

Prevalence of hypertension and related risk factors in central Iran: Results from Yazd Health Study

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Abstract

Background: Hypertension, the most important risk factor for cardiovascular disease, is a public health concern in world. Its prevalence varies between countries, due to differences in lifestyle and other risk factors' profile across the regions. The aim of this study was to investigate the prevalence of hypertension and its related risk factors among adults in Yazd Greater Area. **Methods:** This cross-sectional study is a community-based study of 20-69 year-old adults living in Yazd. The participants were selected by multi-stage random cluster sampling. A valid questionnaire completed in a home visit. Blood pressure (BP), Body Mass Index and Waist Circumference were measured by standard protocol. Self-reported hypertension was recorded. levels of Physical Activity (PA) were categorized by IPAQ-SF. Chi-square test was used for categorical variables to analyze the differences. Multivariate logistic regression was carried out to determine the association of risk factors to hypertension. All statistical analyses were performed using SPSS 16 software. A p-value less than 0.05 were considered statistically significant. **Results:** With 95% responding(n=9975), half of adults have a low PA and two thirds were overweight or obese. Positive history of hypertension was 18.5% (21.9% in females vs. 15.2% in males). The mean systolic and diastolic BP were 126.5 ± 18.4 mmHg and 80.2 ± 12.5 mmHg, respectively. Prevalence of hypertension was 36% (34.7% for women and 37.3% for men). The prevalence of hypertension is reduced with higher education, more PA, lower BMI and no history of diabetes (P value < 0.0001). Higher BP is less common in smokers (P value < 0.0001). By logistic regression analysis, hypertension were higher among men (OR: 1.83, 95% CI: 1.64-2.03), eldest (OR: 5.15, 95% CI: 4.20-6.31), low-educated (OR: 1.40, 95% CI: 1.17-1.67) and diabetics (OR: 1.20, 95% CI: 1.05-1.38).Hypertension was doubled in obese. There was no significant relationship between PA level, place of residence, smoking and hypercholesterolemia with high BP. **Conclusion:** Prevalence of hypertension in adults was high. By identifying common modifiable risk factors, health policy makers should prioritize health interventions to control risk factors. It is necessary to inform younger adult groups about ways to select healthy lifestyle and nutritional habits.

Abstract

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Methods: This cross-sectional study is a community-based study of 20-69 year-old adults living in Yazd. The participants were selected by multi-stage random cluster sampling. A valid questionnaire completed in a home visit. Blood pressure (BP), Body Mass Index and Waist Circumference were measured by standard protocol. Self-reported hypertension was recorded. levels of Physical Activity (PA) were categorized by IPAQ-SF. Chi-square test was used for categorical variables to analyze the differences. Multivariate logistic regression was carried out to determine the association of risk factors to hypertension. All statistical analyses were performed using SPSS 16 software. A p-value less than 0.05 were considered statistically significant.

Results: With 95% responding (n=9975), half of adults have a low PA and two thirds were overweight or obese. Positive history of hypertension was 18.5% (21.9% in females vs. 15.2% in males). The mean systolic and diastolic BP were 126.5 ± 18.4 mmHg and 80.2 ± 12.5 mmHg, respectively. Prevalence of hypertension was 36% (34.7% for women and 37.3% for men). The prevalence of hypertension is reduced with higher education, more PA, lower BMI and no history of diabetes (P value < 0.0001). Higher BP is less common in smokers (P value < 0.0001). By logistic regression analysis, hypertension were higher among men (OR: 1.83, 95% CI: 1.64-2.03), eldest (OR: 5.15, 95% CI: 4.20-6.31), low-educated (OR: 1.40, 95% CI: 1.17-1.67) and diabetics (OR: 1.20, 95% CI: 1.05-1.38). Hypertension was doubled in obese. There was no significant relationship between PA level, place of residence, smoking and hypercholesterolemia with high BP.

Conclusion: Prevalence of hypertension in adults was high. By identifying common modifiable risk factors, health policy makers should prioritize health interventions to control risk factors. It is necessary to inform younger adult groups about ways to select healthy lifestyle and nutritional habits.

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Background

Hypertension (HTN) is one of the most common chronic diseases and a leading risk factor of disability and premature deaths in the world.^[1] Its prevalence is estimated at around 1 billion adults, accounting for about 9% of healthy years of life lost, and more than 9 million deaths annually worldwide.^[1,2] HTN in patients is associated with significant complications such as stroke, coronary artery disease, progression of chronic kidney disease (CKD), heart failure, and mortality.^[3,4] It is estimated that the annual global economic burden related to HTN can be as high as US\$ 370 billion.^[5] In developing countries; the mean prevalence of HTN was 32.2%, awareness was 40.6%, treatment was 29.9% and control was 9.8% among men. Among women, the mean prevalence was 30.5%, awareness was 52.7%, treatment was 40.5% and control was 16.2%. In developed countries, the percentage in men prevalence was 40.8, awareness was 49.2, treatment was 29.1, control was 10.8%, and in women prevalence was 33.0, awareness was 61.7, treatment was 40.6 and control was 17.3%.^[5]

A Systematic review in Iran was conducted on forty-two Iranian studies during 1980 to 2012 which reported the overall prevalence of hypertension 22% (95%CI: 20.2 - 23.8). The prevalence of hypertension in men and women was 23.6% (95%CI: 21.1 - 26.1) and 23.5% (95%CI: 20.2 - 23.8), respectively. The prevalence of hypertension was 22.1% (95%CI: 19.4 - 24.7), in urban areas The prevalence of hypertension in adults aged 20-74 yr, in Yazd city in 2010, was 25.6%, in men was 27.5% and among women was 23.3%.^[6] The incidence rate of hypertension was 39.5 in each 1000 person-year follow up.^[7]

The impact of hypertension and CVD is influenced by a wide variety of risk factors such as smoking, excessive alcohol consumption, unhealthy diet, physical inactivity, overweight and obesity, increased

blood sugar and abnormal blood lipids. The combination of a reduction of risk factors in the general population, early prevention in high-risk groups and intensive treatment in secondary

prevention was claimed to be the best strategy to reduce CVD premature mortality. Several studies in various countries have consistently shown that treating risk factors such as high blood pressure has a greater impact on CVD than just CVD treatment. [6, 7]

Given the high prevalence of hypertension and its economic burden, there is a need for updated studies on prevalence of HTN. These studies will provide the status of the disease for strategic planning for prevention and control.

The study aims to investigate the prevalence of hypertension and its predictive factors in adults 20-69 yr old who live in Yazd Greater area which is located in central Iran.

Methods

Setting and study design

Yazd Health Study (YaHS) is a population-based study conducted to determine the prevalence of non-communicable disease and related risk factors in Yazd Greater Area Based on the study protocol, the team repeatedly reviews and measures every five years to determine longitudinal information on risk factors and health changes. Yazd is a city located in the center of Iran. Sampling procedure of the YaHS study has been published elsewhere.^[8] Briefly, 10,000 residents of Yazd greater area at the age of 20 to 69 years were selected using cluster random sampling method. At first, 200 clusters were randomly selected based on the zip code. Then, each cluster of 50 samples was divided into two equal subgroups of women and men. Each group consists of 10 individuals (5 men,5 women) in the age group of 20-29, 30-39, 40-49, 50-59 and 60-69 years old. Inclusion criteria were ages 20-69 years at the time of the interview and completed informed consent to participate in the study. Those who were guests and residing elsewhere were excluded from the study .

Data collection

The interviewed instructors contacted the target group and a valid questionnaire was completed at a home visit. By follow-up by the interviewers: the final overall response rate was 98%. Demographic characteristics, past medical history of major cardiovascular diseases and risk factors were recorded.

At the physical examination, three blood pressure (BP) was measured by trained and certified person in the seated position using standard auscultatory method with appropriate cuff sizes for participant's arm. [9] After two thirds of the interview questions were completed, so the interviewees had been in a rested state for at least 40 minutes at this time. Pulse and blood pressure measurements were repeated three times with five minutes intervals between each measurement using Reichert electronic sphygmomanometers (Model N-Champion, Reister GMBH, Germany) which were calibrated regularly. The

mean of the second and third measurements were recorded as blood pressure, which was used for analysis.

BP was classified into normal (systolic BP < 120 mm Hg and diastolic BP < 80 mm Hg), pre-hypertension (systolic BP 120–139 mm Hg or diastolic BP 80–89 mm Hg), hypertension stage-1 (systolic BP 140–159 mm Hg or diastolic BP 90–99 mmHg), and hypertension stage-2 (systolic BP \geq 160 mm Hg or diastolic BP \geq 100 mm Hg) by Joint National Committee (JNC) 7 classification for adults.^[10] self-reported previous diagnosis of hypertension by physician was categorized in the hypertensive group.

Body Mass Index (BMI) calculated as weight/height² in kg/m², was categorized to underweight < 18.5, normal = 18.5-24.5, overweight = 25.0-29.9, and obese \geq 30.00 according to World Health Organization (WHO) cut-off points recommendation.^[11] Participants were categorized into three levels of Physical Activity (PA) as low, moderate or high by The International Physical Activity Questionnaire-short form (IPAQ-SF).^[12] It estimates PA level of a person in MET-minutes/week by self-reported of duration (in minutes) and number of days for types of activity in the past seven days. In Iran central Obesity defined Waist Circumference (WC) \geq 90 cm as at risk for CVD for both sexes by Iranian National Committee.^[13]

Statistical analysis

Yazd population in 2011 was obtained from the Statistical Center of Iran^[14] for direct age-standardization of the findings to represent the general adult population aged 20–69 years in Yazd. Mean BP level values \pm standard deviations (SD) were calculated for the overall population by sex, age groups. Prevalence of hypertension was described as proportions. Chi-square test was used for categorical variables to analyze the differences. Multivariate logistic regression was carried out to determine the association risk factors for hypertension. For binary logistic regression, two groups defined; hypertensive (mild to severe) and normal (normal, pre-hypertension). Both crude and adjusted odds ratio were presented by the odds ratios and 95% confidence intervals (CI). All statistical analyses were performed using SPSS version 16 software. A p-value less than 0.05 were considered statistically significant.

Results

With 95% responding, 9975 participants participated in the study. Of these, 4949 (49.6%) were male. Almost a quarter of people has elementary education or was illiterate. Most of the participants were married (84.9%) and lived in urban areas (95.8%). One fifth of people said they were unemployed and 94.5% were covered by health insurance. Half of adults in this study have a low physical activity, and about two thirds of people were overweight or obese. Positive history of hypertension existed in 18.5% of participants (21.9% among women vs. 15.2% in men). Table 1 shows the demographic characteristics of the study population.

Please insert Table 1

The mean values of systolic and diastolic BP according to age and gender were presented in Table 2. The mean systolic and diastolic BP of all the study subjects were 126.5 ± 18.4 mmHg and 80.2 ± 12.5 mmHg, respectively. In both sexes, the mean systolic and diastolic BP increases with age, the highest means are in eldest age group (60-69 years). There was a significant difference between mean systolic and diastolic BP among different age groups (P value < 0.0001) and among both sexes (P value < 0.0001).

Please insert Table 2

Please insert Figure 1

Prevalence of hypertension was 36% [95% CI: (35.1–36.9)] in total subjects (n=9975). The sex specific prevalence was 34.7% [95% CI: 33.4–36.0] for women and 37.3% [95% CI: 35.9–38.7] for males. Hypertension was significantly associated with age in both sexes (P value < 0.0001). Figure 1 shows prevalence of hypertension by age groups and sex. The prevalence of hypertension is reduced in people with higher education, having more physical activity, lower BMI and no history of diabetes (P value < 0.0001). Higher blood pressure is less common in smokers compared to non-smokers (P value < 0.0001). [Table 3](#) shows prevalence of hypertension and its relation with the above factors. Of the 7983 people who stated that they had no hypertension, 21.8% had high blood pressure and 37.8% were classified as pre-hypertensive.

Please insert Table 3

The logistic regression analysis showed that hypertension were higher among the men (OR: 1.83, 95%CI=1.64-2.03), eldest age group (OR: 5.15), low-educated subjects (OR: 1.40). So, being female, younger and educated were protective factors of hypertension. In adults with low physical activity, high blood pressure is higher in comparison with those physically activity but it is not significant in model (p> 0.05). The odds of hypertension in those who are obese are two times more. Positive history of diabetes mellitus (OR: 1.20, 95%CI=1.05-1.37) had higher odds of being hypertensive. In this model, there was no significant relationship between place of residence, smoking and hypercholesterolemia with the chance of having HTN ([Table 4](#)).

Please insert Table 4

Discussion

The prevalence of HTN in adults was 36% (age-adjusted 25.8%), with an increasing trend over the past decade, which indicates that this cardiovascular risk factor in Yazd Greater Area is higher than in other regions of Iran. In our study, male gender, older age group, less education, being overweight or obese, having diabetes were found to have a positive association with high blood pressure. The difference between self-reported hypertension and physical examination findings suggests that a considerable number of adults are unaware of their illness.

In this study, the prevalence of high blood pressure increased with age significantly in both sexes, (age-adjusted prevalence rate in 40-69 years old was 44.7%), and an increase in age-related hypertension is seen in almost every population which is consistent with the findings of similar studies in Iran and other countries.^[15-17] This can be mainly due to age-related changes in the vascular walls due to physiological mechanisms.^[18] The mean systolic and diastolic BP were 126.5 and 80.2 mmHg, respectively, that were significantly higher in men. These results showed a higher prevalence in Yazd than the average results of the study in 30 provinces of Iran (116.24 and 74.58 mmHg).^[17] This difference was observed until the sixth decade of life. Thereafter, there is no difference between the mean systolic and diastolic blood pressure across the genders. Differences in socioeconomic factors such as lifestyle, food habits, culture and educational level in the regions of the country can lead to a difference in the prevalence of hypertension, as well as differences in sampling and method of blood pressure measurement in the study.

The prevalence of hypertension was higher in men which is consistent with other studies in Iran and other studies in high-, middle-, and low income countries.^[15,19,20] Several studies have concluded that changes in level of serum estrogen play an important role in the pathophysiology of high blood pressure in women and it has a protective effect on arterial rigidity during reproductive age, which dramatically changes afterward.^[21]

The level of literacy is related to hypertension. With an increase in education, the prevalence of high blood pressure significantly decreased, which is similar to the results of other studies in Iran and other countries.^[22,23] However, some studies have not seen this relationship.^[24] In the present study, the adjusted effect of education on high blood pressure with logistic regression shows statistical association of hypertension with the least literacy. We suggest that in educated people, having better knowledge about risk factors of high blood pressure can help them choose a healthier lifestyle.

The prevalence of hypertension in rural areas was higher than urban areas (39.4% and 35.8% respectively), but this difference was not statistically significant. Based on national estimates in Iran, according to a systematic review (1980-2012), HTN was more prevalent in urban areas than the rural areas (22.1% vs. 18.6%).^[25] It suggests that the gap between rural and urban areas will be gradually declined. Changes in some lifestyle risk factors such as low physical activity, over-consumption of processed foods, and reduced fruits and vegetables consumption in the rural diet can explain narrowing the gap in prevalence.^[26]

Obesity is one of the most important determinants of hypertension.^[15,27] In our study, with an increase in BMI, the prevalence of hypertension increases (twice in obese people) in line with others also supports association of overweight and central obesity with elevated blood pressure.^[22, 25, 28, 29] Obesity is associated with hyper-insulinemia; it is responsible for activating the renin-angiotensin system and reducing salt excretion from the kidneys in HTN.^[30] Although the relationship between positive history of hypercholesterolaemia and hypertension has been shown in other studies,^[31] but in the present study,

hypercholesterolaemia is not a predictor risk factor for high blood pressure, It should be noted that in the model ($p > 0.05$). To determine the risk factor, the duration of the infection, the treatment and the measurement of cholesterol should be considered in the analysis of future studies.

Our findings revealed that prevalence of HTN was higher in nonsmokers versus current smokers, but in the regression model, this difference is not significant, that is similar to the results of Pankova's study.^[32] The results of studies about the relationship between smoking and blood pressure are not the same, some suggest a positive,^[33] and others reported an inverse relationship.^[34] The difference in frequency and dose of use in women and men can also cause these conflicting evidences. Present study is a cross-sectional study; therefore, cohort studies recommended, it can help to understand the effect of smoking on hypertension due to controversies.

The benefits of physical activity in prevention and treatment of hypertension have been well documented, mainly due to a decrease in peripheral vascular resistance.^[35] In this study, frequency of hypertension is higher in adults with low physical activity, and this prevalence decreases with moderate/severe physical activity. After adjustment; there is no significant difference between hypertension and physical activity, this finding is reported by some studies.^[28,36] But there are studies that have reported a different finding, and have revealed a higher prevalence of hypertension in adults with low physical activity.^[23,37] Use of different physical activity questionnaire in studies can make this difference in results. Although age, gender, or ethnicity does not seem to change in the response to blood pressure, most studies are limited to middle-aged persons.^[36] The mechanism of the effect of physical activity on changes in blood pressure and the role of other factors in making these changes requires further investigation, especially in elderly adults.

In our study, the prevalence of hypertension was significantly higher in people with diabetes than in those without diabetes. Most of the study has reported the same findings above 60% around the world.^[27] In Iran, diabetes is also known as a predictor of hypertension.^[15,17] these are suggesting, that high blood pressure is a comorbidity due to both long-term macro and micro vascular complications of diabetes.^[27]

Limitations and strengths

The cross-sectional and restriction of the cross sectional data collection limits the causal relationship between high blood pressure and the variables studied is main limitations of our study. Another limitation of this study is the lack of attention to the role of stress and the impact of eating habits on hypertension. The strengths of this study were three times standard blood pressure measurement, home-based examination with reduced white coat hypertension and having a large sample size.

Conclusion

The prevalence of high blood pressure in the adult population of Yazd is high, compare to the other study in Iran. It is therefore necessary to inform younger adult groups about ways to select healthy lifestyle till

to control of modifiable risk factors. They are exposed to risk factors such as high-calorie diet, high in salt and fat, low activity and prone to obesity in urban life. Health policy makers should prioritize health interventions for prevention and control of most common risk factors. Community educational intervention is essential according to cultural and nutritional habits.

Abbreviations

YaHS: Yazd Health Study

BP: Blood Pressure, BMI: Body Mass Index, CKD: Chronic Kidney Disease,

CVD: Cardiovascular Disease, HTN: Hypertension WC: Waist Circumference

IPAQ-SF: International Physical Activity Questionnaire-Short Form,

JNC: joint National Committee, CI: Confidence Interval

Declarations

Ethics approval and consent to participate

The research proposal was approved by the ethics committee of Shahid Sadoughi University of medical science, Yazd, Iran (IR.SSU.MEDICINE.REC.1396.311). The study was explained to all respondents willing to participate. All participants had the right to withdraw from the study at any time. Informed consent was obtained from each participant before data collection. Participants with new diagnostics of hypertension were advised to refer their health center or physician for the follow-up.

Consent for publication

Not applicable.

Availability of data and material

The data collected by Yazd Health Study are not open access, but can be shared under conditions of collaboration and endowment. Data are available from the authors upon reasonable request and with permission of principal investigator. For further information, please visit YaHS website at www.yahs.ir / yahs.ssu.ac.ir

Competing interests

The authors have no conflicts of interest.

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Authors' contributions

Conception of research idea was conducted by Mohsen Mirzaei (MM1) and Masoud Mirzaei (MM2) designed the study. Conducted the study under the supervision of MM2, SG, HA and MM1 analyzed the data and wrote the draught of the manuscript. MM2 reviewed and critically revised the manuscript. All authors read and approved the final manuscript. MM1 finalized the manuscript.

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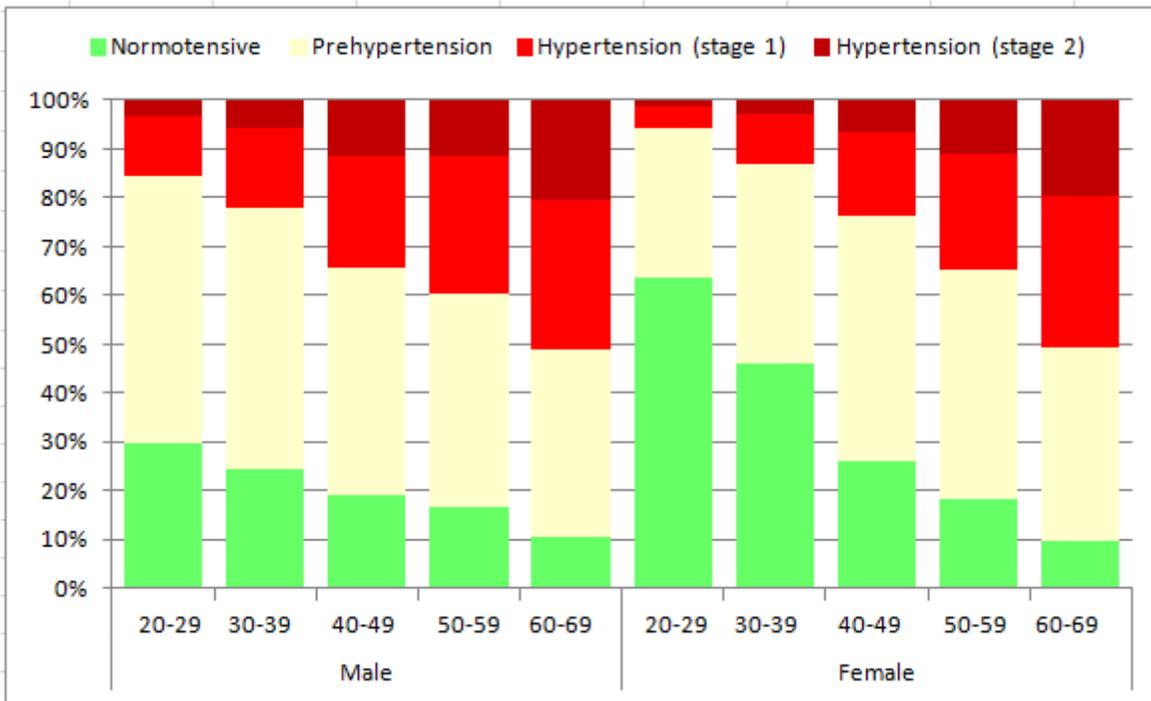


Figure 1

Prevalence of hypertension by gender and age groups among the study subjects (*N* 9975)

Supplementary Files

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