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Abstract

Background: Hypertension is a major risk factor for cardiovascular diseases and has a high prevalence in the Eastern Mediterranean Region.

Aims: To estimate the prevalence and awareness of hypertension and its associated factors in a central province of the Islamic Republic of Iran.

Methods: This cross-sectional study was conducted among 2320 adults aged 40–80 years in Yazd, Islamic Republic of Iran, in 2010–2011. Multivariable logistic regression analysis was performed to calculate the odds ratios (ORs) for exploring the association between hypertension and associated risk factors. Of eligible subjects, 2098 participated in clinical examinations (response rate: 90.4%).

Results: The sex- and age-standardized prevalence of hypertension was 52.8% [95% confidence interval (CI): 49.6–56.1%]. Of 1170 participants with hypertension, 421 were diagnosed for the first time in this survey; therefore, the unawareness proportion was 36.0% (95% CI: 33.2–38.8%). Among known cases (749 of 1170), 68.5% (95% CI: 65.0–71.8%) had uncontrolled blood pressure. Age (OR 70–80 vs. 40–50 years=7.01, 95% CI: 4.01–12.24),

obesity (OR=2.78, 95% CI: 2.06–3.75), diabetes (OR=1.46, 95% CI: 1.12–1.89), hyperlipidaemia (OR=1.60, 95% CI: 1.26–2.03) and living in a rural area (OR=1.57, 95% CI: 1.0–2.45) were significantly associated with hypertension.

Conclusions: Although age is an inevitable risk factor for hypertension, the high unawareness proportion, uncontrolled hypertension and modifiable risk factors such as obesity, hyperlipidaemia and diabetes demand effective preventive and curative strategies.

Keywords: hypertension, Islamic Republic of Iran, prevalence, risk factors

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Introduction

Hypertension is a major risk factor for cardiovascular diseases, including coronary heart disease, heart failure, arrhythmia and cardiomyopathy. There is also an increased risk of chronic kidney disease and stroke among hypertensive patients (1, 2). According to The Global Burden of Disease Study, hypertensive heart disease accounted for 17.5 million disability-adjusted life years in 2015 (3). Research-based evidence has demonstrated an increased risk of hypertension with older age, male sex, and hyperlipidaemia (4).

The World Health Organization (WHO) reported that 30.7% of men and 29.1% of women in the Eastern Mediterranean Region were estimated to have hypertension in 2008 (5). The

prevalence of hypertension in the Islamic Republic of Iran among adults aged > 25 years was estimated at 31% in men and 27% in women. Previous studies conducted in different provinces of the Islamic Republic of Iran (6–8) showed a large variation of hypertension prevalence among different provinces. A study in Yazd revealed that 53.7% of people with hypertension were aware of their disorder, 24% of them were under treatment, and only 8% had controlled hypertension (7). As prevalence of hypertension is probably increasing in low- and middle-income countries (9) including the Islamic Republic of Iran (10), it is important to conduct additional studies to evaluate the trends and associated factors. In addition, population-based surveys on prevalence and risk factors of hypertension are important in settings where routine health monitoring systems are not in place. Due to limited research resources in these settings, most studies of hypertension are performed at subnational level; therefore, collecting data from different geographic areas may be more practical and can later be combined to give a more general picture of hypertension in a country or region. The aim of this study was to estimate the prevalence, awareness and associated factors of hypertension in a central district of the Islamic Republic of Iran.

Methods

Study population

The present study was part of a multidimensional population-based study, as described previously (11). This cross-sectional study was conducted in an urban and rural area of Yazd District, Islamic Republic of Iran in 2010–2011. The sample size was 2320 adult residents of Yazd aged 40–80 years, who were recruited with a systematic cluster sampling method. The Ethics Committee of Shahid Beheshti University of Medical Sciences, Tehran, Islamic Republic of Iran approved the study protocol. Written informed consent was obtained from the participants prior to data collection.

Data collection

A general practitioner conducted general medical assessments including blood pressure measurement. After 5 minutes of rest, blood pressure was taken using a standard mercury sphygmomanometer (nova-presameter; Riester, Jungingen, Germany) in a sitting position twice at the same session and the average measurement was recorded. Fasting blood sugar (FBS) was measured first during the home visit using a glucometer (ACCU CHEK Active Meter; Roche Diagnostics, Indianapolis, IN, USA). A complete blood test from the venous blood sample was conducted after overnight fasting prior to blood sampling at a standard laboratory to measure FBS, haemoglobin A1c and lipid profile. Body weight was measured with indoor clothing using a Balas Miracle Scale (Karaj, Islamic Republic of Iran) and standing height was measured without shoes using a measuring rod (Balas). In addition, self-reported information on tobacco use, physical activity and education level was collected.

Definitions

Hypertension was defined according to the definitions of the Joint National Committee 7 (JNC 7) as: (1) systolic blood pressure (SBP) ≥ 140 mmHg and/or diastolic blood pressure (DBP) ≥ 90 mmHg (12); or (2) self-reported history of hypertension and/or taking any antihypertensive medication. A summary of blood pressure definitions that were used in this study is presented in Table 1 . Diabetes mellitus was defined as two independent FBS measurements ≥ 126 mg/dl (7.0 mmol/l), and/or previous history of diabetes diagnosed by a physician, and/or glucose lowering agent medication. Hyperlipidaemia was based on lipid profile in a fasting blood sample, that is, triglyceride > 150 mg/dl (1.7 mmol/l), low-density lipoprotein > 130 mg/dl (3.4 mmol/l), high-density lipoprotein 150 mg/dl (3.9 mmol/l), previously diagnosed by a physician, or taking lipid lowering medication. For BMI, participants were classified into 3 groups: normal weight, overweight (25 ≤ BMI **Statistical analysis**

The sex and age standardized prevalence of hypertension was calculated considering demographic composition of people aged 40–80 years who lived in the survey area based on the National Census 2006. In evaluation of the relations, we considered the clustering effect by multilevel analysis within logistic regression. First, we evaluated the univariate relations in a simple multilevel logistic regression. Then, to consider the clustering effect and confounders in the evaluation of the relations, we used multilevel multivariable logistic regression. In this model age, sex, education, diabetes, smoking, BMI, hyperlipidaemia, physical activity and living area were independent variables and covariates (for other variables in the model). The main outcome (dependent) variable was a binary variable with 1 for hypertension and 0 for not hypertension. We used similar models for other outcome measurements including awareness, control status, and stage of hypertension. Within these models, we calculated adjusted odds ratios (ORs) to evaluate association of different factors with hypertension and other outcomes. We considered duration of smoking and amount of smoking as quantitative variables and all other variables were considered as categorical variable in all models. P **Results**

Of 2320 invited residents, 2098 participated (response rate: 90.4%) with a mean age (standard deviation) of 54.1 (10.0) years. Eighty-nine percent of the study population were urban dwellers and 53% were women. Among participants, 15.7% reported a history of smoking and ~20% had no level of education. The mean BMI was 27.4 (4.7) kg/m2 and nearly 25% of participants had a physically active lifestyle. The crude proportion of diabetes and hyperlipidaemia was 25.8% (n = 539) and 34.4% (n = 731), respectively. Prevalence of hypertension and more details of participants' characteristics are provided in Tables 2 and 3.

Age- and sex-standardized prevalence of hypertension and prehypertension was 52.8% (95% CI: 49.6–56.1%) and 35.1% (95% CI: 31.9–38.4%), respectively (Table 2). Of these, 19.5% (95% CI: 17.4–21.7%) were newly diagnosed with hypertension and among known cases, 68.5% had uncontrolled blood pressure (≥ 140/90 mmHg).

Urban dwellers had a hypertension prevalence of 54.4%, while prevalence of hypertension among rural residents was 67% (Table 3) (Table 3_1) (Table 3_2) (Table 3_3). Prevalence of hypertension among illiterates was 74.2%, while 45.7% people with > 12 years of education had hypertension. Prevalence of hypertension was greater in non-smokers (58.1% vs. 43%). Among individuals with normal BMI, just 48.5% had hypertension, whereas 69% of obese participants had hypertension. Prevalence of hypertension in patients with hyperlipidaemia and diabetes was 69.6% and 70.1%, respectively.

By sex, prevalence of hypertension was 52% in men and 59.1% in women. Prevalence of hypertension was higher in women, but hypertensive men were more likely to have undiagnosed hypertension. Prevalence of hypertension increased with age in both sexes. Prevalence of hypertension among men and women aged 40–49 was 33.7% and 41.4% and this increased to 54.7% for men and 63.8% for women aged 50–59 years, 66.8% for men and 79.2% for women aged 60–69 years, and 69.7% for men and 89.9% for women aged 70–80 years.

Older age, obesity, diabetes, hyperlipidaemia and living in a rural area were significantly associated with hypertension (Table 4). In addition, older people, women, people with diabetes, and people with hyperlipidaemia were more aware of their hypertension. Uncontrolled hypertension was significantly higher in age group 60–69 years and in people with diabetes. Age had a strong relationship with hypertension, in that people aged 70–80 years had > 7-fold odds of hypertension compared to those aged 40–50 years. On the contrary, we did not find a significant association between hypertension and the sexes, physical activity, level of education or smoking (Table 4).

Discussion

We measured prevalence of hypertension and its associated factors in a central district of the Islamic Republic of Iran. Age- and sex-standardized prevalence of hypertension in this representative sample of the population aged 40–80 years in Yazd was 52.8%. Previous studies reported a wide range of hypertension prevalence in the Islamic Republic of Iran, ranging from 7.21% among 7–12-year-old children in Ghazvin Province (13) to 41.8% in 40–75-year-old residents in Golestan Province (6). A systematic review of 29 studies in the Islamic Republic of Iran in 1996–2004 reported prevalence of hypertension around 50% in the population aged ≥ 55 years (10). A recent study in Yazd Province revealed that prevalence of hypertension in men and women aged 20–74 was 27.6% and 23.9%, respectively (7). The higher percentage of hypertension in our study was probably due to the older age of the study population.

Hypertension is a common health problem and its prevalence is increasing in low- and

middle-income countries. Migration to urban areas, population ageing, dietary patterns and stressful lifestyles are reasons for the increasing prevalence (9). As observed in the current study, age is a strong independent risk factor for hypertension (14) and might have resulted in the higher prevalence of hypertension in our study compared to others. A study among people aged ≥ 65 years in Taiwan reported prevalence of 60.4% hypertension (15). Table 5 compares prevalence of hypertension in different studies by sex and age.

In our study, prevalence of hypertension was higher among women; however, the association was not significant after adjusting for confounders. According to WHO, total prevalence of hypertension is globally higher among men (5). Similarly, studies conducted in East Asia have shown higher prevalence of hypertension among men (16). A systematic review of 33 studies in South Asia indicated that the male sex is associated with a higher prevalence of hypertension, and only 8 studies showed that hypertension is more prevalent among women (17). Some studies in the Middle East have shown that prevalence of hypertension among both sexes is almost identical or slightly higher among women (18). Likewise, a recent systematic review among the Iranian population revealed that prevalence of hypertension is similar in both sexes (19). The sex difference in our study could be explained by the older age of the study population, since we found that the the effect of older age on hypertension was more substantial among women. It could also be explained by other factors such as vitamin D deficiency, which is common among women in the Middle East, and this vitamin plays an important role in pathophysiology of hypertension (20). In addition, hormonal changes in postmenopausal women and decreased levels of estrogen cause vasoconstriction (21).

Similar to some other studies (7), women and people aged ≥ 60 years were more likely to know that they had hypertension in the current study. Men are less likely to seek healthcare services. Therefore, they have a greater risk of being unaware about their health problems in some settings because they pay less attention to their medical condition or have outdoor occupations (22). Moreover, history of diabetes and hyperlipidaemia showed an association with awareness of hypertension in our study. Naturally, older people and those with other medical conditions are more likely to have contact with healthcare professionals during their lifespan, which could explain the higher proportion of awareness in these groups.

The current study showed that both obesity and hyperlipidaemia were associated with hypertension. These results are supported by other studies (23). A study in Macao Special Administrative Region revealed that obese people have 4.5 times higher risk of hypertension compared to normal weight population (24). In addition, there are studies demonstrating that 78% of essential hypertension in men and 65% in women is related to excess weight gain (25). It has also been postulated that stimulation of sympathetic activity by high dietary fat and carbohydrate (26) and obesity-induced overactivation of the renin–angiotensin–aldosterone system (RAAS) are major biological causes of hypertension in obesity and hyperlipidaemia (25).

These all emphasize the importance of weight control in prevention of hypertension.

Our results revealed no significant association between physical activity and hypertension: 45.2% of normotensive and 54.8% of hypertensive individuals reported some level of exercise. A recent meta-analysis of prospective cohort studies demonstrated a decreased risk of hypertension in people with increased recreational physical activity. However, the risk did not change with occupational physical activity (27). Physical activity may play a role in decreasing blood pressure by reducing vascular resistance and by influencing the level of activity in the catecholamine and renin angiotensin aldosterone system (28). Although having a physically active lifestyle was more common in patients with hypertension, the association between exercise and hypertension was not significant.

According to our results, people who live in rural areas have a greater risk of hypertension. The geopolitical variation in the distribution of hypertension is diverse. In the Islamic Republic of Iran, different studies have reported conflicting results. Esteghmati et al. reported higher prevalence of hypertension in urban dwellers in 2007 (29), while a cohort study in Golestan Province conducted by Malakzadeh et al. (2004–2008) showed lower risk of hypertension in urban dwellers (6). In addition, some Iranian studies have shown no difference in prevalence of hypertension between urban and rural residents (30). Yazd Province in the centre of the Islamic Republic of Iran has an arid climate and farming is less developed. Migration of most people to cities, fewer job opportunities, lack of welfare resources, and a more stressful lifestyle could be causes of higher prevalence of hypertension in rural areas (31). In addition, lack of systematic programmes to promote general knowledge about appropriate lifestyles in rural areas could be another reason.

Higher level of education has been demonstrated to reduce risk of hypertension in the Islamic Republic of Iran and other countries (6). Education can increase people’s awareness about their health, including hypertension, and encourage them to pay more attention to it. Although our multivariable analysis showed no significant association between hypertension and education, the descriptive data showed a considerably higher prevalence of hypertension among people who were illiterate. It should be mentioned that about 25% of participants in our study were illiterate and only 11% had an academic education. The number of people who had higher education levels might have been insufficient to show any differences in our study.

In the current study, 17% of participants reported that they were current smokers and we could not find any significant association between smoking and blood pressure. Nevertheless, many studies have revealed that smoking increases prevalence of hypertension (32). The measurement of tobacco consumption is specific and our data collection procedure did not

provide an opportunity for collecting precise information. Anecdotally, smoking tobacco is generally disapproved of in the survey area; therefore, data gathering based on self-reported information may have had a reporting bias.

This study had some limitations. First, this was a cross-sectional study and it cannot predict causality. In addition, we included people aged 40–80 years, and the results cannot be generalized to all age groups living in the study area. Moreover, some risk factors for hypertension such as alcohol consumption, psychological problems and dietary intake were not evaluated. Finally, some of our results such as smoking, education, medication and physical activity were based on self-reported information that may have had a reporting bias.

Conclusion

Hypertension is a major health problem in Yazd. The proportion of those who are not aware of their disorder and the number of cases of uncontrolled hypertension among known cases are considerable. Age, obesity, diabetes, hyperlipidaemia, and living in a rural area are associated with hypertension. Although older age is the main inevitable risk factor for hypertension, there is potential to improve the situation through controlling manageable factors, increasing public awareness and improving care for people with hypertension.

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Competing interests: None declared.

Hypertension et facteurs associés en République islamique d’Iran : étude en population

Résumé

Contexte : L’hypertension est un facteur de risque majeur de maladies cardio-vasculaires. Elle

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a une forte prévalence dans la Région de la Méditerranée orientale.

Objectifs : Estimer la prévalence de l’hypertension et le niveau de connaissance à cet égard ainsi que les facteurs associés dans une province centale de la République islamique d’Iran.

Méthodes : La présente étude transversale a été réalisée auprès de 2 320 adultes âgés de 40 à 80 ans dans la province de Yazd (République islamique d’Iran), en 2010-2011. L’analyse de régression logistique multivariée a été employée pour calculer les odds ratio (OR) permettant d’étudier le lien entre l’hypertension et les facteurs de risque associés. Parmi les sujets remplissant les critères de l’étude, 2 098 ont participé aux examens cliniques (taux de réponse : 90,4 %).

Résultats : La prévalence standardisée de l’hypertension selon le sexe et l’âge était de 52,8 % (intervalle de confiance à 95 % [IC] : 49,6-56,1). Sur les 1 170 participants souffrant d’hypertension, 421 avaient été diagnostiqués pour la première fois lors de cette étude. Par conséquent, la proportion de méconnaissance était de 36,0 % (IC à 95 % : 33,2-38,8). Parmi les cas connus (749 sur 1 170), 68,5 % (IC à 95 % : 65-71,8) avaient une tension artérielle non contrôlée. L’âge (OR 70-80 ; 40-50 ans=7,01, IC à 95 % : 4,01-12,24), l’obésité (OR=2,78, IC à 95 %: 2,06-3,75), le diabète (OR=1,46, IC à 95 % : 1,12-1,89), l’hyperlipidémie (OR=1,60, IC à 95 % : 1,26-2,03) et l’implantation en zone rurale (OR=1,57, IC à 95 % : 1,0-2,45) étaient fortement associés à l’hypertension.

Conclusions : Bien que l’âge soit un facteur de risque d’hypertension inévitable, la proportion élevée de méconnaissance, l’hypertension non contrôlée et les facteurs de risque modifiables tels l’obésité, l’hyperlipidémie et le diabète requièrent des stratégies préventives et curatives efficaces.

ارتفاع ضغط الدم والعوامل المرتبطة به في جمهورية إيران الإسلامية : دراسة سكانية

مرضية كاتباه، علي مقدم، مهدي ياسري، دنيش نوبين، بير كاليستراب، حميد أحمديه

الخلاصة

: يُعد ارتفاع ضغط الدم أحد عوامل الخطر الرئيسية للإصابة بأمراض القلبالخلفية

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والأوعية الدموية، وهو منتشر بنسبة مرتفعة في إقليم شرق المتوسط .

: هدفت الدراسة إلى تقييم مدى انتشار ارتفاع ضغط الدم والعوامل المرتبطة بهاالأهداف
ومستوى الوعي بشأنه في إحدى المناطق الوسطى في جمهورية إيران الإسلامية .

: شملت هذه الدراسة المقطعية 2320 بالغاً تتراوح أعمارهم بين 80-40 عاماً فيطرق البحث
يَزْد، جمهورية إيران الإسلامية، وذلك في الفترة من 2011-2010. وأُجري تحليل الانحدار
المنطقي المتعدد المتغيرات لحساب نِسَب الأرجحية لاستكشاف العلاقة بين ارتفاع ضغط
الدم وعوامل الخطر المرتبطة به . ومن بين الأشخاص المؤهلين للاشتراك في الدراسة، شارك
2098 شخصاً في الفحوص السريرية (معدل الاستجابة : 90.4%).

: بلغ معدل الانتشار المعياري لارتفاع ضغط الدم حسب العمر ونوع الجنس 52.8%النتائ **ج**
[فاصل الثقة 59 % = 56.1 -49.6] ومن بين 1170 مشاركاً مصاباً بارتفاع ضغط الدم، شُخِّصَ
421 شخصاً منهم لأول مرة في هذا المسح؛ وهو ما يعني أن نسبة عدم الوعي بالمرض كانت
36.0% [فاصل الثقة 59 % = 38.8 -33.2] ، ومن بين الحالات التي يُعرَف إصابتها بارتفاع ضغط
الدم (749 من بين 1170) ، 68.5% منهم كانوا غير متحكمين في ضغط الدم [فاصل الثقة 59 % =
71.8 -65]. وقد ارتبط ما يأتي بالإصابة بارتفاع ضغط الدم ارتباطاً كبيراً : العمر (نسبة
الأرجحية للبالغ أعمارهم 80-70 مقابل 50-40 عاماً = 7.01 ، فاصل الثقة 59 % = 12.24
-4.01) ، والبدانة [نسبة الأرجحية = 2.78 ، فاصل الثقة 59 % = 3.75 -2.06] ، والسكري [نسبة
الأرجحية = 1.46 ، فاصل الثقة 59 % = 1.89 -1.12] ، وزيادة شَحْمِيَّات الدم [نسبة
الأرجحية = 1.60 ، فاصل الثقة 59 % = 2.03 -1.26] والعيش في منطقة ريفية [نسبة الأرجحية =
57.1 ، فاصل الثقة 59 % = 2.45 -1.0].

: على الرغم من أن العمر أحد عوامل الخطر المرتبطة حتمياً بارتفاع ضغطالاستنتاجات
الدم، إلا أن ارتفاع نسبة عدم الوعي بشأن ارتفاع ضغط الدم، وعدم التحكم فيه، بالإضافة
إلى بعض عوامل الخطر الأخرى القابلة للتغيير مثل البدانة، وزيادة شَحْمِيَّات الدم،
والسكري، تتطلب جميعها استراتيجيات وقائية وعلاجية .

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