muntner P, et al. Geographic variations in the prevalence, awareness, treatment and control of hypertension in China. *J Hypertens* 2003; 21: 1273-81.

37. Delavari AR, Mahdavi-Hazave AR, Noroozinejad A, Yarahmadi S. National program of prevention and control of Diabetes mellitus. second ed. Tehran, Iran: Health ministry publication, 2004.
38. Chen R, Tunstall-Pedoe H, Morrison C, Connaghan J, A'Brook R. Trends and social factors in blood pressure control in Scottish MONICA surveys 1986-1995: the rule of halves revisited. *J Hum Hypertens* 2003; 17: 751-9.
39. Shirani S, Kelishadi R, Sarrafzadegan N, et al. Determinants of Awareness, Treatment and Control of Hypertension, Dyslipidemia and Diabetes Mellitus in an Iranian Population: Isfahan Healthy Heart Program. *East Mediterrean Health J*. In press 2007.
40. Blaha MJ, Kusz KL, Drake W, Elasy TA. Hypertension prevalence awareness, treatment and control in North Nashville. *Tenn Med* 2006; 99: 35-7.
41. Dickson BK, Blackledge J, Hajjar IM. The impact of lifestyle behavior on hypertension awareness, treatment, and control in a southeastern population. *Am J Med Sci* 2006; 332: 211-5.
42. Psaltopoulou T, Orfanos P, Naska A, Lenas D, Trichopoulos D, Trichopoulou A. Prevalence, awareness, treatment and control of hypertension in a general population sample of 26,913 adults in the Greek EPIC study. *Int J Epidemiol* 2004; 33: 1345-52.
43. Zachariah MG, Thankappan KR, Alex SC, Sarma PS, Vasana RS. Prevalence, correlates, awareness, treatment, and control of hypertension in a middle-aged urban population in Kerala. *Indian Heart J* 2003; 55: 245-51.
44. Pablos-Velasco P, Martinez-Martin FJ, Rodriguez PF, Urioste LM, Garcia RR. Prevalence, awareness, treatment and control of hypertension in a Canarian population. Relationship with glucose tolerance categories. The Guia Study. *J Hypertens* 2002; 20: 1965-71.
45. Stergiou GS, Thomopoulou GC, Skeva II, Mountokalakis TD. Prevalence, awareness, treatment, and control of hypertension in Greece: the Didima study. *Am J Hypertens* 1999; 12: 959-65.
46. Puras A, Sanchis C, Artigao LM, Divison JA. Prevalence, awareness, treatment, and control of hypertension in a Spanish population. *Eur J Epidemiol* 1998; 14: 31-6.
47. Marques-Vidal P, Evans AE, Cambou JP, et al. Awareness and control of hypertension and hypercholesterolaemia in France and Northern Ireland. *QJM* 1997; 90: 341-5.
48. Freeman V, Fraser H, Forrester T, et al. A comparative study of hypertension prevalence, awareness, treatment and control rates in St Lucia, Jamaica and Barbados. *J Hypertens* 1996; 14: 495-501.
49. Ibrahim MM, Rizk H, Appel LJ, et al. Hypertension prevalence, awareness, treatment, and control in Egypt. Results from the Egyptian National Hypertension Project (NHP). NHP Investigative Team. *Hypertension* 1995; 26: 886-90.
50. Pica LA, Boucher MM, Grignon R. The prevalence, awareness and control of hypertension in Laval, Quebec, 1986. *Can J Public Health* 1990; 81: 427-30.