Social disparities in prevalence, treatment and control of hypertension in Iran: Second National Surveillance of Risk Factors of Noncommunicable Diseases, 2006

Mitra Ebrahimi[a,*], Mohammad A. Mansournia[b], Ali A. Haghdoost[c], Arash Abazari[d], Farshid Alaeddini[e], Ali Mirzazadeh[c] and Masud Yunesian[b,f,*]

Objective **Assessing hypertension prevalence, treatment and control by sociodemographic factors in Iran.**

Methods **We analyzed data from the 2006 National Surveillance of Risk Factors for Noncommunicable Diseases of Iran with a population-based sample of almost 30 000 people aged 15–64 years. Multiple logistic regression models were used to explore differences in hypertension prevalence, treatment and control, adjusting for sociodemographic factors, comorbidities and behavioral factors.**

Results **Hypertension prevalence was 17.37%. Among hypertensive patients, 33.35% were under treatment, and, among treated people, 35.10% had hypertension controlled. In multiple-regression analysis, age, male sex, low level of education, Kurd ethnicity, overweight and obesity, diabetes mellitus, lower level of physical activity and high-Human Development Index provinces were independently associated with higher prevalence of hypertension. Income and living in rural or urban area were not related to hypertension prevalence. Treatment rates were lower in men, younger people and people of low education and low income, but there were no treatment rate disparities connected to living area, ethnicity and provinces (by Human Development Index). In addition, diabetic patients, obese people and past daily smokers had higher treatment rates. Lower control rates were independently associated with male sex, higher age and lower education, but not with other variables.**

Conclusion **In Iran, there is comparatively higher prevalence of hypertension among people of Kurdish ethnicity, people of low education and in high-Human Development Index provinces; a lower treatment rate among men, younger people, people of low education and low income; and a lower control rate among men and people of low education. These disparities should be addressed by researchers and health policy makers.** ***J Hypertens*** **28:1620–1629 © 2010 Wolters Kluwer Health | Lippincott Williams & Wilkins.**

Journal of Hypertension 2010, **28**:1620–1629

Keywords: educational status, epidemiology, ethnic groups, health status disparities, income, Iran, residence characteristics, rural health, socioeconomic factors, urban health

Abbreviations: aOR, adjusted odds ratio; CI, confidence interval; HDI, Human Development Index; NCD, noncommunicable disease; NHANES, National Health and Nutrition Examination Survey; OR, odds ratio; STEPS, STEPwise approach to chronic disease risk factor surveillance

[a]Student's Scientific Research Centre, [b]School of Public Health, Tehran University of Medical Sciences (TUMS), [c]Physiology Research Centre, Kerman University of Medical Sciences, Kerman, [d]School of Medicine, Tehran University of Medical Sciences (TUMS), [e]Health Researchers Research and Development Institute and [f]Centre for Environmental Research, Tehran University of Medical Sciences (TUMS), Tehran, Iran

Correspondence to Mitra Ebrahimi, MD, MPH, Student's Scientific Research Centre, Tehran University of Medical Sciences (TUMS), Poursina St., P.O. Box #14155-6537, Tehran, Iran
Tel: +98 21 66495948; fax: +98 21 66418588;
e-mail: ebrahimi_m@razi.tums.ac.ir

Received 11 June 2009 **Revised** 15 March 2010
Accepted 22 March 2010

Introduction

In recent years, social disparities in health, especially in developed countries, have been extensively investigated. It is not surprising that the health measure of many of these studies has been hypertension. Hypertension is one of the leading contributors to the burden of disease and mortality throughout the world [1]. Many studies have investigated the association of hypertension prevalence, treatment and control with race/ethnicity, socioeconomic status and residential environment. For example, a higher prevalence of hypertension in African–Americans has been consistently demonstrated in the United States [2]. In most studies [3–8], the hypertension prevalence is inversely related to the socioeconomic status, education and income. However, associations between hypertension and these measures were absent, or sometimes even positive, in another investigation [5]. Additionally, a study [9] has shown that the people who live in more disadvantaged areas are more likely to have high blood pressure (BP).

Until now, the relation of social factors and health in Iran has been poorly represented in literature. The current study analyzes data from an Iranian national survey in 2006 in order to explore the association of sociodemographic factors (sex, age, living in rural or urban area, ethnicity, income, education and the province of

*M.E. and M.Y. contributed equally to the writing of this article.

0263-6352 © 2010 Wolters Kluwer Health | Lippincott Williams & Wilkins DOI:10.1097/HJH.0b013e32833a38f2

inhabitation of the people) with hypertension prevalence, treatment and control in Iran.

Methods

Participants

We analyzed data from the Second National Survey of Noncommunicable Disease (NCD) Risk Factors of Iran conducted in 2006. This national survey has been designed according to the WHO STEPwise approach to chronic disease risk factor surveillance (STEPS) [10]. In brief, a probability representative sample of 29 972 Iranian individuals between 15 and 64 years of age was selected through multistage cluster sampling. In each of the 30 provinces of Iran, 50 clusters (20 people in each cluster, two persons in each age-sex group) were randomly selected through the national postcode data bank. Each 10-digit postcode represents an individual household in the country. The clusters were selected proportional to population size of rural and urban areas in each province. Interviews and physical measurements of the selected people were done at their homes. The methodology of the first national survey of NCD risk factors of Iran (2005) has already been published [11]. Apart from some differences in sampling method, the methodology of these two surveys is the same.

Blood pressure and anthropometric measurement

A certified operator performed BP measurements using an aneroid sphygmomanometer during the home interview. All devices were daily validated against a mercury sphygmomanometer. A cuff size appropriate for the participant's arm circumference was used. BP was measured with the participant in a sitting position after 5-min rest and with the midpoint of the arm at the level of the heart. A second measurement was done after 5-min interval. If the difference of SBP, DBP or both of the first and second time was more than 10 mmHg, then the BP was measured for a third time. The ultimate SBP and DBP is the average of the two or three recorded BPs. Height and weight were measured with participants in light clothes and without shoes. Height was measured using a portable inflexible bar to the nearest 0.5 cm. Weight was measured using a daily-calibrated analogue scale.

Definition of variables

Our outcome variables were hypertension treatment and control. The participants were considered to be hypertensive if they had an average SBP of at least 140 mmHg or an average DBP of at least 90 mmHg or if the participants had received antihypertensive medications in the past 2 weeks. Participants were considered to be treated if they reported that they took antihypertensive medications in the past 2 weeks, and they were considered to have their hypertension controlled if they reported that they were receiving antihypertensive medications in the past 2 weeks and had an average SBP of less than 140 mmHg and average DBP of less than 90 mmHg. The same criteria were used for both diabetic and nondiabetic participants.

Our covariates were sex, age, living area (rural/urban), education, income, ethnicity and provinces of inhabitation. We also adjusted the models for potential confounders including comorbidities (diabetes, overweight or obesity) and behavioral factors (physical activity and smoking). Participants were asked about the highest level of education they had completed and this was classified in three categories: low (illiterate or less than primary school), middle (primary, secondary or high school completed) and academic (bachelor's, master's and PhD). Income was determined through this question: Taking the past year, what the average earnings of the household have been? These were named low ($\leq$2 000 000 Iranian Rials per month), middle ($>$2 000 000 and $<$7 000 000 Iranian Rials per month) and high ($\geq$7 000 000 Iranian Rials per month). Ethnicities were Fars, Arab, Balooch, Gilak, Kurd, Lor, Turk and Turkman based on the opinion of responders. Provinces were categorized in terms of Human Development Index (HDI), which is calculated by Iran's Strategic Planning and Control Deputy (2005) [12], into four quartile groups of low (0–25), low-moderate (25–50), high-moderate (50–75) and high (75–100). HDI is a summary measure of human development calculated by life expectancy at birth; adult literacy and combined gross enrolment in primary, secondary and tertiary level education; and gross domestic product per capita in purchasing power parity US dollars [13].

Participants were considered diabetic if they answered 'yes' to one of these questions: 'Have you ever been told by a doctor that you have diabetes or sugar diabetes'? or 'Are you now taking insulin or diabetes pills to lower blood sugar'? BMI was calculated as weight (kg) divided by height (m^2) (overweight or obese, BMI $\geq$ 25 kg/m^2; low or normal, BMI $<$ 25 kg/m^2). Physical activity was the sum of the total metabolic equivalent minutes of activity computed for each setting of work, transport (walking or cycling) and recreation, and was categorized as low, moderate and high [14]. Smoking was described as current daily smoker (currently smoking cigarette(s) daily), past daily smoker (in the past used to smoke daily; but now does not smoke) and noncurrent or past daily smoker.

Statistical methods

Data cleaning and management was done in SPSS version 11 for Windows (SPSS Inc., Chicago, Illinois, USA) and Stata version 9.1 (StataCorp, College Station, Texas, USA), and the analysis was done in Stata version 9.1. Cleaning the data, handling missing data and outliers were done according to the guidelines of WHO for STEPS data management [15]. Women who reported that they were pregnant at the time of the survey were

excluded from the analysis. Most of the variables did not have any missing data, and the missing data for BMI, income, diabetes and physical activity was less than 5%. We included only individuals with nonmissing data in the related analyses. In order to analyze hypertension prevalence and its covariates, the 1500 clusters (each consisting of 20 people) were considered in the analysis. Data were weighted according to the age-sex population groups of each province derived from National Population and Housing Census 2006 [16] and, therefore, were nationally representative of the noninstitutionalized civilian population in Iran. In case of hypertension treatment and control, the analysis was done on the subpopulation of hypertensive patients for analysis of hypertension treatment, and the subpopulation of treated people for analysis of hypertension control. As there were no national data available for these two subpopulations for the purpose of weighting, at this stage of analysis, we did not weight the data. Additionally, the clusters did not remain the same as before. Accordingly, the analyses were made by means of random effect logistic regression models.

The crude binary logistic regression models provided baseline estimates of individual-level social disparities in the prevalence, treatment and control rate of hypertension. Then we used adjusted binary logistic regression models to explore socioeconomic factors associated with hypertension prevalence, treatment and control and to determine their independent associations. The models included sociodemographic factors (sex, age, ethnicity, living area, education, income and provinces by HDI) as well as comorbidities (diabetes and high BMI) and behavioral factors (smoking and physical activity). Selection and retention of a variable were done on the basis of importance of variables, the extent to which entering or eliminating them would affect the odds ratios (ORs) of other variables and a significance level of 0.05. To achieve the greatest power of the statistical tests in all models, the largest category of each variable was considered as base. For comparison purposes, SBP measures were also age adjusted to WHO World Standard Population [17].

The Centre for Disease Management of Iran approved the study protocol, and all participants gave verbal informed consent.

Results

Table 1 presents weighted percentages for the population characteristics of Iranian people aged 15–64 years. The number of men and women were almost the same. Age category 15–24 years had the largest proportion of people (36.53%) and age category 55–64 years was the smallest (6.58%). Almost two-thirds of the patients were living in urban areas. Nearly 65% of people had income of less than 2 000 000 Rials per month, and only 3.47% reported that their income was high. Education data showed 22.5% of people were illiterate or had low education and 11% had academic education. Most people were of Fars ethnicity (53.37%) and the smallest ethnicity group was Turkman (0.75%). About 45% of the population was overweight or obese, and self-reported diabetes was 3.48%. About half of the population had high physical activity. About 11% were current daily smokers.

Table 1 Characteristics of participants

Variable	Frequency in the sample	Percentage (95% CI) in Iran population 2006[a]
Sex		
Female	15 005	49.37 (49.26–49.49)
Male	14 966	50.63 (50.51–50.74)
Age category (years)		
15–24	6113	36.53 (36.14–36.92)
25–34	6004	25.94 (25.71–26.18)
35–44	5981	18.1 (17.89–18.31)
45–54	6056	12.85 (12.71–12.99)
55–64	5817	6.58 (6.49– 6.67)
Living area		
Rural	11 378	33.38 (30.2–36.71)
Urban	18 593	66.62 (63.29–69.8)
Income		
Low	19 626	64.86 (62.76–66.9)
Middle	8446	31.67 (29.81–33.59)
High	737	3.47 (2.694–4.46)
Education		
Low	11 367	22.53 (21.33–23.78)
Middle	15 983	66.48 (65.41–67.53)
Academic	2613	11 (9.95–12.13)
Ethnicity		
Fars	14 406	53.37 (50.51–56.21)
Arab	567	3.12 (2.25–4.31)
Balooch	772	2.20 (1.62–2.97)
Gilak	1032	4.02 (2.999–5.369)
Kurd	3591	7.86 (6.73–9.16)
Lor	2849	7.39 (6.22–8.75)
Turk	6279	21.29 (19.08–23.67)
Turkman	355	0.75 (0.47–1.19)
Provinces by HDI		
High	7018	43.89 (39.92–47.94)
High-moderate	9003	23.33 (20.68–26.21)
Low-moderate	7001	17.81 (15.73–20.1)
Low	6948	14.97 (13.22–16.9)
BMI		
Low or Normal	13 886	55.39 (54.28–56.5)
High	14 372	44.61 (43.5–45.72)
Diabetes		
No	26 959	96.52 (96.15–96.85)
Yes	1527	3.48 (3.15–3.84)
Physical activity		
High	14 088	47.55 (46.11–48.99)
Moderate	7591	27.55 (26.46–28.67)
Low	7784	24.9 (23.81–26.02)
Smoking		
Not current or past daily smoker	25 017	86.24 (85.67–86.8)
Current daily smoker	3752	10.94 (10.43–11.48)
Past daily smoker	1202	2.814 (2.529–3.13)

$N = 29\,971$. CI, confidence interval; HDI, Human Development Index. [a]Data are weighted to the Iranian population 15–64 years old in 2006.

Table 2 provides summary statistics of the outcome measures. After weighting the data, the prevalence of hypertension was 17.37% [95% confidence interval (95% CI) 16.44–18.34]. In the Iranian population aged 15–64 years, mean SBP and mean DBP were 116.24 and 74.58 mmHg, respectively. Age-adjusted mean SBP to WHO World Standard Population was 115.89 mmHg. Among those who had hypertension, 33.35% had

Table 2 Summary statistics of hypertension in Iranian population aged 15–64 years in 2006

Variable	Frequency	Percentage or mean (95% CI)
Hypertension prevalence ($n=29\,971$)[a]	6851	17.37 (16.44–18.34)
Hypertension treatment ($n=6851$)	2258	33.35 (32.23–34.48)
Recommended diet ($n=6851$)	1826	26.97 (25.91–28.03)
Recommended weight reduction ($n=6851$)	732	10.81 (10.07–11.55)
Recommended physical activity ($n=6851$)	638	9.42 (8.72–10.12)
Recommended to stop smoking ($n=843$)	81	9.60 (7.61–11.60)
Hypertension control among those treated ($n=2258$)	794	35.10 (33.13–37.07)
Hypertension control among hypertensive patients ($n=6851$)	794	11.59
Informed of their hypertension during past 12 months ($n=6851$)	2860	41.89 (40.72–43.06)
Blood pressure measured ($n=29\,971$)[a]		
Not within 5 years	5046	21.69 (20.68–22.72)
1–5 years ago	4785	17.12 (16.30–17.97)
Within past 12 month	20 140	61.2 (60.07–62.31)
Mean SBP of the population[a]		116.24 (115.81–116.66)
Mean DBP of the population[a]		74.58 (74.14–75.02)
Mean SBP by age (years) category[a]		
15–24		111.08 (110.61–111.55)
25–34		113.63 (113.02–114.23)
35–44		117.87 (117.22–118.52)
45–54		125.36 (124.52–126.21)
55–64		132.77 (131.97–133.58)
Age adjusted mean SBP of the population[b]		115.89

CI, confidence interval. [a]Data are weighted to the Iranian population 15–64 years old in 2006. [b]Age adjusted to WHO World Standard Population.

received treatment and 35.10% of those who were treated had their hypertension controlled. Among hypertensive people, about one-fourth were currently receiving advice for their hypertension by a health worker for special prescribed diet, about 10% for losing weight and about 10% for exercise. Also, only about 10% of hypertensive current daily smokers were receiving advice or treatment to stop smoking. In the whole population, the BP of 22% was not measured at all during the past 5 years, and the BP of 61% was measured during past 12 months.

Table 3 shows hypertension prevalence, treatment and control in different social and behavioral subgroups. In Table 4, the results of crude and adjusted regression analyses in hypertension prevalence, treatment and control by sociodemographic, comorbidities and behavioral factors are depicted.

Hypertension determinants

The prevalence of hypertension was 16.1% for women and 18.5% for men (Tables 3 and 4). In crude analysis, the odds of being hypertensive in men were 1.18 times that of women. This association increased after adjusting for confounders and remained statistically significant. Odds of being hypertensive increased progressively with age [adjusted OR (aOR) (95% CI), 1.65 (1.57–1.74)]. Concerning age-specific prevalence of hypertension (Table 5), men aged 15–34 years had odds of hypertension more than two times that of women of the same age. In the 35–44 years age group, the difference between men and women was not significant; and finally in older ages of 45–64 years, the odds of being hypertensive were significantly higher in women. Odds of hypertension were not different in urban and rural areas in crude and adjusted analysis. After omission of the confounders, the prevalence of hypertension was not related to the level of income. People with middle and academic education had lower odds of hypertension than people with low education (aORs, 0.73 and 0.67, respectively). Kurd and Turk ethnicity had higher odds of hypertension than Fars in crude analysis. After adjusting for the confounders, in case of Kurd ethnicity, the difference of odds increased and remained significant [aOR (95% CI), 1.34 (1.09–1.65)], but we did not find any difference between other ethnicities and Fars. The odds of hypertension were lower in the low-HDI provinces than the high-HDI provinces in crude and adjusted models [aOR (95% CI), 0.70 (0.56–0.86)]; but in the middle-ranged HDI, no statistically significant result was obtained. Figure 1 shows weighted prevalence of hypertension in provinces of Iran in quartiles. East Azerbayejan province had the highest prevalence of hypertension with 24.49% (95% CI, 20.84–28.56), followed by Tehran with 21.97% (95% CI, 18.77–25.54). The lowest prevalence of hypertension was in Yazd province with 8.84% (95% CI, 7.27–10.71).

Treatment determinants

Men had considerably lower odds of treatment of hypertension than women, both before and after adjustment [aOR (95% CI), 0.35 (0.30–0.41)] (Tables 3 and 4). The rate of treatment among the hypertensive people increased with age [aOR (95% CI), 1.92 (1.79–2.07)]. Urban hypertensive people had higher odds of treatment than rural ones, but after adjustment for confounders, the odds differences were no longer significant. In adjusted analysis, low-income people had slightly lower odds of treatment than middle-income people. Also, low-educated people had lower odds of treatment than middle-educated people. Among ethnicities, in Kurds and Lors, the odds of treatment were lower in comparison to Fars, but after adjustment, the odds differences were not

Table 3 Hypertension prevalence, treatment and control rates in Iranian population in 2006

Variable	Hypertension prevalence[a] [% (SE)]	Treatment [% (SE)] (in hypertensive patients)	Control [% (SE)] (in treated patients)
Sex			
Female	16.16 (0.51)	43.14 (0.83)	35.62 (1.22)
Male	18.54 (0.71)	22.64 (0.73)	34.01 (1.74)
Age category (years)			
15–24	7.38 (0.53)	7.58 (1.38)	53.57 (9.59)
25–34	12.82 (0.86)	12.24 (1.36)	53.52 (5.96)
35–44	19.65 (0.84)	21.04 (1.24)	42.47 (3.29)
45–54	34.12 (1.01)	33.97 (1.08)	36.04 (1.88)
55–64	51.79 (1.11)	45.31 (0.9)	31.90 (1.30)
Living area			
Rural	16.26 (0.65)	30.51 (0.92)	30.77 (1.67)
Urban	17.92 (0.64)	34.99 (0.72)	37.27 (1.24)
Income			
Low	18.14 (0.58)	33.25 (0.68)	33.05 (1.19)
Middle	16.12 (0.69)	33.53 (1.15)	39.53 (2.06)
High	16.33 (2.00)	35.57 (3.93)	43.39 (6.87)
Education			
Low	30.25 (0.76)	38.13 (0.76)	31.01 (1.17)
Middle	13.50 (0.59)	26.48 (0.91)	42.83 (1.98)
Academic	14.36 (1.18)	25.62 (2.19)	50.00 (4.97)
Ethnicity			
Fars	16.63 (0.65)	34.68 (0.86)	36.66 (1.48)
Arab	17.31 (2.30)	26.77 (3.94)	23.52 (7.38)
Balooch	13.41 (1.61)	41.81 (3.85)	42.02 (5.98)
Gilak	18.36 (1.37)	38.88 (3.19)	34.06 (4.99)
Kurd	19.50 (0.98)	29.19 (1.50)	35.20 (2.92)
Lor	15.74 (1.48)	30.96 (1.79)	28.78 (3.16)
Turk	19.06 (1.03)	33.64 (1.22)	34.59 (2.12)
Turkman	15.96 (3.62)	36.36 (5.51)	28.57 (8.69)
Provinces by HDI			
High	18.26 (0.92)	35.12 (1.20)	38.54 (2.07)
High-moderate	17.38 (0.83)	33.11 (1.05)	35.24 (1.85)
Low-moderate	17.61 (0.79)	32.48 (1.16)	30.47 (2.01)
Low	14.45 (0.55)	32.81 (1.17)	35.93 (2.09)
BMI			
Low or Normal	10.79 (0.52)	25.29 (0.98)	35.88 (2.15)
High	25.97 (0.72)	36.91 (0.71)	34.90 (1.16)
Diabetes			
No	16.24 (0.48)	29.64 (0.60)	35.44 (1.15)
Yes	48.53 (2.01)	57.30 (1.77)	34.15 (2.24)
Physical activity			
High	15.88 (0.60)	26.56 (0.81)	34.57 (1.70)]
Moderate	18.96 (0.85)	34.54 (1.13)	34.15 (1.92)
Low	18.44 (0.84)	42.64 (1.11)	36.07 (1.65)
Smoking			
Not current or past daily smoker	16.55 (0.49)	34.23 (0.63)	35.24 (1.09)
Current daily smoker	20.48 (1.27)	21.79 (1.41)	37.1 (3.54)
Past daily smoker	30.27 (2.24)	38.89 (2.45)	30.57 (3.68)

HDI, Human Development Index; SE, standard error. [a]Data are weighted to the Iranian population 15–64 years old in 2006.

significant. Additionally, Balooch ethnicity had two times the odds of treatment of Fars in adjusted analysis. HDI of the provinces did not have any association with the rate of treatment. In adjusted analysis, the people with high BMI as well as the diabetic individuals had higher odds of treatment (aORs, 1.29 and 2.40, respectively), and the odds of treatment among past daily smokers were higher than nonsmokers.

Control determinants

In crude analysis, there was no difference between men and women in terms of control, but after adjustment, the odds of control were lower in men [aOR (95% CI), 0.76 (0.60–0.97)] (Tables 3 and 4). With increasing age, the rate of control decreased [aOR (95% CI), 0.76 (0.66–0.87)]. The odds of control in urban people were higher than rural people; nonetheless, after adjusting, the difference was not statistically significant. Income and ethnicity did not have any association with control rate in adjusted analysis. Middle-educated people and the people with academic education had adjusted odds of control of 1.61 and 2.17, respectively, compared with low-educated people. Low-moderate HDI provinces had lower odds of control in comparison with high-HDI provinces in crude and adjusted analysis.

Discussion

This study indicates that almost 17% of the Iranian population aged 15–64 years had hypertension in 2006. In the first survey of NCD risk factors in 2005 in which 25–64-year-old people were included, the prevalence of hypertension was 25.2% (95% CI, 24.8–25.5) [18]. In our

Table 4 Multiple-regression analysis of the association between hypertension prevalence, treatment, control and selected characteristics in Iranian population in 2006

	Hypertension prevalence[a]		Treatment[b]		Control[b]	
Variable	Crude OR (95% CI)	aOR (95% CI)[c]	Crude OR (95% CI)	aOR (95% CI)[d]	Crude OR (95% CI)	aOR (95% CI)[e]
Sex						
Female	–	–	–	–	–	–
Male	**1.18 (1.06–1.31)**	**1.50 (1.32–1.70)**	**0.34 (0.30–0.38)**	**0.35 (0.30–0.41)**	0.92 (0.75–1.13)	**0.76 (0.60–0.97)**
Age category[f] (per 10 year)	**1.89 (1.82–1.97)**	**1.65 (1.57–1.74)**	**1.84 (1.74–1.95)**	**1.92 (1.79–2.07)**	**0.75 (0.67–0.83)**	**0.76 (0.66–0.87)**
Age category (years)						
15–24	–		–		–	
25–34	**1.84 (1.52–2.22)**		**1.75 (1.08–2.82)**		**0.86 (0.31–2.35)**	
35–44	**3.06 (2.56–3.66)**		**3.36 (2.19–5.18)**		**0.50 (0.20–1.25)**	
45–54	**6.49 (5.58–7.55)**		**6.92 (4.57–10.48)**		**0.37 (0.15–0.91)**	
55–64	**13.47 (11.52–15.74)**		**11.56 (7.66–17.43)**		**0.30 (0.12–0.72)**	
Living area						
Rural	–	–	–	–	–	–
Urban	1.12 (0.99–1.27)	1.13 (0.97–1.32)	**1.26 (1.09–1.46)**	1.14 (0.98–1.34)	**1.40 (1.12–1.77)**	1.25 (0.97–1.61)
Income						
Low	–	–	–	–	–	
Middle	**0.86 (0.77–0.97)**	0.87 (0.75–1.01)	0.97 (0.85–1.11)	**1.18 (1.01–1.38)**	**1.36 (1.08–1.72)**	
High	0.88 (0.65–1.18)	0.91 (0.62–1.33)	1.03 (0.69–1.54)	1.05 (0.66–1.65)	1.56 (0.81–3.02)	
Education						
Low	–	–	–	–	–	–
Middle	**0.36 (0.32–0.40)**	**0.73 (0.64–0.83)**	**0.51 (0.45–0.58)**	**1.21 (1.03–1.43)**	**1.77 (1.42–2.22)**	**1.61 (1.24–2.10)**
Academic	**0.38 (0.31–0.47)**	**0.67 (0.53–0.85)**	**0.43 (0.33–0.56)**	1.26 (0.91–1.75)	**2.47 (1.55–3.93)**	**2.17 (1.27–3.70)**
Ethnicity						
Fars	–	–	–	–	–	
Arab	1.05 (0.75–1.45)	1.05 (0.73–1.51)	0.62 (0.37–1.02)	0.75 (0.43–1.31)	0.49 (0.19–1.26)	
Balooch	0.77 (0.58–1.03)	1.17 (0.82–1.68)	1.41 (0.92–2.16)	**2.11 (1.27–3.52)**	1.34 (0.73–2.46)	
Gilak	1.12 (0.93–1.35)	0.91 (0.71–1.17)	1.18 (0.83–1.68)	1.13 (0.77–1.67)	0.88 (0.51–1.53)	
Kurd	**1.21 (1.04–1.40)**	**1.34 (1.09–1.65)**	**0.71 (0.58–0.88)**	0.82 (0.63–1.06)	0.94 (0.67–1.33)	
Lor	0.93 (0.73–1.18)	1.14 (0.85–1.53)	**0.77 (0.61–0.98)**	0.82 (0.62–1.10)	0.69 (0.46–1.02)	
Turk	**1.18 (1.01–1.37)**	1.19 (0.98–1.46)	0.93 (0.78–1.10)	1.04 (0.85–1.27)	0.91 (0.69–1.19)	
Turkman	0.95 (0.55–1.63)	0.88 (0.46–1.68)	1.07 (0.56–2.02)	1.45 (0.74–2.85)	0.66 (0.24–1.79)	
Provinces by HDI						
High	–	–	–	–	–	–
High-moderate	0.94 (0.79–1.11)	1.06 (0.87–1.29)	0.88(0.73–1.07)	0.93 (0.75–1.15)	0.86 (0.64–1.15)	0.93 (0.69–1.26)
Low-moderate	0.95 (0.81–1.12)	0.99 (0.81–1.22)	0.85(0.70–1.05)	0.88 (0.69–1.11)	**0.66 (0.48–0.90)**	**0.67 (0.47–0.95)**
Low	**0.75 (0.65–0.87)**	**0.70 (0.56–0.86)**	0.84(0.69–1.03)	0.90 (0.69–1.16)	0.89 (0.66–1.21)	1.02 (0.74–1.40)
BMI						
Low or normal	–	–	–	–	–	–
High	**2.90 (2.59–3.24)**	**2.07 (0.31–0.47)**	**1.76 (1.54–2.00)**	**1.29 (1.12–1.50)**	0.93 (0.73–1.18)	0.85 (0.66–1.09)
Diabetes						
No	–	–	–	–	–	–
Yes	**4.86 (4.13–5.71)**	**2.32 (1.89–2.85)**	**3.42 (2.89–4.06)**	**2.40 (2.00–2.88)**	0.95 (0.74–1.22)	0.99 (0.77–1.29)
Physical activity						
High	–	–	–		–	
Moderate	**1.24 (1.09–1.40)**	**1.33 (1.14–1.54)**	**1.50 (1.30–1.73)**		0.93 (0.72–1.20)	
Low	**1.19 (1.04–1.36)**	1.09 (0.95–1.26)	**2.24 (1.95–2.58)**		1.02 (0.81–1.29)	
Smoking						
Not current or past daily smoker	–		–	–	–	
Current daily smoker	**1.29 (1.11–1.51)**		**0.50 (0.41–0.60)**	0.91 (0.73–1.14)	1.12 (0.78–1.59)	
Past daily smoker	**2.18 (1.77–2.70)**		1.19 (0.94–1.50)	**1.63 (1.25–2.13)**	0.79 (0.53–1.17)	

Boldface indicates $P < 0.05$. aOR, adjusted odds ratio; CI, confidence interval; HDI, Human Development Index; OR, odds ratio. [a] Data are weighted to the Iranian population 15–64 years old in 2006. [b] Random-effects logistic regression. [c] Adjusted for age, sex, living area, income, ethnicity, province by HDI, education, diabetes, BMI, physical activity and smoking. [d] Adjusted for age, sex, living area, income, ethnicity, province by HDI, education, diabetes, BMI and smoking. [e] Adjusted for age, sex, living area, income, ethnicity, province by HDI, education, diabetes, BMI, physical activity and smoking. [f] Each age category compared with the previous one, linear assumption for age categories.

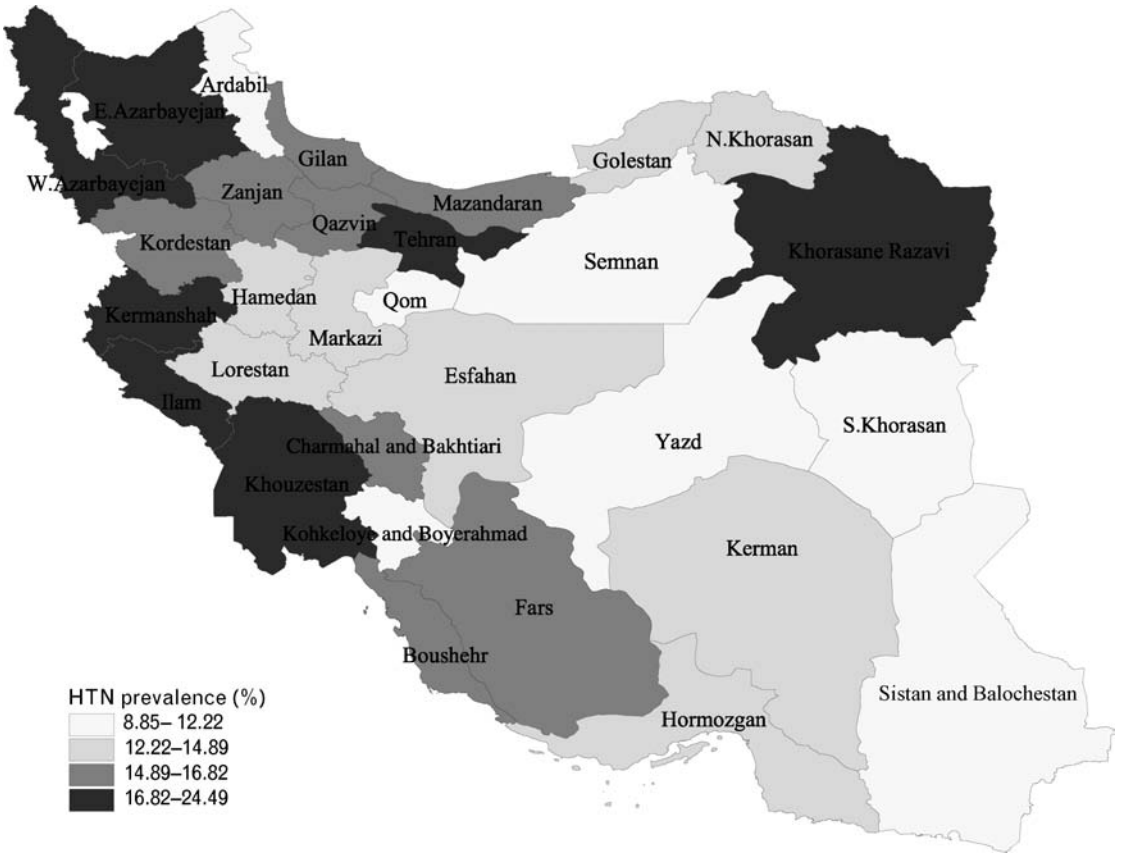
Table 5 Odds ratio and 95% confidence interval of age-specific prevalence of hypertension by sex

Sex by age (years) category (male to female)	Crude OR (95% CI)
15–24	**2.53 (1.78–3.59)**
25–34	**2.08 (1.60–2.71)**
35–44	1.07 (0.89–1.29)
45–54	**0.63 (0.54–0.73)**
55–64	**0.68 (0.58–0.80)**

Boldface indicates $P < 0.05$. CI, confidence interval; OR, odds ratio.

study, the prevalence of hypertension in the same age range was 23.12% (95% CI, 21.97–24.3), which was slightly less than that in the first survey. In the second Surveillance of Risk Factors Report of WHO, Iran has been categorized in the group with lowest mean SBP (<120 mmHg). The age-adjusted mean SBP of our study (adjusted to WHO World Standard Population) was 115.89 mmHg, which corresponds to the estimation and projections of WHO, which is 118.1 for men and

Fig. 1



Provincial disparities in hypertension prevalence in Iran in 2006. HTN, hypertension.

118.6 for women (15 years and above) for 2002, 2005 and 2010 [19]. The prevalence of hypertension in the United States, derived from the last National Health and Nutrition Examination Survey (NHANES), was 29.6% in 2003–2004, which was higher than Iran [20]; however, comparison cannot correctly be made before proper standardization.

The BP of 40% of the population has not been measured during the previous year and 22% had not been measured during the past 5 years. According to the British Hypertension Society [21] 2004 report, all adults should have their BP measured at least every 5 years.

In this study, only about one-third of hypertensive people were under treatment, of whom about one-third had their hypertension controlled. Also, the proportion of hypertensive people who received advice for lifestyle change was considerably low. In comparison to the United States, our treatment and control rates were considerably lower (the treatment and control rates of the United States in NHANES 2003–2004 were 65.1 and 56.6%, respectively [20]). Again, it has to be kept in mind that comparing these two data is not without error. The reasons for poor treatment and control, according to a study done in Texas, are false perception of good health due to asymptomatic nature of hypertension and lack of perceived need for having a regular physician [22]. Other studies [23–26] have demonstrated that poor control is the result of poor adherence of the patients on the one hand and lack of intensification or modification of medication by the health provider on the other hand. Specifically in Iran, according to one qualitative study [27], the reasons for low control rate are noncompliance, lack of knowledge and lack of effective caring relationship. The low rates of measurement of BP, hypertension treatment and control warrant better health programs as well as long-term educational efforts at the national level.

Sex

Although overall male sex was associated with higher prevalence of hypertension, women aged 45–64 years had higher prevalence of hypertension. Women were more likely to have their hypertension treated and controlled than men; this is in accordance with the result of

other studies [28–31] in other countries. The lower rate of treatment and control in men is consistent with the literature on sex and health, according to which men are more prone to neglect health-promoting behaviors, including use of preventive medical services, because of a desire to assert their masculinity [32,33].

Age

In our study, the odds of being treated increase with age and the odds of control decrease with age. The literature on the association of age with treatment and control is not consistent. In some, treatment or control is positively associated with age and in others, the association is negative [20,28,34]. In Iran, the low proportion of treatment in younger people and the low control proportion in older people require further planning for these two groups.

Rural/urban

According to the adjusted analysis, there were no differences in the odds of hypertension, its treatment and control between urban and rural areas. Also in the first national survey of NCDs [18], as well as a systematic review [35] of epidemiology of hypertension in Iran, the prevalence of hypertension in rural and urban areas was the same. In general, the prevalence of hypertension in rural areas in developing countries is less and in the developed countries is equal to or even more than urban areas [19,36]. The factors that contribute to hypertension in rural and urban areas might be lifestyle (physical activity, smoking, diet, etc.), types of stress and perception of these stresses (deprivation, unemployment, lacking modern facilities or the complications of having these facilities) and physical environment.

Income

In many studies, the low-income people were more likely to have hypertension [28]. However, in our study, there was not any association between the prevalence of hypertension and income. Treatment rate was lower in the low-income hypertensive people in comparison to the middle-income ones. This finding may show that the low-income people had less access to healthcare. It has to be mentioned that income was measured by direct questioning, which is not the optimal way, and about two-thirds of the population answered that their income is less than 2 000 000 Iranian Rials per month, which seems to be incorrect.

Education

Overall illiterates or those who had not finished primary school had higher hypertension prevalence and lower rates of treatment and control than more educated people. The association between low education and higher prevalence of hypertension has been observed in the previous national survey of Iran [18] and also in many other studies [20,28,29,37]. However, this relation is not confirmed by another study [38]. In a study [9] in Chicago, the high prevalence of hypertension among low-educated people was attributed to neighborhood context. However, this could not explain the lower rates of treatment and control [9].

Ethnicity

Our study has shown that the prevalence of hypertension is higher among Kurds. Unfortunately, there is almost no literature on the health status of different ethnicities in Iran. Notwithstanding, one study [39] reported that the prevalence of disturbed mental health in Kurds was higher as compared with the rest of Iranian population. This may suggest a common social underlying background in these two phenomena. In the adjusted analysis, we found no difference among ethnicities in terms of treatment and control, except in the case of Balooch ethnicity in which the odds of treatment were, unexpectedly, two times that of Fars. As the coverage of primary healthcare in the Balooch province of Sistan and Baloochestan is much lower than other provinces, this finding seems to be incorrect and should be addressed by other studies.

Human Development Index

Our study has demonstrated that the prevalence of hypertension in provinces with high HDI is higher than that of provinces with low HDI. In contrast, in some studies [9,40,41] in the United States and UK, residence in deprived areas was associated with higher prevalence of hypertension. Additionally, we found that treatment of hypertension is not associated with the HDI of the provinces. This might be attributed to relatively equal distribution of healthcare facilities in different provinces. The lower control rate in provinces with low-moderate HDI than in provinces with high HDI seems to be an accidental finding. The highest prevalence of hypertension in East Azerbayejan province was also seen in the Iranian Health Profile Survey in 1999 [35].

Comorbidities and lifestyle factors

In our study, control rate did not have any association with comorbidities and lifestyle factors. Diabetic individuals, obese or overweight people and past daily smokers were more likely to have their hypertension treated. This might be attributed to higher perception of risk in these populations. Also, in other studies, higher rate of hypertension treatment in diabetic individuals and obese people has been observed [7,20,28]. It is shown that smokers are less likely to use health services [42], but in our study, there was no difference between current smokers and noncurrent or past daily smokers in terms of treatment.

Limitations

This study is based on cross-sectional data, which are not suitable for finding causal relations. The causal

mechanisms of different associations found in this study should be detected by longitudinal and experimental study designs. The analysis of hypertension prevalence is done on a sample of nearly 30 000 adults, which leads to a good power of the statistical test for this objective. However, the low number of cases in a few categories has reduced the power of analysis to detect disparities in these categories. For instance, the low number of cases in the high-income group and a number of ethnicities (Arab and Turkman in prevalence, treatment and control; Gilak in treatment and control; and Balooch in control) might have obscured the real differences. This is especially more noticeable in the analysis of control, which naturally entails fewer cases. As we had entered large numbers of variables and responses in each model, some associations might not be represented in our analysis. The sampling is not proportional to population of provinces, so we had to weigh data with highly variable weighing values. This may potentially cause parameter estimators to vary greatly, thereby lowering the efficiency of the analysis [43,44]. Unfortunately, we were unable to assess the awareness of hypertension because of the unsuitability of the question in this regard in the questionnaire. On the basis of STEPS sampling guide, people over 64 years were not included in our study, although this group is important regarding hypertension. It is worth mentioning, however, that only about 5% of Iranians are more than 64 years old.

Acknowledgements

The National Survey of Risk Factors for Noncommunicable Diseases of Iran (2006) is commissioned by Centre for Disease Management, Ministry of Health and Medical Education. We are very grateful to Dr Simak Alikhani and Dr Kazem Heidari for their kind contribution to the work.

There are no conflicts of interest.

References

1 Ezzati M, Lopez AD, Rodgers A, Vander HS, Murray CJ. Selected major risk factors and global and regional burden of disease. *Lancet* 2002; **360**:1347–1360.
2 Mensah GA, Mokdad AH, Ford ES, Greenlund KJ, Croft JB. State of disparities in cardiovascular health in the United States. *Circulation* 2005; **111**:1233–1241.
3 Bell AC, Adair LS, Popkin BM. Understanding the role of mediating risk factors and proxy effects in the association between socio-economic status and untreated hypertension. *Soc Sci Med* 2004; **59**:275–283.
4 Matthews KA, Kiefe CI, Lewis CE, Liu K, Sidney S, Yunis C. Socioeconomic trajectories and incident hypertension in a biracial cohort of young adults. *Hypertension* 2002; **39**:772–776.
5 Colhoun HM, Hemingway H, Poulter NR. Socio-economic status and blood pressure: an overview analysis. *J Hum Hypertens* 1998; **12**:91–110.
6 Gorman BK, Sivaganesan A. The role of social support and integration for understanding socioeconomic disparities in self-rated health and hypertension. *Soc Sci Med* 2007; **65**:958–975.
7 Maahs DM, Kinney GL, Wadwa P, Snell-Bergeon JK, Dabelea D, Hokanson J, *et al.* Hypertension prevalence, awareness, treatment, and control in an adult type 1 diabetes population and a comparable general population. *Diabetes Care* 2005; **28**:301–306.
8 Winkleby MA, Fortmann SP, Barrett DC. Social class disparities in risk factors for disease: eight-year prevalence patterns by level of education. *Prev Med* 1990; **19**:1–12.
9 Morenoff JD, House JS, Hansen BB, Williams DR, Kaplan GA, Hunte HE. Understanding social disparities in hypertension prevalence, awareness, treatment, and control: the role of neighborhood context. *Soc Sci Med* 2007; **65**:1853–1866.
10 STEPwise approach to chronic disease risk factor surveillance (STEPS). Geneva, Switzerland: World Health Organization. http://www.who.int/chp/steps/riskfactor/en/index.html. [Accessed 15 October 2007]
11 Alikhani S, Delavari A, Alaedini F, Kelishadi R, Rohbani S, Safaei A. A province-based surveillance system for the risk factors of non-communicable diseases: A prototype for integration of risk factor surveillance into primary healthcare systems of developing countries. *Public Health* 2009; **123**:358–364.
12 The economical report of year 2005 and monitoring of third national development program (in Persian). Tehran, Iran: Iran's Strategic Planning and Control Deputy; 2005.
13 Human development report 2007/2008 Fighting climate change: human solidarity in a divided world. USA: United Nations Development Program; 2007. http://hdr.undp.org/en/media/HDR_20072008_EN_Complete.pdf. [Accessed 12 February 2008]
14 Global Physical Activity Questionnaire (GPAQ) Analysis Guide. Surveillance and Population-Based Prevention, Department of Chronic Diseases and Health Promotion. Geneva, Switzerland: World Health Organization. http://www.who.int/chp/steps/resources/GPAQ_Analysis_Guide.pdf. [Accessed 20 October 2007]
15 STEPS manual. Geneva, Switzerland: World Health Organization. http://www.who.int/chp/steps/manual/en/print.html. [Accessed 15 October 2007]
16 National Population and Housing Census (NPHC) 2006. Statistical Centre of Iran (SCI). http://www.sci.org.ir. [Accessed 18 January 2008]
17 Ahmad O, Boschi-Pinto C, Lopez A, Murray C, Lozano R, Inoue M. Age standardization of rates: a new WHO standard, (GPE Discussion Paper No. 31). Geneva, Switzerland: World Health Organization; 2001. http://www.who.int/healthinfo/paper31.pdf. [Accessed 30 January 2008]
18 Esteghamati A, Abbasi M, Alikhani S, Gouya MM, Delavari A, Shishehbor MH, *et al.* Prevalence, awareness, treatment, and risk factors associated with hypertension in the Iranian population: the national survey of risk factors for noncommunicable diseases of Iran. *Am J Hypertens* 2008; **21**:620–626.
19 WHO Global InfoBase team. The SuRF Report 2. Surveillance of chronic disease risk factors: country-level data and comparable estimates. Geneva, Switzerland: World Health Organization; 2005. http://apps.who.int/infobase/surf2/SuRF2.pdf. [Accessed 15 October 2007]
20 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.
21 Williams B, Poulter NR, Brown MJ, Davis M, McInnes GT, Potter JF, *et al.* Guidelines for management of hypertension: report of the fourth working party of the British Hypertension Society, 2004 BHS IV. *J Hum Hypertens* 2004; **18**:139–185.
22 Victor RG, Leonard D, Hess P, Bhat DG, Jones J, Vaeth PA, *et al.* Factors associated with hypertension awareness, treatment, and control in Dallas County, Texas. *Arch Intern Med* 2008; **168**:1285–1293.
23 Heisler M, Hogan MM, Hofer TP, Schmittdiel JA, Pladevall M, Kerr EA. When more is not better: treatment intensification among hypertensive patients with poor medication adherence. *Circulation* 2008; **117**:2884–2892.
24 Elliott WJ. What factors contribute to the inadequate control of elevated blood pressure? *J Clin Hypertens (Greenwich)* 2008; **10 (1 Suppl 1)**:20–26.
25 Burnier M. Medication adherence and persistence as the cornerstone of effective antihypertensive therapy. *Am J Hypertens* 2006; **19**:1190–1196.
26 Borzecki AM, Oliveria SA, Berlowitz DR. Barriers to hypertension control. *Am Heart J* 2005; **149**:785–794.
27 Mohammadi E, Abedi HA, Gofranipour F, Jalali F. Partnership caring: a theory of high blood pressure control in Iranian hypertensives. *Int J Nurs Pract* 2002; **8**:324–329.
28 Wyatt SB, Akylbekova EL, Wofford MR, Coady SA, Walker ER, Andrew ME, *et al.* Prevalence, awareness, treatment, and control of hypertension in the Jackson Heart Study. *Hypertension* 2008; **51**:650–656.
29 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**:1345–1352.
30 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**:703–709.

31 Cifkova R, Skodova Z, Lanska V, Adamkova V, Novozamska E, Petrzilkova Z, *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**:1479–1485.

32 Courtenay WH. Constructions of masculinity and their influence on men's well being: a theory of gender and health. *Soc Sci Med* 2000; **50**:1385–1401.

33 Williams DR. The health of men: structured inequalities and opportunities. *Am J Public Health* 2008; **98 (9 Suppl)**:S150–S157.

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

35 Haghdoost AA, Sadeghirad B, Rezazadehkermani M. Epidemiology and heterogeneity of hypertension in Iran: a systematic review. *Arch Iran Med* 2008; **11**:444–452.

36 Kearney PM, Whelton M, Reynolds K, Whelton PK, He J. Worldwide prevalence of hypertension: a systematic review. *J Hypertens* 2004; **22**:11–19.

37 Winkleby MA, Jatulis DE, Frank E, Fortmann SP. Socioeconomic status and health: how education, income, and occupation contribute to risk factors for cardiovascular disease. *Am J Public Health* 1992; **82**:816–820.

38 Wu Y, Huxley R, Li L, Anna V, Xie G, Yao C, *et al.* Prevalence, awareness, treatment, and control of hypertension in China: data from the China National Nutrition and Health Survey 2002. *Circulation* 2008; **118**:2679–2686.

39 Mofidi N, Ghazinour M, Araste M, Jacobsson L, Richter J. General mental health, quality of life and suicide-related attitudes among Kurdish people in Iran. *Int J Soc Psychiatry* 2008; **54**:457–468.

40 Aslanyan S, Weir CJ, Lees KR, Reid JL, McInnes GT. Effect of area-based deprivation on the severity, subtype, and outcome of ischemic stroke. *Stroke* 2003; **34**:2623–2628.

41 Cubbin C, Hadden WC, Winkleby MA. Neighborhood context and cardiovascular disease risk factors: the contribution of material deprivation. *Ethn Dis* 2001; **11**:687–700.

42 Adab P, McGhee SM, Hedley AJ, Lam TH. Smoking, respiratory disease and health service utilisation: the paradox. *Soc Sci Med* 2005; **60**:483–490.

43 Korn EL, Graubard BI. Epidemiologic studies utilizing surveys: accounting for the sampling design. *Am J Public Health* 1991; **81**:1166–1173.

44 Graubard BI, Korn EL. Analyzing health surveys for cancer-related objectives. *J Natl Cancer Inst* 1999; **91**:1005–1016.