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Hypertension: diagnosis, control status and its predictors in general population aged between 15 and 75 years: a community-based study in southeastern Iran

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Abstract

Objectives Hypertension (HTN) is an important cause of cardiovascular related morbidity and mortality. This study aimed at providing the prevalence of pre-HTN, diagnosed and undiagnosed HTN, along with its control and associated factors in an adult population.

Methods 5,900 participants aged 15–75 years took part in the study. HTN was verified by examination, self-reported history or using anti-hypertensive drug(s). Pre-hypertension and hypertension were defined as 120–139/80–89 mmHg and >140/>90 mmHg for systolic/diastolic BP, respectively.

Results The prevalence of hypertension was 18.4 % from which 10.5 %were diagnosed and 7.9 % were undiagnosed. The prevalence of pre-HTN was 35.5 %. HTN increased by age (2.4 % in 15–24 to 49 % in 55–64 years). The men had higher pre-HTN (42.7 vs. 28.1 %) and undiagnosed HTN (11.3 vs. 4.6 %). Of those diagnosed, 56.3 % had uncontrolled BP levels. Smoking, anxiety, obesity, and positive family history of HTN were the most significant predictors for HTN.

Conclusions Hypertension affected almost one-fifth of the population. Given the poor control in diagnosed hypertensive patients, it is alarming that the current health system in urban areas in Iran is not effective enough to control the epidemic spread of non-communicable diseases.

Keywords Hypertension · Pre-hypertension · Undiagnosed hypertension · Uncontrolled hypertension · Risk factors · Iran

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Introduction

Hypertension (HTN) is the leading modifiable risk factor for cardiovascular, cerebral, and renal diseases worldwide(Esteghamati et al. 2008; Whelton et al. 2004). The international society of HTN data on the global burden of blood-pressure-related disease mentioned that almost 50 % of stroke and ischemic heart diseases and 25 % of other cardiovascular diseases worldwide was attributable to high blood pressure (Lawes et al. 2008). In addition, HTN is the second contributor to the global burden of diseases, according to the latest analyses (Lim et al. 2012). It is mentioned, in the Global Burden of the Hypertension study, that more than 25 % of the world's adult population are hypertensive in the year 2000 and this is likely to increase approximately to 60 % by 2025, while the population burden will be greater in the developing countries (Kearney et al. 2005).

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HTN has become a common health problem in developing countries and its prevalence is currently steadily rising (Whelton et al. 2004; Kearney et al. 2004). Also, current dimensions of socioeconomic position provide different aspects of protection as well as future risk (Ploubidis et al. 2013). The increase in the rate of HTN in Iran could be attributed to the rapid social and economic transition which has been accompanied by changes in nutritional habits and sedentary life, the increase in life expectancy, the aging of the population, obesity prevalence, and urbanization (Ebrahimi et al. 2010; Haghdoost et al. 2008; Mirzazadeh et al. 2009). It has been reported that approximately 6.6 million of Iranians aged 25–64 years are hypertensive and 11.9 million others have pre-hypertension (pre-HTN) in 2005 (Esteghamati et al. 2008). It has also been reported that HTN prevalence is increasing in Iranian children and adolescents (Noohi et al. 2012).

HTN can be easily treated and controlled; however, the number of hypertensive people who are unaware of their diagnosis is considerable, and of those who are aware, only a small proportion are treated and many of those treated have not been able to successfully control their HTN (Maimaris et al. 2013). Prevention, diagnosis, and the control of HTN have been the most important goals of many public health programs around the world, including Iran. Awareness, treatment, and controlling HTN in Iran are estimated to be low and the proportion does not follow the 'rule of halves' (Ramezani et al. 2009; Shirani et al.2009). However, in Iran, the public knowledge of HTN and pre-HTN prevalence, awareness, treatment, and its control is inadequate and limited to few national studies (Esteghamati et al. 2008; Ramezani et al.2009; Shirani et al. 2009).

It is extremely important to know about the prevalence of HTN and pre-HTN. We also need to know more about the diagnosis, treatment, and control of HTN so that we are able to assess the depth of the problem. Such knowledge also helps us control and prevent HTN. Also it has been shown that socioeconomic position could determine the risk of hypertension (Ploubidis et al. 2013; Alves et al. 2012), and Iran is among developing countries with high transition rate in socioeconomic conditions. Therefore, this subnational study aimed to investigate the current status of HTN and pre-HTN in a community-based setting in the southeast of Iran and also to assess the prevalence of undiagnosed and uncontrolled HTN and their predictors in general population aged between 15 and 75 years.

Methods

Study population

This report is part of a larger study on coronary artery disease risk factors (KERCADR study) in Kerman, the largest province in the southeast of Iran. KERCADRS is a population based cohort study started in 2009. 5,900 individuals from aged between 15 and 75 years were recruited into the first phase of the study. The study sample was formed using a non-proportional to size one-stage cluster sampling household survey. Concisely, 250 postal codes (as clusters) were selected randomly among an updated roster in provincial post office. The research coordinator team attended households in clusters, and all the eligible members (15–75 years old) were recruited to the study. The recruitment was continued until 24 subjects were allotted to each cluster. More details of sampling and sample size calculation have already been published (Najafipour et al. 2012). The Ethic Committee of Kerman University of Medical Sciences of Iran approved the study protocol (Ethic committee permission code No 88/110KA). A written informed consent was given by all participants.

Interview and measurements

For the purpose of data collection, each participant was interviewed by trained interviewers, and a physician assessed the subjects for different CAD risk factors using a structured questionnaire. The data of the current study include demographic information (age and sex), education (illiterate, primary to high school, and above high school), smoking (currently smoking/non-current or past smoker), the status of opium use (non-current or past daily user/occasional as using for fun/and currently consuming opium), level of depression and anxiety (BECK questionnaires). We also asked the subjects about their past medical history and familial history of HTN. A more detailed description of the variables of the study has been published elsewhere (Najafipour et al. 2012).

The physical activity level was determined using global physical activity questionnaire and metabolic equivalents. Physical activity level was defined as the sum of total metabolic equivalent time (minutes) of activity calculated for each status of work, transport and recreation. It was classified into three levels of low, moderate and high (GPAQ 2013). To calculate BMI, the weight and height of the subjects (having light clothes and no shoes) were obtained. Based on the WHO definition, BMI was categorized as normal (BMI 18.5–24.9 kg/m^2), overweight (BMI 25–29.9 kg/m^2), and obese (BMI over 30 kg/m^2) (WHO 2006).

Definition of hypertension and diabetes

Blood pressure (BP) was measured by a physician using Rishter mercury BP manometer (Rishter co, Germany) after at least a 5-min rest. Blood pressure was measured twice (with 30 min interval) (Robert et al. 2012) by using

Table 1 Blood pressure and hypertension categories based on the current blood pressure measurements, history of diagnosis hypertension and anti-hypertensive drugs (Community-Based Cohort Study; KERCADRS—1st Round—n = 5,895, Kerman, Iran, 2009-2011)

Blood pressure/hypertension categories	Average of blood pressure at the time of recruitment	Self-reported of previously diagnosed hypertension	Self-reported of taking any anti-hypertensive drug
Normal blood pressure	systolic <120 mmHg and diastolic <80 mmHg	Negative	Negative
Pre-hypertension	systolic 120–139 mmHg or diastolic 80–89 mmHg	Negative	Negative
Undiagnosed hypertension—stage 1	Stage 1: systolic 140–159 mmHg or diastolic 90–99 mmHg	Negative	Negative
Undiagnosed hypertension—stage 2	Stage 2: systolic ≥160 or diastolic ≥100 mmHg	Negative	Negative
Controlled—diagnosed hypertension	Systolic <140 mmHg and diastolic <90 mmHg	Positive	Positive or negative
Uncontrolled—diagnosed hypertension	Systolic ≥140 mmHg or diastolic ≥90 mmHg	Positive	Positive or negative

mmHg millimeter of mercury

right arm in a sitting position. The mean of the two measurements was recorded for systolic blood pressure (SBP) and diastolic blood pressure (DBP). We used the mean of systolic and DBP together with self-reported history of hypertension or any-hypertensive drug used by participant and we categorized every person accordingly as could be observed in Table 1. Every individual with previously diagnosed diabetes (by a physician) or anyone taking insulin or non-insulin anti-diabetes drugs was considered as diabetic case. Diabetic individuals took FPG ≥7 mmol/L (126 mg/dL) of anti-diabetic drugs at the time of recruitment (see below).

Measurement of anthropometric and laboratory indices

A blood sample was taken from each participant at the time of attendance. The blood was centrifuged after 20 min of clotting time to the serum. Anthropometric measurements were as height (using a non-stretchable measuring tape with a minimum measurement of 0.1 cm in a standing position, without shoes, while the shoulders were in a normal resting state) and weight (light clothing without shoes measures by Seca 707 weighing balance with the range of 0.1–150 kg, with an accuracy of up to 100 gr), waist circumference (measured at the umbilical level between the last rib and pelvic crest, over light clothing, without any pressure to the body surface; to the nearest 0.1 cm). BMI was calculated by dividing weight (in kg) to the square of height (in meter).

Fasting blood glucose (KIMIA Kit, code 890410, Iran) and all lipid and lipoprotein measurements were made at a central laboratory. The total cholesterol was measured enzymatically by standard methods (KIMIA Kit, code 890303, Iran), and triglyceride was measured via standard spectrophotometric technique KIMIA Kit, code 890201, Iran). The lipid profile was categorized based on the current measurements, the history of diagnosis and taking lipid lowering drugs. For establishing the cholesterol profile, normal level was considered as <200 mg/dL, borderline 200–250 and high >250 mg/dL. For TG, normal level was considered as <150 mg/dL, borderline 150–200 and high >200 mg/dL (Robert et al. 2012).

Statistical analysis

The data cleaning, management and all statistical analyses were done by a survey using STATA v.12 (StataCorp. 2011 College Station, TX: StataCorp LP). Kerman population census 2006 was used for age and sex direct standardization. All of the prevalence rates were measured according to the sampling weight (reciprocal of the probability of selection) and individual response rate. The data were reported in the form of absolute and relative frequencies as well as 95 % confidence intervals (95 % CI). Univariate and multivariate logistic regression models were utilized to determine the predictors of diagnosed HTN (both controlled and uncontrolled together). Crude and adjusted odds ratios (AOR) were also reported. The prevalence of co-morbidities including diabetes mellitus type 2 (prior diagnosed diabetes and/or taking insulin or non-insulin drugs and/or had fasting plasma glucose ≥126 mg/dL at the time of recruitment), hypercholesterolemia (≥200 mg/dL), hypertriglyceridemia (≥200 mg/dL), depression, anxiety and overweight/obesity were also reported based on the type of HTN. p values less than 0.05 were considered as statistically significant.

Results

Pre-hypertension (Table 2)

Overall, the prevalence of hypertension (both undiagnosed and diagnosed) was 18.4 % (20.2 % in men and 16.7 % in

Table 2 The standardized prevalence of pre-hypertension, undiagnosed (stage 1 and 2) and diagnosed hypertension, community-based study (KERCADRS—1st round—$n = 5,895$), Kerman, Iran, 2009–2011

Subgroups	Normal ($n = 2,027$)	Pre-HTN ($n = 1,909$)	Undiagnosed HTN-stage 1 ($n = 522$)	Undiagnosed HTN-Stage 2 ($n = 121$)	Diagnosed HTN (1,229)
Overall	46.0 (44.2, 47.8)	35.5 (33.7, 37.4)	6.6 (5.8, 7.5)	1.3 (1.0, 1.7)	10.5 (9.7, 11.3)
Sex					
Men	37.2 (34.5, 40.0)	42.7 (39.9, 45.5)	9.3 (7.9, 10.9)	2.0 (1.4, 2.7)	8.9 (7.8, 10.2)
Women	55.2 (52.9, 57.5)	28.1 (25.8, 30.4)	3.9 (3.3, 4.7)	0.7 (0.5, 1.0)	12.1 (11.1, 13.2)
Age groups					
15–24	62.3 (58.3, 66.2)	31.8 (28.0, 35.7)	3.1 (2.0, 4.9)	0.5 (0.1, 1.5)	2.4 (1.4, 4.0)
25–34	50.8 (47.3, 54.4)	39.8 (36.4, 43.4)	5.3 (3.9, 7.1)	0.5 (0.2, 1.3)	3.5 (2.4, 5.2)
35–44	40.5 (37.1, 43.9)	40.7 (37.3, 44.2)	7.6 (6.0, 9.7)	1.4 (0.8, 2.4)	9.9 (8.0, 12.2)
45–54	27.6 (24.8, 30.6)	34.7 (31.6, 37.8)	10.6 (8.7, 12.9)	2.9 (2.0, 4.4)	24.2 (21.5, 27.1)
55–64	15.2 (12.8, 17.8)	25.4 (22.4, 28.5)	15.1 (12.8, 17.7)	3.0 (2.0, 4.5)	41.5 (38.0, 45.0)
65–75	9.5 (7.1, 12.6)	23.8 (19.9, 28.2)	11.7 (8.8, 15.3)	6.0 (4.0, 9.0)	49.0 (44.1, 53.9)
Education					
Illiterate	43.4 (27.8, 60.4)	42.2 (26.8, 59.2)	3.6 (2.1, 5.9)	1.6 (0.8, 3.1)	9.3 (7.2, 12.0)
Primary to high school	46.1 (44.0, 48.2)	36.2 (34.1, 38.4)	6.3 (5.4, 7.2)	1.1 (0.8, 1.4)	10.4 (9.5, 11.3)
Above high school	45.2 (41.6, 48.7)	34.6 (31.0, 38.3)	7.3 (5.5, 9.5)	1.9 (1.1, 3.3)	11.1 (9.3, 13.2)
Current cigarette smoker					
No	44.8 (42.9, 46.7)	35.5 (33.7, 37.5)	7.2 (6.3, 8.2)	1.5 (1.1, 1.9)	11.0 (10.1, 11.9)
Yes	48 (41.1, 55.0)	37.9 (31.0, 45.2)	3.7 (2.0, 6.9)	1.0 (0.4, 2.5)	9.3 (6.9, 12.5)
Opium addiction					
No	45.4 (43.5, 47.3)	35.8 (34.0, 37.8)	6.9 (6.0, 7.8)	1.5 (1.2, 2.0)	10.4 (9.5, 11.3)
Occasional user	54.3 (47.4, 61.0)	27.8 (21.5, 35.1)	6.0 (3.9, 9.0)	1.0 (0.5, 2.3)	10.8 (8.6, 13.6)
Depended user	46.9 (38.2, 55.9)	32.5 (24.4, 41.8)	7.2 (3.3, 15.0)	0.6 (0.3, 1.5)	12.7 (9.2, 17.2)
Depression					
No	46.2 (44.1, 48.4)	35.5 (33.4, 37.7)	6.8 (5.9, 7.9)	1.4 (1.0, 1.9)	10.0 (9.1, 11.1)
Yes	45.7 (42.3, 49.2)	35.8 (32.5, 39.4)	6.1 (4.6, 7.9)	1.1 (0.7, 1.8)	11.2 (9.7, 12.9)
Anxiety					
No	45.4 (41.6, 49.4)	38.9 (35.1, 42.9)	6.5 (5.1, 8.1)	1.2 (0.7, 1.8)	8.0 (6.8, 9.4)
Yes	46.1 (44.0, 48.1)	34.6 (32.6, 36.8)	6.7 (5.7, 7.7)	1.4 (1.0, 1.9)	11.3 (10.3, 12.3)
Obesity					
Normal	53.6 (51.2, 55.9)	34.1 (31.8, 36.5)	4.7 (3.8, 5.8)	0.8 (0.5, 1.2)	6.9 (6.0, 7.9)
Overweight	40.6 (36.7, 44.5)	38.1 (34.2, 42.0)	8.4 (6.4, 10.9)	1.1 (0.8, 1.6)	11.9 (10.1, 13.9)
Obese	22.7 (17.7, 28.7)	40.6 (33.7, 47.9)	14.2 (9.7, 20.3)	4.2 (2.4, 7.2)	18.2 (14.7, 22.4)
Physical activity					
Low	44.6 (41.7, 47.5)	35.6 (32.7, 38.6)	6.3 (5.2, 7.7)	1.4 (0.8, 2.4)	12.1 (10.7, 13.7)
Moderate	46.4 (43.6, 49.1)	35.5 (32.8, 38.3)	7.1 (5.9, 8.6)	1.3 (0.9, 1.9)	9.7 (8.7, 10.8)
High	47.2 (40.9, 53.6)	38.9 (32.7, 45.4)	5.3 (3.5, 7.8)	1.8 (0.9, 3.4)	6.8 (5.0, 9.4)
Family history BP					
No	48.5 (46.1, 51.0)	36.3 (33.9, 38.8)	6.9 (5.8, 8.3)	1.5 (1.1, 2.1)	6.8 (6.0, 7.7)
Yes	43.5 (40.7, 46.4)	34.9 (32.1, 37.8)	6.3 (5.2, 7.7)	1.1 (0.7, 1.6)	14.2 (12.8, 15.8)

Numbers are reported as % and (95 % confidence interval)

HTN hypertension, *BP* blood pressure

women). With respect to sex and age, the standardized prevalence of pre-hypertension (pre-HTN) was 35.5 % (men 33.7 % vs. women 37.4 %). The Pre-HTN prevalence constantly increased from 31.8 % in young adults (age group 15–24 years) to the maximum of 40.7 % in the subjects aged 35–44 years. The minimum of pre-HTN prevalence

(23.8 %) was observed in elderly people (age group 65–75 years). 42.2 % of the illiterate people had blood pressure at pre-HTN status, which decreased to 34.6 % in people with education higher than high school. Compared to the non-cigarette smokers, Pre-HTN was slightly more prevalent in the smokers (35.5 vs. 37.9 %). Regarding opium addiction, those with occasional use had the lowest prevalence of pre-HTN (27.8 %). Pre-HTN prevalence was identified in 35.8 % of the depressed people and 34.6 % of those with anxiety symptoms. 34.1 % of the people with normal BMI had pre-HTN, which increased to 38.1 % in the overweight and 40.6 % in the obese people. The level of physical activity had no significant effect on Pre-HTN prevalence. Pre-HTN prevalence was also not affected by having the familial history of HTN.

Undiagnosed hypertension, stage I and II (Table 2)

Overall, the standardized prevalence of stage I and II undiagnosed hypertension (UD-HTN) was 6.6 and 1.3 %, respectively.

UDHTN stage 1 was more prevalent in men (9.3 %), elderly people (15.1 % in people aged 44–64 years), educated people (7.3 % in people with above high school education), non-smokers (7.2 %), opium-dependent users (7.2 %) and obese individuals (14.2 %). The prevalence of UDHTN-stage 1 was almost the same regarding depression, anxiety, the level of physical activity and the family history of HTN. However, it was twice more prevalent among the highly educated people compared to the illiterate (7.3 vs. 3.6 %).

UDHTN-stage 2 was more prevalent in men (2.0 %), elderly people (6.0 % in people aged 65–75 years), educated people (1.9 % in people with above high school education), and obese individuals (4.2 %). The prevalence of UDHTN-stage 2 was almost the same with respect to depression, anxiety, level of physical activity and family history of HTN.

Diagnosed hypertension (Table 2)

Overall, the standardized prevalence of diagnosed hypertension (diagnosed-HTN) was 10.5 % (men 8.9 % vs. women 12.1 %). Diagnosed-HTN increased steadily from 2.4 % in young adults (age group 15–24) to 49.0 % in elderly people (aged 65–75 years). Hypertension was diagnosed in 9.3 % of the illiterate people, and it increased to 11.1 % in the people with above high school education status. Among smokers, diagnosed-HTN was about 9.3 %. Among those addicted to opium, diagnosed-HTN increased from 10.4 % in non-users to 12.7 % in opium addicts. Among those having symptoms of depression and anxiety, diagnosed-HTN was 11.2 and 11.3 %, respectively.

Diagnosed-HTN increased dramatically in the obese people (18.2 %). 12.1 % of the subjects with low physical activity had diagnosed-HTN. The people with a positive familial history of hypertension had experienced higher prevalence of diagnosed-HTN (14.2 %).

Hypertension management (Table 3)

Overall, 56.3 % (men 62.4 % vs. women 52.6 %) of the diagnosed-HTN patients had a blood pressure more than 140/90 mmHg. 13.0 % of the patients who were under HTN treatment used calcium channel blocker (including Nifedipine, Amlodipine, Diltiazem);35.0 % used B blockers (including Atenolol, Metoral, Propranolol); 27.0 % used angiotensin converting enzyme inhibitors (including Captopril, Enalapril, Losartan); 3.0 % used alpha blocker(including Prazocin, Trazocin); 1 % used Beta blocker and ACI together; 3 % used calcium channel blocker and losartan together, 1.0 % made use of diuretics (including Teriameteren H), and 0.5 % used diuretics and losartan together. Uncontrolled HTN prevalence was 58.8 %. The uncontrolled HTN increased steadily from 21.8 % in the young adults to 63.0 % in the elderly people (aged 55–64 years). In 57.8 % of the hypertensive people who had education between primary and high school, the blood pressure was not controlled adequately. Opium addiction did not change the level of uncontrolled-HTN. Uncontrolled-HTN was observed in 56.0 and 54.9 % of the hypertensive depressed and anxious people. The highest level of uncontrolled-HTN (60.6 %) was observed in the obese people. Surprisingly, people who had a higher level of physical activity experienced a higher level of uncontrolled-HTN (67.2 %). In 55.1 % of people with a positive history of familial HTN, the disease was not controlled adequately.

Predictors of hypertension (Table 4)

After adjustment for the confounders, chance of hypertension decreased significantly in women (AOR 0.61) and people with primary or higher level of education (AOR 0.63, 0.64). Also AOR for current smokers and former smokers, was 0.58 and 1.32. Conversely, the chance of hypertension increased significantly after 35 years of age (AOR >1.93). It also increased because of anxiety (AOR 1.23), overweightness and obesity (AOR 2.05, 4.28), moderate and low physical activity (AOR 1.18, 1.31), and the familial history of HTN (AOR 1.76).

Predictors of pre-hypertension (Table 5)

After adjustment for confounders, the odds of hypertension decreased significantly among the women (AOR 0.38), the

Table 3 The prevalence of uncontrolled hypertension among diagnosed hypertensive patients ($n = 1,230$), community-based study (KERCADRS)—1st round—$n = 5,895$, Kerman, Iran, 2009–2011

Subgroups	Controlled BP	Uncontrolled BP
Overall	43.7 (40.6, 46.9)	56.3 (53.1, 59.4)
Patients received drug treatment for HTN	41.2 (37.6, 44.9)	58.8 (55.1, 62.4)
Sex		
Men	37.6 (32.7, 42.7)	62.4 (57.3, 67.3)
Women	47.4 (43.4, 51.5)	52.6 (48.5, 56.6)
Age groups		
15–34	78.2 (61.1, 89.2)	21.8 (10.8, 38.9)
35–44	65.4 (53.9, 75.3)	34.6 (24.7, 46.1)
45–54	47.3 (40.8, 53.8)	52.7 (46.2, 59.2)
55–64	37.0 (31.9, 42.5)	63.0 (57.5, 68.1)
65–75	39.4 (33.0, 46.3)	60.6 (53.7, 67.0)
Education		
Illiterate	44.9 (39.0, 51.0)	55.1 (49.0, 61.0)
Primary to high school	42.2 (38.1, 46.4)	57.8 (53.6, 61.9)
Above high school	47.8 (39.3, 56.4)	52.2 (43.6, 60.7)
Current cigarette smoker		
No	43.3 (40.0, 46.6)	56.7 (53.4, 60.0)
Yes	49.3 (38.4, 60.3)	50.7 (39.7, 61.6)
Opium addiction		
No	43.7 (40.2, 47.2)	56.3 (52.8, 59.8)
Occasional user	41.9 (31.3, 53.3)	58.1 (46.7, 68.7)
Depended user	44.8 (35.1, 54.8)	55.2 (45.2, 64.9)
Depression		
No	43.7 (39.1, 48.3)	56.3 (51.7, 60.9)
Yes	44.0 (39.6, 48.5)	56.0 (51.5, 60.4)
Anxiety		
No	38.0 (31.0, 45.5)	62.0 (54.5, 69.0)
Yes	45.1 (41.6, 48.7)	54.9 (51.3, 58.4)
Obesity		
Normal	48.2 (42.0, 54.4)	51.8 (45.6, 58.0)
Overweight	44.9 (40.0, 49.8)	55.1 (50.2, 60.0)
Obese	39.4 (34.0, 45.2)	60.6 (54.8, 66.0)
Physical activity		
High	32.8 (20.0, 48.7)	67.2 (51.3, 80.0)
Moderate	44.7 (40.1, 49.3)	55.3 (50.7, 59.9)
Low	43.7 (39.2, 48.4)	56.3 (51.6, 60.8)
Family history HTN		
No	41.9 (36.7, 47.4)	58.1 (52.6, 63.3)
Yes	44.9 (40.9, 49.0)	55.1 (51.0, 59.1)

people with primary or higher level of education (AOR 0.73, 0.74). Also AOR for the smokers and former smokers, was 0.64 and 0.87. Conversely, odds of hypertension increased significantly after 35 years of age (AOR >1.81). It also increased due to anxiety (AOR 1.10), overweight and obesity (AOR 1.80, 2.42), moderate and low physical activity (AOR 0.94, 0.88), and the familial history of HTN (AOR 1.66).

Co-morbidities in different subpopulations regarding hypertension (Table 6)

Overall, anxiety (75.0 % in pre-HTN to 86.3 % in diagnosed-HTN subgroup) and overweight/obesity (30.0 % in normotensive to 69.4 % in undiagnosed HTN-stage 1 subgroups) were the commonest co-morbidities in all of the subpopulations. Overall mean BMI in the total population

Table 4 Crude and adjusted odds ratio for different predictors of hypertension, community-based study (KERCADRS—1st round—n = 5,895), Kerman, Iran, 2009–2011

Subgroups	Crude OR	Adjusted OR
Sex		
Men	1	1
Women	0.98 (0.86, 1.11)	0.61 (0.5, 0.75)
Age groups		
15–24	1	1
25–34	1.58 (1.0, 2.3)	1.12 (0.74, 1.6)
35–44	3.25 (2.2, 4.6)	1.93 (1.3, 2.8)
45–54	8.17 (5.7, 11.5)	4.91 (3.4, 7.1)
55–64	19.64 (13.9, 27.7)	12.1 (8.3, 17.7)
65–75	26.82 (18.4, 39.1)	17.5 (11.6, 26.5)
Education		
Illiterate	1	1
Primary to high school	10.30 (0.2, 0.38)	10.63 (0.5, 0.8)
Above high school	0.28 (0.2, 0.3)	0.64 (0.4, 0.8)
Cigarette smoking		
Never	1	1
Former	1.87 (1.43, 2.44)	1.32 (0.93, 1.88)
Current	0.60 (0.47, 0.77)	0.58 (0.41, 0.08) 6)
Opium addiction		
No	1	1
Occasional user	1.42 (1.1, 1.8)	1.18 (0.86, 1.6)
Depended user	1.40 (1.1, 1.7)	1.08 (0.8, 1.4)
Depression		
No	1	1
Yes	1.46 (1.3, 1.6)	1.01 (0.9, 1.2)
Anxiety		
No	1	1
Yes	1.15 (0.99, 1.34)	1.23 (1.01, 1.5)
Obesity		
Normal	1	1
Overweight	2.41 (2.1, 2.8)	2.05 (1.7, 2.4)
Obese	4.6 (3.8, 5.5)	4.28 (3.4, 5.3)
Physical activity		
High	1	1
Moderate	1.88 (1.4, 2.4)	1.18 (0.9, 1.6)
Low	2.12 (1.6, 2.7)	1.31 (0.9, 1.7)
Family history BP		
No	1	1
Yes	1.54 (1.3, 1.7)	1.76 (1.5, 2.1)

Numbers are reported as OR and (95 % confidence interval)

OR odds ratio, *HTN* hypertension, *BP* blood pressure

Table 5 Crude and adjusted odds ratio for different predictors of pre_HTN, Community-Based Study (KERCADR—1st Round—n = 5,895), Kerman, Iran

Subgroups	Crude OR	Adjusted OR
Sex		
Men	1	1
Women	0.59 (0.52, 0.67)	0.38 (0.31, 0.4)
Age groups		
15–24	1	1
25–34	1.61 (1.29, 2.01)	1.55 (1.17, 2.05)
35–44	2.08 (1.67, 2.59)	1.81 (1.34, 2.44)
45–54	3.21 (2.57, 4.00)	2.82 (2.08, 3.82)
55–64	5.30 (4.13, 6.81)	4.53 (3.24, 6.32)
65–75	8.55 (6.05, 12.08)	7.26 (4.76, 11.07)
Education		
Illiterate	1	
Primary to high school	0.48 (0.38, 0.60)	
Above high school	0.47 (0.36, 0.61)	
Cigarette smoking		
Never	1	1
Former	1.77 (1.31, 2.39)	0.87 (0.61, 1.26)
Current	1.04 (0.85, 1.26)	0.64 (0.49, 0.84)
Opium addiction		
No	1	1
Occasional user	1.16 (092, 1.47)	0.75 (0.56, 1.00)
Depended user	1.35 (1.01, 1.80)	0.78 (0.56, 1.10)
Depression		
No	1	1
Yes	1.02 (0.90, 1.17)	0.95 (0.81, 1.11)
Anxiety		
No	1	1
Yes	0.86 (0.74, 1.01)	1.10 (0.91, 1.33)
Obesity		
Normal	1	1
Overweight	1.89 (1.71, 2.07)	1.80 (1.61, 2.00)
Obese	2.55 (2.42, 3.87)	2.42 (1.95, 2.95)
Physical activity		
High	1	1
Moderate	0.92 (0.75, 1.10)	0.94 (081, 1.10)
Low	0.80 (0.55, 1.20)	0.88 (0.68, 1.147)
Family history BP		
No	1	1
Yes	1.40 (1.20, 1.85)	1.66 (1.55, 2.31)

Numbers are reported as OR and (95 % confidence interval)

OR odds ratio, *BP* blood pressure

was 25.85 kg/cm^2 (24.8 in men and 26.7 in women). Mean waist circumference in total population was 85.7 cm (88 cm in men and 83.9 cm in women) (see Gozashti et al. 2013 for more details).

Diabetes was 6.9 % in the per-HTN subpopulation and increased to 12.3–14.3 % in the undiagnosed-HTN people and then to 18.5 % in those with diagnosed-HTN. Hypercholesterolemia was constantly over 26.2 % in all

subpopulations and increased to 42.4 % in (diagnosed) the hypertensive group. One-fifth (20.9 %) of diagnosed-HTN had also hypertriglyceridemia. Depression was 28.5 % in the undiagnosed HTN-stage 2 and 37.2 % in the diagnosed subpopulation.

Sex and age interacted on hypertension (Fig. 1)

By the age of 45 years, hypertension was more prevalent in men compared to women. Women aged above 45 years experienced more level of hypertension. The trend is constantly upward in both men and women after the age of 45, and particularly speeds up in women after 55 years. Unlike women, it started to decrease in men after age of 70.

The pattern of prevalence due to overweight and obesity was similar to hypertension trend, although men and women status switched at age of 25–29 years. In women, it peaked at age of 45–49 (at level of 80 %) and then stabilized. In women aged between 60 and 64, it starts to decrease. In men aged between 35 and 39, it increased to about 50 and then stabilized and started to decrease at age of 55–59 years.

Discussion

The main finding of this study was that more than 10 % of the adult population has been diagnosed with hypertension, and almost 8 % of them suffered from the disease but not yet diagnosed. Another finding indicated the high prevalence of pre-hypertension in this area. Among those who have been already diagnosed with hypertension, less than half have their blood pressure at control level. Remarkably, one per two in the adult population is either hypertensive or at pre-hypertension stage. Based on the results, obesity, anxiety and low physical activity were the most significant predictors for hypertension and pre-hypertension, which were all modifiable. This is a missed opportunity for the health authorities in response to hypertension and pre-hypertension epidemics in Iran.

Table 6 The standardized prevalence of different co-morbidities in normotensive, pre-hypertension, undiagnosed and diagnosed hypertension, community-based study (KERCADRS—1st Round—$n = 5,895$), Kerman, Iran, 2009–2011

Co-morbidities	Normotensive	Pre-HTN	Undiagnosed HTN-stage 1	Undiagnosed HTN-Stage 2	Dignosed HTN
Diabetes mellitus	7.2 (6.0, 8.6)	6.9 (5.9, 8.1)	12.3 (7.6, 19.2)	14.3 (10.2, 19.6)	18.5 (12.6, 26.2)
Hypercholesterolemia	26.2 (24.2, 28.4)	29.6 (27.2, 32.1)	36.1 (28.7, 44.1)	36.5 (28.6, 45.2)	42.4 (31.9, 53.7)
Hypertriglyceridemia	11.0 (9.5, 12.7)	14.0 (12.3, 15.9)	21.2 (14.8, 29.5)	15.2 (10.3, 21.8)	20.9 (15.1, 28.1)
Depression	35.0 (32.5, 37.6)	35.0 (32.0, 38.2)	31.8 (23.7, 41.2)	28.5 (21.8, 36.3)	37.1 (26.6, 48.9)
Anxiety	77.1 (74.6, 79.4)	75.0 (72.2, 77.6)	80.6 (74.6, 85.4)	83.4 (76.4, 88.6)	86.3 (78.8, 91.4)
Overweight and obesity	32.0 (29.7, 34.4)	45.3 (42.3, 48.4)	69.4 (59.7, 77.6)	65.9 (55.3, 75.2)	58.3 (50.2, 66.0)

Numbers are reported as % and (95 % confidence interval)
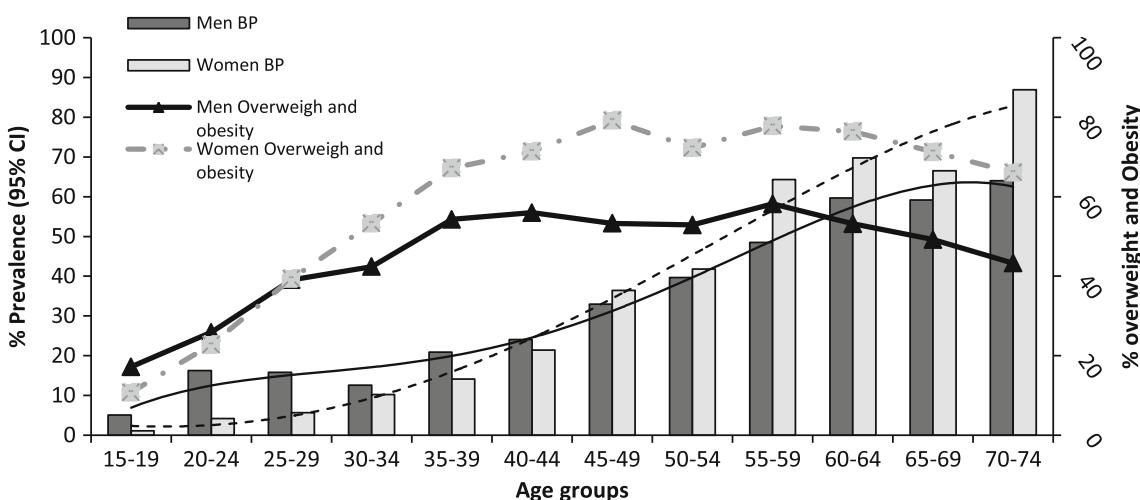
HTN hypertension

Fig. 1 Prevalence of hypertension by age group and sex in Kerman, Iran 2009–2011, [community-based study (KERCADRS—1st round— $n = 5,895$)]

Given the high observed prevalence of hypertension and pre-hypertension and their co-morbidities (diabetes, hypercholesterolemia, hypertrigliceridemia and obesity), the disease may cause serious fatalities in the future unless timely measures are taken (Talaei et al. 2013). 14.6 million Iranian people (35.5 % of populations aged 15–75 years—see Table 2) who suffer from pre-hypertension could have been prevented from progressing into higher level of blood pressure/hypertensive levels. This could be much more important when we look at the population pyramid of Iran. The majority of Iranians are aged between 25 and 35 years now, and this portion will be 45–55 years in next two decades with only less than 28 % normal BP and more than 52 % uncontrolled HTN based on the present data (see Tables 2, 3). As reported by Talaie et al. (2013) rather than age and sex, all other predictors (such as low education, BMI, weight gain, waist circumference, high triglycerides, impaired fasting glucose, diabetes mellitus) of hypertension occurrence are modifiable.

The high rate of pre-hypertension in the present study is comparable with that found in other Asian countries including Saudi Arabia, Taiwan and China where the prevalence of pre-hypertension range from 34.0 to 45.0 % (Ibrahim et al. 2008; Pang et al. 2008; Sun et al. 2007; Tsai et al. 2007; Whelton et al. 2004).

The prevalence of hypertension among men has been continually more than women aged 45. After this age, women suffer more. This could be partly explained by menopause that usually starts at around this age. The other predisposing factor could be obesity that starts to increase disproportionately among women around age of 25 years before hypertension (see Fig. 1). The rise of obesity, particularly among women has been reported in other studies (Mirzazadeh et al. 2009; Navadeh et al. 2011).This makes women population more exposed and vulnerable to hypertension.

Other studies indicate that the control rate of blood pressure among diagnosed hypertensive patients ranged from 17 to 42.7 % in Iran (Esteghamati et al. 2008; Azizi et al. 2002; Sadeghi et al. 2004) and 32.2 % in other developing countries (Pereira et al. 2009). The observed uncontrolled rate of 56.2 % is unacceptable, and it indicates the ineffectiveness of current urban health networks in this region of Iran. The current urban health system should be improved to extend national non-communicable (including hypertension) intervention programs, using the experiences of rural health system changes happened in early 90s.(Shadpour et al. 2000). Current family physician reforms are a promising system in urban settings to monitor and manage the basic health disorders such as hypertension (Takian et al. 2011).

In Iran and the adjacent countries, the traditional belief is that the opium is effective in reducing blood pressure and treating other cardiovascular diseases risk factors. However, our results showed that those people who used opium had higher prevalence and higher level of uncontrolled hypertension. People should formally be aware of this by public health messages. No explanation could be given for some unpredicted results such as higher prevalence in more educated people and weaker control in those with high physical activity. These issues are in urgent need of investigation.

Our study has provided a deep epidemiological view of pre-hypertension, hypertension and overall health response to it in the context and limitation of a cross-sectional survey. The findings may be much more intimidating when we look at the population pyramid of Iran where the majority of people are between 25 and 35 years now, and will be 45–55 years after decades with only less than 28 % normal BP and more than 52 % uncontrolled HTN (see Tables 2, 3). Our findings are good to provide an updated picture of hypertension among adults and limitations in preventing the disease. Further follow-up studies need to be done to assess the impact of the ongoing measures taken to help the policy makers to decide on the best cost-effectiveness interventions.

Study limitations: there are some missing data for some other correlates/risk factors for hypertension in this study, e.g., sleep problems, dietary patterns/dietary salt intake or alcohol consumption. However, due to socio-economic status of the region, it is unlikely that these factors play a significant role in the high prevalence of HTN/pre-HTN. As more than 98 % of the study population are muslims and alcohol is prohibited by religion (also not available in market) its consumption rate would not be considerable. In this regard, approximately, 2.0 % of participants in this study were alcoholic (unpublished results). In another study recently conducted in this area, the rate of alcohol consumption was 2.0 % in general population (Naghibzadeh et al. 2014). Meat consumption and western dietary pattern is not popular and salt intake is not high compared to some neighbor countries like Turkey. Nevertheless, the exact role of these factors and also sleep problems needs further investigations in future studies including the second round of the KERCADR study that we are going to start in next few months.

Conclusion

Hypertension affected almost one-fifth of the adults and disease control was also poor among the diagnosed patients. As majority of Iranians are young now and aging will affect the population in near future, hypertension would definitely be one of the serious health problems soon. The problem is much more acute since more

population with pre-hypertension are at the risk of sift to hypertension soon. Therefore, it is vital for the health system to be prepared for the spreading epidemy.

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