Current Hypertension Reports (2019) 21: 27
https://doi.org/10.1007/s11906-019-0933-z

GUIDELINES / CLINICAL TRIALS/META-ANALYSIS (WILLIAM J. KOSTIS, SECTION EDITOR)

# Hypertension and Pre-Hypertension Among Iranian Adults Population: a Meta-Analysis of Prevalence, Awareness, Treatment, and Control

Roghaiyeh Afsargharehbagh[1] · Khadije Rezaie-Keikhaie[2] · Hosien Rafiemanesh[3] · Abbas Balouchi[4] · Salehoddin Bouya[5,6] · Behroz Dehghan[6]

Published online: 4 April 2019


## Abstract

**Purpose of Review** This meta-analysis and systematic review was conducted to evaluate hypertension and prehypertension prevalence, awareness, treatment, and control in Iranian adults population.

**Recent Findings** In this study, six international and national databases were searched from inception until August 30, 2018. Forty-eight studies performed on 417,392 participants were included in the meta-analysis. Based on the results of random effect method (95% CI), the overall prevalence of pre-hypertension, hypertension, awareness, treatment, and control were 31.6% (95% CI 24.9, 38.3; I2 = 99.7%), 20.4% (95% CI 16.5, 24.4; I2 = 99.9%), 49.3% (95% CI 44.8, 53.8; I2 = 98.5%), 44.8% (95% CI 28.3, 61.2; I2 = 99.9%), 37.4% (95% CI 29.0, 45.8; I2 = 99.3%), respectively.

**Summary** Considering the increasing prevalence of pre-hypertension, hypertension, as well as more than half of the participants were unaware of their disease and were not treated, the results of the present study can help policy-makers to increase hypertension awareness, control, and treatment, especially in high-risk individuals.

**Keywords** Adults · Prehypertension · Prevalence · Iran · Hypertension · Awareness

## Introduction

Hypertension (HTN) is the most common cardiovascular and respiratory disorder leading to global mortality worldwide [1, 2]. The global hypertension prevalence is 32.3%, and it affects more than 20% of the world's population (more than 1.39 billion people) [3••]. It is predicted that the hypertension prevalence is going to rise by 30% by 2025 [4]. Studies have also shown that the prevalence of hypertension is higher in developing and underdeveloped countries, suggesting that more than three-quarters of hypertensive people will be living in these countries over the next decade [5••]. Studies show that the hypertension prevalence is 32.4% in the Eastern Mediterranean [6••]. Age is one of the most important risk factors for hypertension [7••, 8••]. Individualized studies in Iran show different hypertension rates. For example, Sarrafzadegan et al. [9] and Ebrahimi et al. [10] reported a prevalence rate of 18% and 23%, respectively. Despite the

This article is part of the Topical Collection on *Guidelines / Clinical Trials/Meta-Analysis*

✉ Salehoddin Bouya
hresearchh@gmail.com

[1] Department of Cardiology, Shohada Hospital, Urmia University of Medical Science, Urmia, Iran

[2] Zabol Medicinal Plants Research Center, Zabol University of Medical Sciences, Zabol, Iran

[3] Student Research Committee, Department of Epidemiology, School of Public Health and Safety, Shahid Beheshti University of Medical Sciences, Tehran, Iran

[4] Student Research Committee, Nursing and Midwifery School, Iran University of Medical Sciences, Tehran, Iran

[5] Internal Medicine and Nephrology, Clinical Immunology Research Center, Ali-Ebne Abitaleb Hospital, Zahedan University of Medical Sciences, Zahedan, Iran

[6] Zahedan University of Medical Sciences, Hesabi St, Zahedan, Iran

high importance of early prevention and screening of hypertension, many patients have still no or little awareness of their disease [11••]. Hypertension awareness rates are 16.9% and 46% in Africa and developing countries, respectively [12••, 13]. Individualized studies in Iran have reported hypertension awareness rates between 11 and 46% [14, 15•].

Despite individualized studies on adults in Iran, there has been no comprehensive study on the hypertension prevalence, awareness, treatment, and control in Iran. In addition, the previous systematic reviews have solely evaluated the hypertension prevalence through searching few databases, over a short period of time generally; however, the present study reviewed more studies over a longer period (1996–2018) using more databases, and more studies are included as well. Another advantage of the present study is the pre-hypertension (pre-HTN) and hypertension prevalence, awareness, treatment, and control in an Iranian adult's population. According the importance of the prevalence, awareness, treatment, and control of hypertension, as the most important risk factor for cardiovascular diseases in the world and developing countries, including Iran, as well as the precise determination and timely screening of hypertension, prevents cardiovascular events such as myocardial infarction and stroke and thus helping to significantly reduce the cost of the health system; on the other hand, the aim of the present meta-analysis and systematic review was to determine the prevalence, awareness, treatment, and control of hypertension and pre-hypertension in Iranian adults population.

## Methods

### Registration and Eligibility Criteria

The protocol has been published (PROSPERO: CRD42018108348), and methods adopted for this systematic review have been developed in accordance with the Cochrane Handbook for Systematic Reviews and reported using Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) tool [16]. Inclusion studies included descriptive, population-based, and cohort studies that were conducted on an adult's population older than 15 years old. Clinical trial, review, letter to editor studies, low-quality studies, studies that did not allow access to the full text version, and studies written in languages other than Persian and English were excluded from the study. The target population of the current study was the adults over 15 years of age. Studies that were conducted on children, adolescents, and elderly people were also excluded.

### Definition of Pre-HTN, HTN, Awareness, Treatment, and Control

World health organization (WHO) and Joint National Committee (JNC) defined hypertension as systolic pressure above 140 mmg and diastolic pressure above 90 mmg, blood pressure medications, or being diagnosed by a doctor as a hypertensive patient. According to JNC criteria, hypertension is defined as blood pressure lower than 120/80 (normal), 120–139/80–89 (pre-hypertension), 140–159/90–99 (stage 1 hypertension), and above 160/100 (stage 2 hypertension) [17]. According to the WHO old and new criteria, hypertension is defined as blood pressure (BP) greater than 130/85 and 160/90 [18]. In the present study, all studies in which participants had a BP higher than 140/90 were identified as hypertensive people according to the JNC criteria. To determine hypertension awareness, treatment, and control, the global criteria mentioned in Gee et al.'s study was used [19•]. "Prevalence of awareness of hypertension is defined as the proportion of adults with hypertension who report either having been diagnosed with hypertension by a health professional or who report taking medication for high BP." "Prevalence of treatment of hypertension is defined as the proportion of adults with hypertension who report taking medication for high BP". "Prevalence of controlled hypertension is defined as the proportion of adults with hypertension who both: (1) report taking medication for high BP and (2) have SBP < 140 mm Hg and DBP< 90 mm Hg".

### Search Strategy

The International (PubMed, Google scholar, WOS, and Scopus) and National (Scientific Information Database (SID) and Magiran) databases were searched for relevant studies without settings limits in English and Persian languages from inception to 30 August 2018. The MEDLINE search strategy was adopted to search in other databases. The specific search strategies were created by a Health Sciences Librarian with expertise in systematic review according to the PRESS standard [20]. In addition, PROSPERO was used to search for ongoing or recently completed systematic reviews. Boolean operators (AND, OR, and NOT), Medical Subject Headings (MeSH), truncation "*", and related text words were used for search in title and abstract using the following keywords: "prevalence," "awareness," "control" and "treatment" and "hypertension treatment" and "Hypertension" and "high blood pressure" and "adults" and "Iran."

### Selection of Studies and Data Extraction

Following the study protocol, two researchers (SB, KRK) independently screened the titles and abstracts based on the eligibility criteria; in the next step, after removing duplicated studies, studies in full texts were screened based on

the eligibility criteria, and the required information was extracted. Consensus method was used for solving controversies among two researchers. Extracted data items included: first author, year of publication, province, sampling method, age, design, diagnostic criteria for hypertension, community location (urban/rural), gender, risk of bias, prevalence, awareness, treatment, and control of hypertension and pre-hypertension.

### Quality Assessment

To assess the methodological quality and risk of bias, each included observational study was evaluated by using the Hoy et al. tool. This 10-item tool evaluated the quality of studies in two dimensions including external validity (items 1–4 assess target population, sampling frame, sampling method, and nonresponse bias minimal) and internal validity (items 5–9 assess data collection method, case definition, study instrument, mode of data collection, and item 10 assesses bias related to the analysis). Risk of bias was evaluated by two researchers independently; disagreements were resolved via consensus method.

### Data Synthesis

All the eligible studies were included in the synthesis after a systematic review. Data were combined with the forest plot. The random-effects model was evaluated by the overall hypertension. The heterogeneity of the preliminary studies was evaluated with I2 tests. Sub-group analysis was conducted to determine heterogeneity based on the study gender and age, community location (rural/urban). Meta-analysis was performed using STATA 14 (StataCorp, Texas, USA) statistical software.

## Results

### Overall Results

#### Study Selection

A total of 3004 articles from initial searches were retrieved in various databases. Out of 1933 non-duplicated studies in the title and summary screening process, 1861 studies were excluded due to inappropriate titles. Out of 72 studies, 48 had eligibility criteria. Out of 24 excluded studies, five studies were review, two studies were letter to the editor, two studies were case report, one study had no full text, three studies were published from same data, and 11 studies did not meet the minimum quality requirements for inclusion in the study (Fig. 1).

### Study Characteristics

Forty-eight studies were conducted on 417,392 participants. The age range of the participants was between 15 and 69 years.

Geographically, most studies were conducted in Tehran Province ($n = 9$) (19–27) and at the national level ($n = 5$). The most common sampling method was multistage cluster random sampling ($N = 25$). The type of studies included cross-sectional ($N = 28$), population-based ($n = 15$), and cohort ($N = 5$), respectively. Hypertension was diagnosed according to JNC criteria in more than 90% of the studies included. Most of studies were conducted on urban populations ($n = 37$). The sample size of the studies was between 195 [21•] and 75,162 participants [22]. In addition, the bias risk was low in more than 92% of studies ($n = 43$). In all studies, the participants' BP was measured, according to the WHO guideline, using a blood pressure monitor at least two times after resting for 5–30 min intervals in the sitting mode. In most the included studies, individuals with BP above 140/90 were considered as hypertensive individuals, except for one study that referred to BP above 130/90 as an indication for hypertension [23]. (Table 1).

### Main Results

#### Prevalence of Pre-Hypertension and Hypertension

Pre-HTN in 14 studies was between 8.2 and 53.3%, and the overall prevalence of Pre-HTN (random effect model) in 50,987 Iranian people was 31.6% (95% CI 24.9, 38.3; $I^2 = 99.7\%$). (Fig. 2).

Based on the results of random effect method, the overall prevalence of HTN in 417,392 Iranian adults population was 20.4% (95% CI 16.5, 24.4; $I^2 = 99.9\%$). Pooled prevalence of HTN did not have a difference in community location (urban and rural) population, so prevalence for 262,114 urban and 48,834 rural population was 19.5% and 19.0%, respectively. (Fig. 3).

Sub-group analysis was done for diagnosis of heterogeneity based on sex and community location (urban or/and rural). In 39 studies, HTP prevalence was reported by sex and community location. The prevalence of HTN was a little more prevalent in females and this difference was more than in rural population, so that overall random pooled prevalence in 158,034 persons (male) and 176,511 persons (female) was 19.9% (95% CI 15.8, 24.0; $I^2 = 99.8$) and 22.1% (95% CI 17.3, 26.9; $I^2 = 99.9$), respectively (Table 2).

Pooled prevalence of HTN was 1.42 times more in > 40 mean age group than =< 40 mean age group, so that pool estimated (in random model) prevalence was 22.9% (95% CI 13.6, 32.1,) and 16.1% (95% CI 10.0, 22.2), respectively.

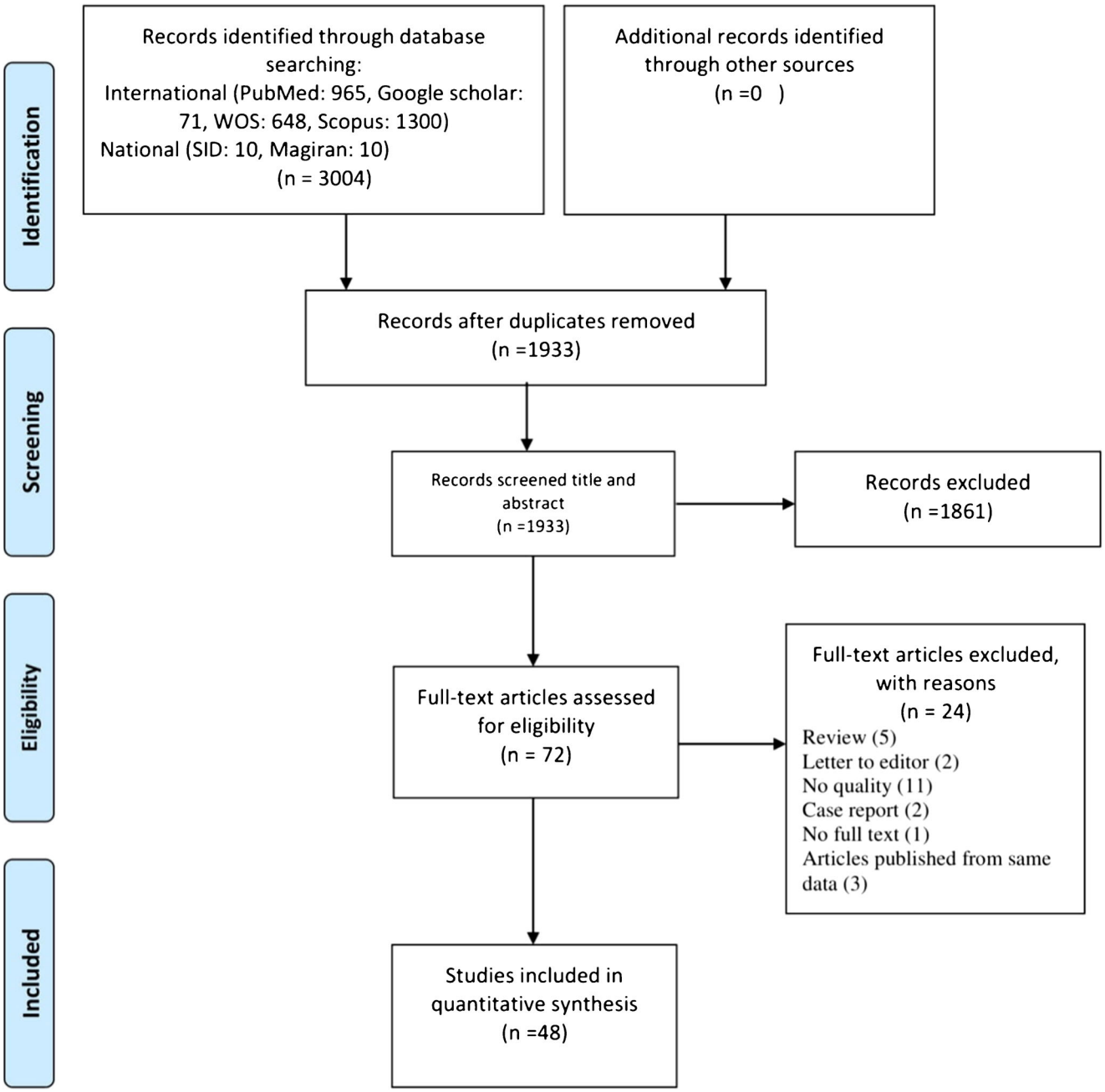


**Fig. 1** Flow diagram of study selection process

### Awareness, Treatment, and Control of Hypertension

Hypertension awareness among hypertensive patients in 17 studies was 11.4 to 69.2%, and the overall prevalence (random effect model) in 42,099 Iranian people with HTN was 49.3% (95% CI 44.8, 53.8; $I^2 = 98.5\%$). HTN treatment in 19 studies was 8.6 to 88.0%, and the overall prevalence (random effect model) in 44,611 Iranian people with HTN was 44.8% (95% CI 28.3, 61.2; $I^2 = 99.9\%$). HTN control in 17 studies was between 10.1 and 69.1%, and the overall prevalence (random effect model) in 17,236 HTN people under treatment was 37.4% (95% CI 29.0, 45.8; $I^2 = 99.3\%$) (Fig. 4).

### Meta-Regression Results

In multivariate meta-regression with mean age of participants, publication year, community location, and female-to-male ratio showed age and community location contributed to heterogeneity, adj $R$-squared = 52.79% and $P$ value = 0.001 (Table 3).

**Table 1** Demographic characteristics of included studies

| ID | First author | Year | Province | Sampling methods | Age target | Design | Diagnostic criteria for hypertension | Community location | Participants | Risk of bias |
|---|---|---|---|---|---|---|---|---|---|---|
| 1 | Aghaei Meybodi, HR [24] | 2014 | National | Cluster random | ≥ 19 | Population-based | JNC | Urban | 3636 | Low |
| 2 | Agheli, N [25] | 2006 | Tehran | Simple random | ≥ 30 | Population-based | JNC | Urban | 9752 | Low |
| 3 | Amani, S [26] | 2017 | Kurdistan | Multistage cluster random | ≥ 20 | Population-based | JNC | Rural | 13,710 | Low |
| 4 | Amiri, ZM | 2015 | Guilan | Multistage cluster random | ≥ 18 | Population-based | JNC | Urban | 1953 | Low |
| 5 | Arefi, SH [27] | 1996 | Tehran | Multistage cluster random | ≥ 15 | Population-based | JNC | Urban | 9692 | Low |
| 6 | Assadi, SN [28] | 2013 | Khorasan Razavi and Tehran | Simple random | ≥ 18 | Cross-sectional | JNC | Urban | 875 | Low |
| 7 | Azizi, A [29] | 2008 | Kermanshah | Multistage cluster random | ≥ 15 | Population-based | JNC | Urban | 4718 | Low |
| 8 | Azizi, F [30] | 2003 | Tehran | Multistage cluster random | 20–69 | Population-based | JNC | Urban | 8491 | Low |
| 9 | Baygi, F [31] | 2016 | National | Census | ≥ 20 | Cross-sectional | JNC | Urban | 234 | Low |
| 10 | Chaman, R [32] | 2008 | Golestan | Cluster random | ≥ 30 | Cross-sectional | JNC | Rural | 1500 | Low |
| 11 | Cheraghian, B [33] | 2014 | Tehran | Multistage cluster random | 25–64 | Cross-sectional | JNC | Urban | 69,173 | Low |
| 12 | Dabghmanesh, M [34] | 2007 | Fars | Multistage cluster random | 19–99 | Cross-sectional | JNC | Urban | 3245 | Low |
| 13 | Delavari, A [22] | 2007 | National | Cluster random | ≥ 20 | Population-based | JNC | Both | 75,132 | Low |
| 14 | Ebrahimi, M [10] | 2016 | Razavi Khorasan | Multistage cluster random | 30–65 | Cross-sectional | JNC | Urban | 9762 | Low |
| 15 | Eghbali, M [35] | 2018 | Isfahan | Multistage cluster random | ≥ 18 | Population-based | JNC | Urban | 2107 | Low |
| 16 | Fakhrzadeh, H [36] | 2008 | Qazvin | Multistage cluster random | ≥ 25 | Population-based | JNC | Urban | 846 | Low |
| 17 | Fakhrzadeh, H [37] | 2004 | Tehran | Cluster random | 25–64 | Population-based | WHO | Urban | 1573 | Low |
| 18 | Gandomkar, A [38] | 2018 | Fars | Simple random | 40–75 | Cohort | JNC | Urban | 9264 | Low |
| 19 | Ghanbarian, A [39] | 2004 | Tehran | Multistage cluster random | ≥ 30 | Population-based | JNC | Urban | 5539 | Low |
| 20 | Ghorbani, R [40] | 2009 | Semnan | Multistage cluster random | 30–69 | Cross-sectional | JNC | Both | 3799 | Low |
| 21 | Ghorbani, Z [41] | 2018 | East Azarbayjan | Cluster random | ≥ 35 | Cohort | JNC | Urban | 1038 | Low |
| 22 | Goodarzi, M [42] | 2002 | Sistan v baluchistan | Stratified cluster random | ≥ 18 | Cross-sectional | JNC | Urban | 1530 | Moderate |
| 23 | Hatmi, Z [43] | 2007 | Tehran | Multistage cluster random | > = 18 | Population-based | JNC | Urban | 3000 | Low |
| 24 | Heydari, ST [44] | 2010 | Fars | Cluster random | 20–54 | Cross-sectional | JNC | Urban | 341 | Moderate |
| 25 | Isfeedvajani, MS [21•] | 2014 | Tehran | Convenience | 19–64 | Cross-sectional | JNC | Urban | 195 | Moderate |
| 26 | Jahromi, MK [45] | 2017 | Fars | Census | ≥ 18 | Cross-sectional | JNC | Urban | 263 | Moderate |
| 27 | Kazemi, T [46] | 2017 | South Khorasan | Multistage cluster random | 15–70 | Cross-sectional | JNC | Urban | 1286 | Low |
| 28 | Kelishadi, R [47] | 2008 | Isfahan | Multistage cluster random | ≥ 19 | Cross-sectional | NCEP | Urban | 3694 | Low |
| 29 | Khajedaluee, M [48] | 2016 | Razavi Khorasan | Multistage cluster random | ≥ 16 | Population-based | JNC | Urban | 2974 | Low |
| 30 | Khani, M [49] | 2002 | Zanjan | Multistage cluster random | ≥ 15 | Cross-sectional | JNC | Rural | 1500 | Low |
| 31 | Khoshandam Sarvynehbaghi, F [50] | 2013 | Mazandaran | Multistage cluster random | 20–66 | Cross-sectional | JNC | Urban | 400 | Moderate |
| 32 | Khosravi, A [51] | 2014 | Semnan | Stratified cluster random | 40–64 | Cross-sectional | JNC | Urban | 5190 | Low |
| 33 | Malekzadeh, MM [11••] | 2013 | Golestan | Cluster Random | 40–75 | Cohort | JNC | Both | 50,045 | Low |
| 34 | Mojahedi, MJ [14] | 2015 | Razavi Khorasan | Multistage cluster random | 20–29 | Cross-sectional | JNC | Urban | 3608 | Low |
| 35 | Najafipour, H [52] | 2012 | Kerman | One-stage cluster sampling | 15–75 | Cohort | JNC | Urban | 5900 | Low |

**Table 1** (continued)

| ID | First author | Year | Province | Sampling methods | Age target | Design | Diagnostic criteria for hypertension | Community location | Participants | Risk of bias |
|---|---|---|---|---|---|---|---|---|---|---|
| 36 | Namayandeh, S [53] | 2011 | Yazd | Multistage cluster random | 20–74 | Cross-sectional | JNC | Urban | 2000 | Low |
| 37 | Pakzad, B [54] | 2018 | Isfahan | Simple random | ≥ 20 | Cross-sectional | JNC | Urban | 1317 | Low |
| 38 | Peymani, P [55] | 2012 | Fars | Cluster random | 15–64 | Cross-sectional | JNC | Urban | 3909 | Low |
| 39 | Ramezani, MA [56] | 2009 | Isfahan | Multistage cluster random | 15–65 | Cross-sectional | JNC | Both | 3760 | Low |
| 40 | Ramezankhani, A [57] | 2016 | Tehran | Simple random | ≥ 20 | Cohort | JNC | Urban | 6205 | Low |
| 41 | Sadeghi, M [58] | 2004 | National | Random cluster | ≥ 19 | Cross-sectional | JNC | Urban | 12,494 | Low |
| 42 | Sahebi, L [59] | 2010 | Fars | Multistage cluster random | ≥ 19 | Cross-sectional | JNC | Urban | 1027 | Low |
| 43 | Sahraki, MR [60] | 2011 | Sistan and Baluchestan | Simple random | ≥ 30 | Cross-sectional | JNC | Urban | 2300 | Low |
| 44 | Sepanlou, S [23] | 2016 | Golestan | Simple random | 40–75 | Cross-sectional | JNC | Both | 46,626 | Low |
| 45 | Shirani, S [61] | 2011 | Isfahan | Multistage cluster random | ≥ 19 | Cross-sectional | JNC | Both | 12,014 | Low |
| 46 | Tabrizi, JS [62] | 2016 | East Azarbayjan | Multistage cluster random | 15–65 | Cross-sectional | JNC | Both | 2818 | Low |
| 47 | Yazdanpanah, L [15•] | 2015 | Khuzestan | Multistage cluster random | ≥20 | Cross-sectional | JNC | Urban | 944 | Low |
| 48 | Yusufali, AM [5••] | 2017 | National | Proportional | 35–70 | Population-based | JNC | Both | 6013 | Low |

There was a statistically significant linear trend in univariate meta-regression to explain effect size variation by age mean of participants with coef. = 0.86% (95% CI 0.49, 1.22), adj $R$-squared = 46.63% and $P < 0.001$ (Fig. 5) and by community location with coef. = 4.79% (95% CI 1.04, 8.54), adj $R$-squared = 9.97% and $P = 0.013$. (Fig. 6).

## Discussion

As far as the researchers know, the present study is the most comprehensive study on the prevalence of hypertension in Iranian adults. Hypertension is one of the most common preventable causes of mortality and major health challenges in the world. The aim of the present meta-analysis and systematic review was to determine the prevalence of hypertension in Iranian adult's population. A total of 48 studies conducted on 417,392 individuals from 1996 to 2018 were entered into the final phase. The hypertension prevalence in the Iranian adult's population was 20.4%. The above prevalence in the various studies was reported to be between 1 and 65.69%. Reviewing previous studies in Iran have shown a prevalence rate of 22–23% in different populations, which is similar to the present study [63•, 64•]. Unlike the prevalence of hypertension in Iran, Katherine T. Mills study showed that the global prevalence of hypertension in adults is 31.2% [65]. The prevalence of hypertension in Brazil (32–36%) [66], India (29.8%) [67], and Africa (19.7–30.8%) [12••] was also higher than that in Iran, which can be due to differences in the sample size of the studies, cultural differences, and the level of education in different populations. The present study showed no significant difference between urban and rural populations in terms of the prevalence of hypertension. However, the results of a study in India showed that the prevalence of hypertension in urban populations was significantly higher than rural populations, which could be due to differences in hypertension awareness rates, level of access to health services, and social and economic characteristics in the populations of above two studies [67]. It seems that there is a strong direct relationship between the prevalence of hypertension with the economic and social characteristics. As the previous study in Iran shows, the prevalence of hypertension in areas with good socioeconomic status is far less than those that their socioeconomic status is worse [68].

The prevalence of hypertension was higher in women than in men, which is consistent with a study conducted in Africa [12••]. The odds of hypertension was 1.5 times in people over 40 years of age, which can indicate the role of aging in increasing the risk of cardiovascular diseases caused by vascular wall changes [67, 69]. The overall prevalence of prehypertension was 31.6%, which was lower than the global prevalence (36%) [70] and individualized studies in India (40.8%) [71]; but it was consistent with a study in China

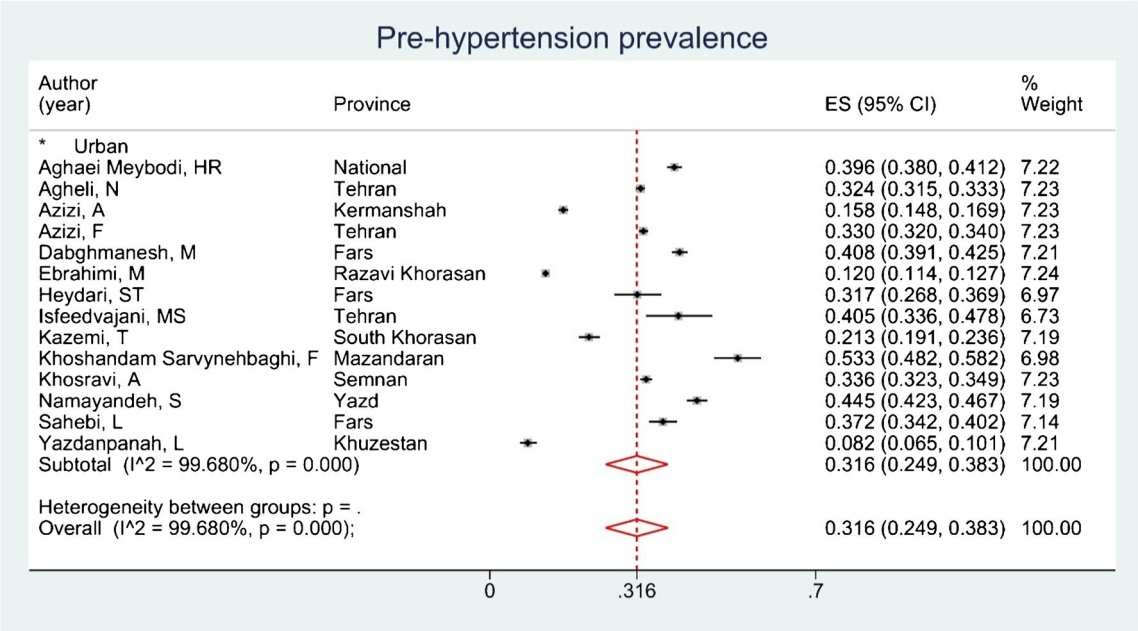


**Fig. 2** Prevalence of pre-hypertension among Iranian adults population

(32.3%) [72], Korea (31.6%) [73], and more than the same rate reported in Turkey (14.5%) [74]. Different pre-hypertension rates may be due to economic and social differences and hypertension prevention initiatives in Iran and other countries [68].

It is important to identify the pre-hypertensive population, as early detection and easy and cost-effective programs (low salt diet and exercise) reduce the number of hypertensive people. International guidelines state that regular blood pressure measurement is essential in people with pre-hypertension [17, 75]. The present study showed that only less than half (49.3%) of hypertensive people were aware of their disease, which is consistent with previous studies, showing that more than half and, in some cases, two thirds of the hypertensive population are aware of their disease in developed countries. However, only one quarter to half of the populations in developing countries are aware of their disease [11••].

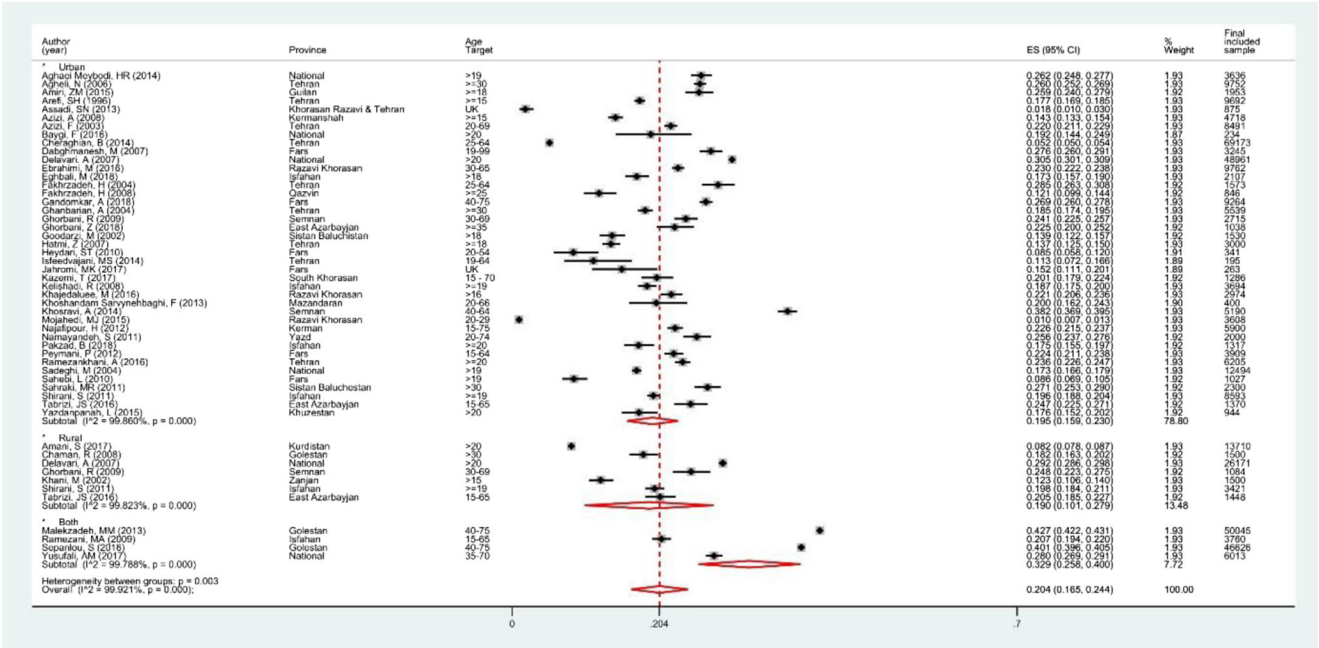


**Fig. 3** Prevalence of hypertension among Iranian adults population

**Table 2** Prevalence of hypertension based on gender and community location among Iranian adults

| | | Male | | | Female | | |
|---|---|---|---|---|---|---|---|
| ID | First author | ES | 95% CI for ES | % Wight | ES | 95% CI for ES | % Wight |
| • Urban population | | | | | | | |
| 1 | Aghaei Meybodi, HR (2014) [24] | 29.7 | 27.3, 32.2 | 2.44 | 24.1 | 22.3, 25.9 | 2.66 |
| 2 | Amiri, ZM (2015) | 22.3 | 19.6, 25.2 | 2.43 | 28.9 | 26.2, 31.7 | 2.64 |
| 3 | Arefi, SH (1996) [27] | 17.6 | 16.5, 18.7 | 2.46 | 17.9 | 16.8, 19.0 | 2.66 |
| 4 | Azizi, A (2008) [29] | 15.1 | 13.6, 16.8 | 2.45 | 13.7 | 12.4, 15.1 | 2.66 |
| 5 | Azizi, F (2003) [30] | 20.0 | 18.7, 21.4 | 2.45 | 23.3 | 22.1, 24.5 | 2.66 |
| 6 | Baygi, F (2016) [31] | 19.2 | 14.4, 24.9 | 2.37 | | | |
| 7 | Cheraghian, B (2014) [33] | 3.8 | 3.6, 4.0 | 2.46 | 6.6 | 6.3, 6.8 | 2.67 |
| 8 | Dabghmanesh, M (2007) [34] | 26.8 | 24.4, 29.3 | 2.44 | 28.1 | 26.1, 30.1 | 2.65 |
| 9^[1] | Delavari, A (2007) [22] | 29.9 | 29.3, 30.5 | 2.46 | 31.1 | 30.5, 31.7 | 2.67 |
| 10 | Ebrahimi, M (2016) [10] | 9.0 | 8.1, 9.9 | 2.46 | 14.0 | 13.1, 14.9 | 2.66 |
| 11 | Eghbali, M (2018) [35] | 18.9 | 16.6, 21.4 | 2.44 | 15.5 | 13.4, 17.9 | 2.65 |
| 12 | Fakhrzadeh, H (2004) [37] | 24.1 | 20.7, 27.6 | 2.42 | 31.4 | 28.5, 34.5 | 2.64 |
| 13 | Fakhrzadeh, H (2008) [36] | 7.5 | 5.2, 10.5 | 2.44 | 15.4 | 12.1, 19.3 | 2.63 |
| 14 | Gandomkar, A (2018) [38] | 21.7 | 20.4, 22.9 | 2.45 | 31.3 | 30.0, 32.6 | 2.66 |
| 15 | Ghanbarian, A (2004) [39] | 19.0 | 17.5, 20.6 | 2.45 | 18.0 | 16.7, 19.4 | 2.66 |
| 16 | Ghorbani, Z (2018) [41] | 18.7 | 15.3, 22.6 | 2.42 | 25.8 | 22.3, 29.6 | 2.63 |
| 17 | Goodarzi, M (2002) [42] | 12.5 | 10.1, 15.2 | 2.44 | 15.0 | 12.6, 17.6 | 2.65 |
| 18 | Hatmi, Z (2007) [43] | 10.9 | 9.5, 12.6 | 2.45 | 16.9 | 15.0, 19.0 | 2.65 |
| 19 | Heydari, ST (2010) [44] | 8.5 | 5.8, 12.0 | 2.43 | | | |
| 20 | Isfeedvajani, MS (2014) [21•] | 10.6 | 6.5, 16.0 | 2.39 | 20.0 | 4.3, 48.1 | 1.81 |
| 21 | Kelishadi, R (2008) [47] | 16.1 | 14.4, 17.8 | 2.45 | 21.6 | 19.7, 23.6 | 2.66 |
| 22 | Khajedaluee, M (2016) [48] | 25.9 | 23.2, 28.6 | 2.44 | 20.0 | 18.2, 21.9 | 2.66 |
| 23 | Khoshandam Sarvynehbaghi, F (2013) [50] | 20.0 | 16.2, 24.3 | 2.41 | | | |
| 24 | Khosravi, A (2014) [51] | 37.1 | 35.1, 39.2 | 2.45 | 39.0 | 37.2, 40.8 | 2.66 |
| 25 | Mojahedi, MJ (2015) [14] | 1.4 | 1.0, 2.0 | 2.46 | 0.4 | 0.1, 0.8 | 2.67 |
| 26 | Najafipour, H (2012) [52] | 21.0 | 19.4, 22.6 | 2.45 | 23.9 | 22.5, 25.4 | 2.66 |
| 27 | Namayandeh, S (2011) [53] | 42.8 | 39.7, 45.9 | 2.43 | 41.9 | 38.8, 45.0 | 2.64 |
| 28 | Pakzad, B (2018) [54] | 15.1 | 12.6, 18.0 | 2.44 | 21.4 | 18.2, 24.8 | 2.63 |
| 29 | Peymani, P (2012) [55] | 23.8 | 21.9, 25.7 | 2.45 | 21.1 | 19.3, 22.9 | 2.66 |
| 30 | Ramezankhani, A (2016) [57] | 26.5 | 24.8, 28.1 | 2.45 | 21.4 | 20.0, 22.8 | 2.66 |
| 31 | Sadeghi, M (2004) [58] | 15.6 | 14.7, 16.6 | 2.46 | 18.8 | 17.8, 19.8 | 2.66 |
| 32 | Sahebi, L (2010) [59] | 16.3 | 12.4, 20.9 | 2.40 | 5.2 | 3.7, 7.1 | 2.66 |
| 33 | Sahraki, MR (2011) [60] | 32.3 | 29.6, 35.0 | 2.43 | 22.5 | 20.1, 25.0 | 2.65 |
| 34^[2] | Shirani, S (2011) [61] | 16.9 | 15.8, 18.1 | 2.46 | 22.4 | 21.2, 23.7 | 2.66 |
| 35 | Yazdanpanah, L (2015) [15•] | 17.5 | 14.1, 21.4 | 2.42 | 17.6 | 14.4, 21.2 | 2.63 |
| Sub-total random pooled ES | | 19.2 | 15.4, 23.1 | 85.31 | 21.1 | 17.0, 25.1 | 84.07 |
| • Rural population | | | | | | | |
| 36 | Chaman, R (2008) [32] | 14.0 | 11.6, 16.6 | 2.44 | 22.8 | 19.8, 26.0 | 2.64 |
| 37^[1] | Delavari, A (2007) [22] | 27.8 | 27.0, 28.6 | 2.46 | 30.6 | 29.8, 31.4 | 2.67 |
| 38^[2] | Shirani, S (2011) [61] | 17.5 | 15.7, 19.4 | 2.45 | 21.9 | 20.0, 24.0 | 2.66 |
| Sub-total random pooled ES | | 19.8 | 10.7, 28.9 | 7.34 | 25.2 | 18.6, 31.8 | 7.96 |
| • Provincial (urban and rural population) or not specified community location | | | | | | | |
| 39 | Ghorbani, R (2009) [40] | 25.1 | 23.1, 27.3 | 2.44 | 23.6 | 21.8, 25.5 | 2.66 |
| 40 | Malekzadeh, MM (2013) [11••] | 37.6 | 37.0, 38.3 | 2.46 | 46.4 | 45.8, 47.0 | 2.67 |
| 41 | Ramezani, MA (2009) [56] | 20.5 | 18.7, 22.4 | 2.45 | 21.0 | 19.1, 22.9 | 2.66 |
| Sub-total random pooled ES | | 27.8 | 15.8, 39.7 | 7.35 | 30.3 | 11.5, 49.2 | 7.98 |
| Overall random pooled ES | | 19.9 | 15.8, 24.0 | 100.0 | 22.1 | 17.3, 26.9 | 100.0 |

*ES* effect size; ^One study which reported results by community location

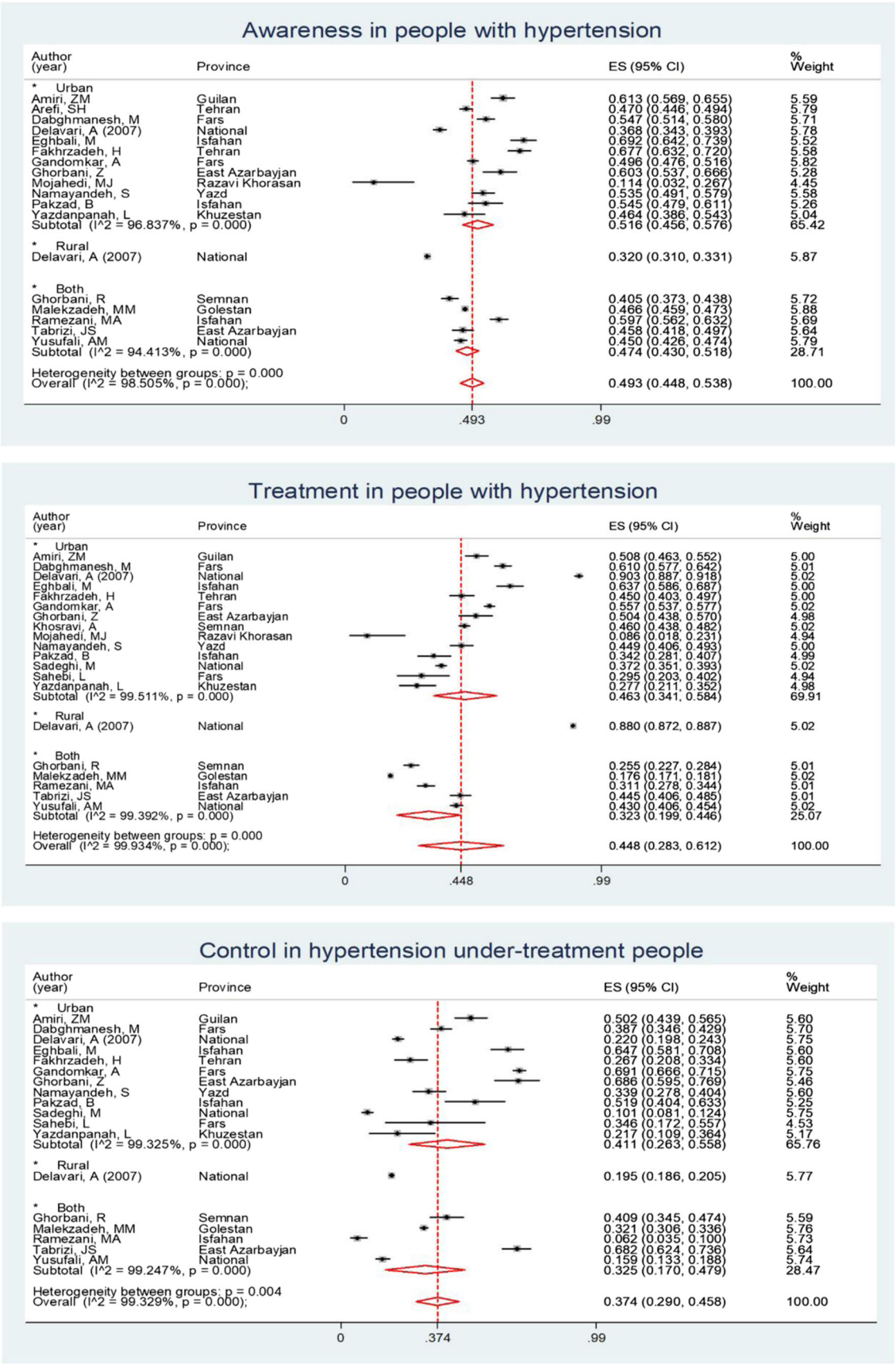


**Fig. 4** Awareness, treatment and control of hypertension among Iranian adult's hypertensive patients

**Table 3** Multivariate meta-regression in HTN study heterogeneity in adults population in Iran

| | % coef. | *t* value | 95% CI coef. | *P* value |
|---|---|---|---|---|
| Mean age of participants | 0.75 | 4.04 | 0.36 to 1.14 | 0.001 |
| Publication year | 0.07 | 0.28 | − 0.45 to 0.61 | 0.781 |
| Community location* | 6.43 | 1.98 | − 0.36 to 13.22 | 0.062 |
| Female-to-male ratio | 2.58 | 1.29 | − 1.61 to 6.76 | 0.213 |

*Urban = 1, Rural = 2, and Both = 3

Also, individualized studies in Africa (31.7%) [76] and China (24%) [77] showed less awareness rate and a study in Vietnam (67.3%) [78] showed better awareness in hypertensive people. This difference may be due to the better health infrastructure for hypertension screening and prevention and higher levels of literacy in developed countries than developing or underdeveloped ones [79, 80]. Results on hypertensive people undergoing treatment in the Iranian adults population showed that less than half (44.8%) of the affected patients are under treatment, with hypertension being controlled only in

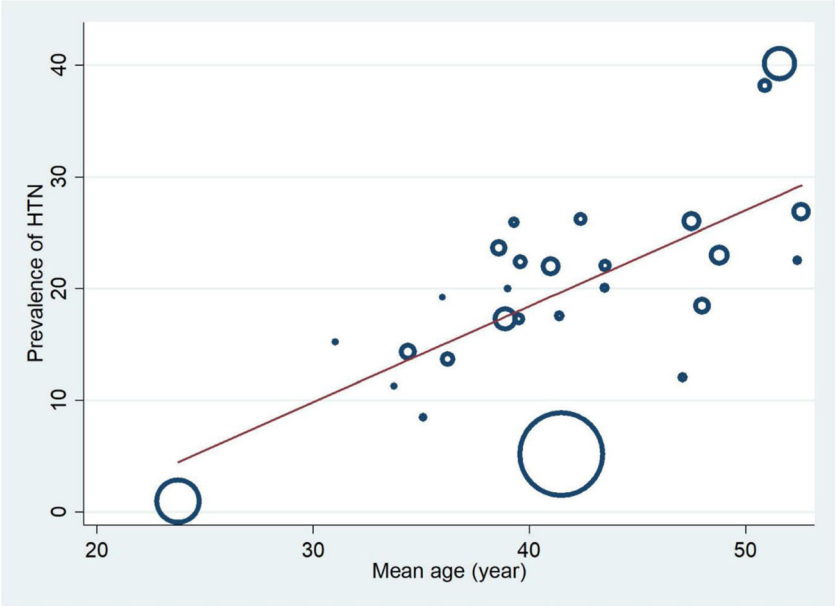


**Fig. 5** Meta-regression between mean age (year) and the prevalence of HTN in adult's population in Iran

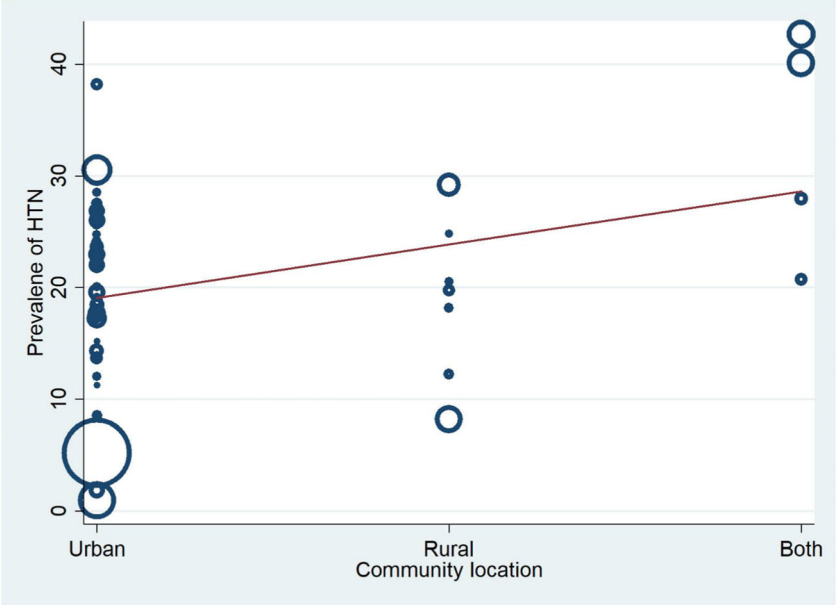


**Fig. 6** Meta-regression between community location and the prevalence of HTN in adult's population in Iran

one third of them (29.1%). The results also showed that the control level is higher in low and middle-income countries (36.9%) [13], which are consistent with individualized studies conducted in Vietnam (33.2%) [78] and lower than studies carried out in China (78%) [77]. On the other hand, the hypertension disease was controlled only in about one-third of the patients undergoing treatment that is slightly more than the control rate in Africa (24.6%) [58] and China (19%) [59]. Low levels of hypertension treatment and control can be due to the high cost of some blood pressure drugs, lack of access to more effective medications, the cost of referral to the physicians, the weakness of the health system infrastructure, lack of adequate information for timely referral to the physicians, and the socioeconomic differences between different provinces of the country and other countries [11••, 68]. One of the limitations of the present study is that all or some studies did not include information about the prevalence by gender and place of residence. Another limitation was the unequal number of studies in different provinces and lack of study in many provinces. In addition, the included studies were descriptive in nature, which have their own specific methodological limitations. The important limitation was the high heterogeneity among studies due the methodological and sample difference between included studies that we should attend to it. The advantage of the present study is that bias risk is moderate and low in all of the studies included. Another advantage of this study was the use of a meta-analysis approach to determine the prevalence of hypertension. In addition, databases were comprehensively investigated in the longest possible time. To reduce the risk of bias, all steps were performed by two individuals separately.

## Conclusion

This study suggests a high pre-hypertension and hypertension prevalence. More than half of the participants were unaware of their disease and were not treated. Besides, hypertension was under control only in one-third of the patients, which highlights the growing attention of health policymakers towards screening, preventing, and treating hypertension through the periodical implementation of the national blood pressure monitoring program, increasing general awareness about hypertension, and increasing community-based, and family-based programs for preventing hypertension.

### Compliance with Ethical Standards

**Conflict of Interest** The authors declare no conflicts of interest relevant to this manuscript.

**Human and Animal Rights and Informed Consent** This article does not contain any studies with human or animal subjects performed by any of the authors.

**Publisher's Note** Springer Nature remains neutral with regard to jurisdictional claims in published maps and institutional affiliations.

## References

Papers of particular interest, published recently, have been highlighted as:
- • Of importance
- •• Of major importance


1. Stevens G, Mascarenhas M, Mathers C. WHO brochure». Bulletin of the World Health Organization. 2009;87:646-.
2. Federation WH. Cardiovascular disease risk factors. 2015. http://www.world-heart-federation.org/cardiovascular-health/cardiovascular-disease-risk-factors. Accessed 27 september 2018.
3.•• Kearney PM, Whelton M, Reynolds K, Muntner P, Whelton PK, He J. Global burden of hypertension: analysis of worldwide data. Lancet. 2005;365(9455):217–23.
4. Negi PC, Chauhan R, Rana V, Lal K. Epidemiological study of non-communicable diseases (NCD) risk factors in tribal district of Kinnaur, HP: a cross-sectional study. Indian Heart J. 2016;68(5):655–62.
5.•• Yusufali AM, Khatib R, Islam S, Alhabib KF, Bahonar A, Swidan HM, et al. Prevalence, awareness, treatment and control of hypertension in four Middle East countries. J Hypertens. 2017;35(7):1457–64. https://doi.org/10.1097/hjh.0000000000001326.
6.•• Sarki AM, Nduka CU, Stranges S, Kandala N-B, Uthman OA. Prevalence of hypertension in low-and middle-income countries: a systematic review and meta-analysis. Medicine. 2015;94(50).
7.•• Vlachopoulos C, Aznaouridis K, Stefanadis C. Prediction of cardiovascular events and all-cause mortality with arterial stiffness: a systematic review and meta-analysis. J Am Coll Cardiol. 2010;55(13):1318–27.
8.•• Addo J, Smeeth L, Leon DA. Hypertension in sub-saharan Africa: a systematic review. Hypertension. 2007;50(6):1012–8.
9. Sarraf Zadegan N, Boshtam M, Mostafavi S, Rafiei M. Prevalence of hypertension and associated risk factors in Isfahan, Islamic Republic of Iran. 1999.
10. Ebrahimi M, Heidari-Bakavoli AR, Mazidi M, Moohebati M, Azarpazhooh MR, Nematy M, et al. Prevalence of hypertension, pre-hypertension and undetected hypertension in Mashhad, Iran. Mediterr J Nutr Metab. 2016;9(3):213–23.
11.•• Malekzadeh MM, Etemadi A, Kamangar F, Khademi H, Golozar A, Islami F, et al. Prevalence, awareness and risk factors of hypertension in a large cohort of Iranian adult population. J Hypertens. 2013;31(7):1364–71.
12.•• Adeloye D, Basquill C. Estimating the prevalence and awareness rates of hypertension in Africa: a systematic analysis. PLoS One. 2014;9(8):e104300.
13. Chow CK, Teo KK, Rangarajan S, Islam S, Gupta R, Avezum A, et al. Prevalence, awareness, treatment, and control of hypertension in rural and urban communities in high-, middle-, and low-income countries. JAMA. 2013;310(9):959–68.
14. Mojahedi MJ, Hami M, Shakeri MT, Hasani MH, Ahadi M. The prevalence and related risk factors of hypertension in young adults in Mashhad hypertension in young adults. Med J Mashhad Univ Med Sci. 2015;58(5):252–7. https://doi.org/10.22038/mjms.2015.4742.
15.• Yazdanpanah L, Shahbazian H, Shahbazian H, Latifi S-M. Prevalence, awareness and risk factors of hypertension in south-west of Iran. J Renal Inj Prev. 2015;4(2):51.

16. Moher D, Liberati A, Tetzlaff J, Altman DG, Group P. Preferred reporting items for systematic reviews and meta-analyses: the PRISMA statement. PLoS Med. 2009;6(7):e1000097.
17. James PA, Oparil S, Carter BL, Cushman WC, Dennison-Himmelfarb C, Handler J, et al. 2014 evidence-based guideline for the management of high blood pressure in adults: report from the panel members appointed to the eighth joint National Committee (JNC 8). JAMA. 2014;311(5):507–20.
18. America N. Guidelines set new definitions, update treatment for hypertension. Bull World Health Organ. 1999;77(3).
19.• Gee ME, Campbell N, Sarrafzadegan N, Jafar T, Khalsa TK, Mangat B, et al. Standards for the uniform reporting of hypertension in adults using population survey data: recommendations from the World Hypertension League Expert Committee. J Clin Hypertens. 2014;16(11):773–81.
20. McGowan J, Sampson M, Salzwedel DM, Cogo E, Foerster V, Lefebvre C. PRESS peer review of electronic search strategies: 2015 guideline statement. J Clin Epidemiol. 2016;75:40–6.
21.• Isfeedvajani MS, Zarchi AAK, Heris AM, Sajjadi F, Tavana AM. Evaluation of personnel blood pressure and its risk factors in university affiliated medical centers: Irans Health Day 2013. Med J Islam Repub Iran. 2014;28(1).
22. Delavari A, Horri N, Alikhani S, Gouya M, Mahdavi A, Hosseini S, et al. Prevalence of hypertension in Iranian urban and rural populations aged over 20 years in 2004. JMUMS. 2007;17(58):79–86.
23. Sepanlou S, Sharafkhah M, Poustchi H, Malekzadeh M, Etemadi A, Khademi H, et al. Hypertension and mortality in the Golestan Cohort Study: a prospective study of 50 000 adults in Iran. J Hum Hypertens. 2016;30(4):260–7.
24. Aghaei Meybodi HR, Khashayar P, Rezai Homami M, Heshmat R, Larijani B. Prevalence of hypertension in an Iranian population. Ren Fail. 2014;36(1):87–91. https://doi.org/10.3109/0886022x.2013.832315.
25. Agheli N. Evaluation of risk factors of cardiovascular diseases in the Iranian population: role of hypertriglyceridemia. Angeiologie. 2006;58(3):24–7.
26. Amani S, Rahmani K, Ghaderi E, Bidarpour F, Rahimzadeh A, Rasaeian S. Prevalence of non-communicable diseases risk factors among the population of rural areas of Kurdistan Province, in Iran: a population-based study by rapid assessment method in 2015. Sci J Kurdistan Univ Med Sci. 2017;22(4):101–10.
27. Arefi SH, Hagh MHB, Naghavi M, Kassaian SE, Mar'Ashie SS, Mortazavi F, et al. Prevalence, patient awareness and control rates of high blood pressure in the adult population of Tehran: a report from the Tehran blood pressure study, 1990-1991. Med J Islam Repub Iran. 1996;10(2):125–35.
28. Assadi SN. Cardiovascular disorders risk factors in different industries of Iran. Int J Prev Med. 2013;4(6):728–33.
29. Azizi A, Abasi M, Abdoli G. The prevalence of hypertension and its association with age, sex and BMI in a population being educated using community-based medicine in Kermanshah: 2003. Iran J Endocrinol Metab. 2008;10(4):323–9.
30. Azizi F, Ghanbarian A. Distribution of blood pressure in Tehran's adult population: Tehran lipid and glucose study. Iran J Endocrinol Metab. 2003;5(4):425–35.
31. Baygi F, Jensen OC, Qorbani M, Farshad A, Salehi SA, Mohammadi-Nasrabadi F, et al. Prevalence and associated factors of cardio-metabolic risk factors in Iranian seafarers. Int Marit Health. 2016;67(2):59–65. https://doi.org/10.5603/imh.2016.0013.
32. Chaman R, Younesian M, Hajimohammadi A, Gholamitaramsari M. Investigating hypertension prevalence and some of its influential factors in an ethnically variant rural sample. J Know Health Basic Med Sci. 2008;3(3):39–42. https://doi.org/10.22100/jkh.v3i3-4.224.
33. Cheraghian B, Asadi-Lari M, Mansournia MA, Majdzadeh R, Mohammad K, Nedjat S, et al. Prevalence and associated factors of self-reported hypertension among Tehran adults in 2011: a population-based study (Urban HEART-2). Med J Islam Repub Iran. 2014;28:105.
34. Dabghmanesh M, Mostafavi H, Zare N. Blood pressure levels, risk factors and hypertension control status in adult. Hormozgan Med J. 2007;11(1):41–9.
35. Eghbali M, Khosravi A, Feizi A, Mansouri A, Mahaki B, Sarrafzadegan N. Prevalence, awareness, treatment, control, and risk factors of hypertension among adults: a cross-sectional study in Iran. Epidemiol Health. 2018;40:e2018020. https://doi.org/10.4178/epih.e2018020.
36. Fakhrzadeh H, Bandarian F, Adibi H, Samavat T, Malekafzali H, Hodjatzadeh E, et al. Coronary heart disease and associated risk factors in Qazvin: a population-based study. Eastern Mediterranean health journal = La revue de sante de la Mediterranee orientale = al-Majallah al-sihhiyah li-sharq al-mutawassit. 2008;14(1):33–41.
37. Fakhrzadeh H, Nouri M, Pour-Ebrahim R, Ghotbi S, Heshmat R, Bastanhagh M. Prevalence of hypertension and correlated risk factors among 25-64 aged inhabitants of Tehran university of medical sciences population lab region. IJDLD. 2004;3(0):37–43.
38. Gandomkar A, Poustchi H, Malekzadeh F, Malekzadeh MM, Moini M, Moghadami M, et al. Prevalence, awareness, treatment, control, and correlates of hypertension in the pars cohort study. Arch Iran Med. 2018;21(8):335–43.
39. Ghanbarian A, Rashidi A, Madjid M, Azizi F. Blood pressure measures and electrocardiogram-defined myocardial infarction in an Iranian population: Tehran Lipid and Glucose study. J Clin Hypertens (Greenwich, Conn). 2004;6(2):71–75.
40. Ghorbani R, Askandarian R, Malek M, Rashidy-Pour A. Prevalence of hypertension among the adult population of Semnan province. Iran J Endocrinol Metab. 2009;10(5).
41. Ghorbani Z, Shamshirgaran SM, Ghaffari S, Sarbakhsh P, Najafipour F, Aminisani N. Hypertension prevalence, awareness, treatment and its correlates among people 35 years and older: result from pilot phase of the Azar cohort study. J Educ Health Promot. 2018;7:45. https://doi.org/10.4103/jehp.jehp_118_17.
42. Goodarzi M, Maseiainegad N. Outbreak of hypertension in the population over 18 years old in Zabol. Zahedan J Res Med Sci. 2002;4(4):9–15.
43. Hatmi Z, Tahvildari S, Motlag AG, Kashani AS. Prevalence of coronary artery disease risk factors in Iran: a population based survey. BMC Cardiovasc Disord. 2007;7(1):32.
44. Heydari ST, Khoshdel AR, Sabayan B, Abtahi F, Zamirian M, Sedaghat S. Prevalence of cardiovascular risk factors among military personnel in Southern Iran. Iran Cardiovasc Res J. 2010;4(1):22–7.
45. Jahromi MK, Hojat M, Koshkaki SR, Nazari F, Ragibnejad M. Risk factors of heart disease in nurses. Iran J Nurs Midwifery Res. 2017;22(4):332–7. https://doi.org/10.4103/1735-9066.212986.
46. Kazemi T, Hajihosseini M, Mashreghimoghadam H, Azdaki N, Ziaee M. Prevalence and determinants of hypertension among Iranian adults, Birjand, Iran. Int J Prev Med. 2017;8:36. https://doi.org/10.4103/ijpvm.IJPVM_103_16.
47. Kelishadi R, Gharipour M, Sadri GH, Tavasoli AA, Amani A. Cardiovascular disease risk factors, metabolic syndrome and obesity in an Iranian population. Eastern Mediterranean health journal = La revue de sante de la Mediterranee orientale = al-Majallah al-sihhiyah li-sharq al-mutawassit. 2008;14(5):1070–9.
48. Khajedaluee M, Hassannia T, Rezaee A, Ziadi M, Dadgarmoghaddam M. The prevalence of hypertension and its relationship with demographic factors, biochemical, and anthropometric indicators: a population-based study. ARYA atherosclerosis. 2016;12(6):259–65.
49. Khani M, Vakili M, Ansari A, Mosavinasab N. Prevalence of hypertension and some related risk factors in rural population

affiliated to Tarom health network in 2001. J Zanjan Univ Med Sci. 2002;10(40):23–9.
50. Khoshandam Sarvynehbaghi F, Reza Mozaffari SA, Yaghoubi Poor A, Nezamtabar MA. Prevalence of hypertension among professional drivers in Mazandaran province, 2010. JMUMS. 2013;23(102):24–9.
51. Khosravi A, Emamian MH, Shariati M, Hashemi H, Fotouhi A. The prevalence of pre-hypertension and hypertension in an Iranian urban population. High Blood Press Cardiovasc Prev. 2014;21(2):127–35. https://doi.org/10.1007/s40292-013-0035-y.
52. Najafipour H, Mirzazadeh A, Haghdoost AA, Shadkam M, Afshari M, Moazenzadeh M, et al. Coronary artery disease risk factors in an urban and pen-urban setting, Kerman, southeastern Iran (KERCADR study): methodology and preliminary report. Iran J Public Health. 2012;41(9):86–92.
53. Namayandeh S, Sadr S, Rafiei M, Modares-Mosadegh M, Rajaefard M. Hypertension in Iranian urban population, epidemiology, awareness, treatment and control. Iran J Public Health. 2011;40(3):63–70.
54. Pakzad B, Akbari M, Baberi F. Prevalence, awareness, treatment, and control of hypertension in an Isfahan state institution sample. J Tehran Uni Heart Cent. 2018;13(2):65–72.
55. Peymani P, Heydari ST, Ahmadi SM, Sarikhani Y, Joulaei H, Moghadami M, et al. The prevalence of high blood pressure and its relationship with anthropometric indicators; a population based study in Fars Province. IR Iran Iran Cardiovasc Res J. 2012;6(2):40–5.
56. Ramezani MA, Dastanpour M, Eshaghi SR, Fadaee-Nobari R, Heydari K. Determinants of awareness, treatment and control of hypertension in Isfahan. Central Iran Arch Med Sci. 2009;5(4):523–30.
57. Ramezankhani A, Kabir A, Pournik O, Azizi F, Hadaegh F. Classification-based data mining for identification of risk patterns associated with hypertension in Middle Eastern population: A 12-year longitudinal study. Medicine. 2016;95(35). https://doi.org/10.1097/md.0000000000004143.
58. Sadeghi M, Roohafza HR, Kelishadi R. Blood pressure and associated cardiovascular risk factors in Iran: Isfahan Healthy Heart Programme. Med J Malaysia. 2004;59(4):460–7.
59. Sahebi L, Vahidi RG, Mousavi SH. Prevalence of hypertension and associated variables in hospital staff in Iran. Acta Med Saliniana. 2010;39(1):6–13. https://doi.org/10.5457/ams.138.10.
60. Sahraki MR, Mirshekari H, Sahraki AR, Mohammadi M, Sahraki E, Khazaei FA. Hypertension among 30+ year-old people in Zahedan (Southeast of Iran). Shiraz E Med J. 2011;12(3):129–34.
61. Shirani S, Gharipour M, Khosravi A. Gender differences in the prevalence of hypertension in a representative sample of Iranian population: the Isfahan Healthy Heart Program. Acta Bio Medica Atenei Parmensis. 2011;82(3):223–9.
62. Tabrizi JS, Sadeghi-Bazargani H, Farahbakhsh M, Nikniaz L, Nikniaz Z. Prevalence and associated factors of prehypertension and hypertension in Iranian population: the lifestyle promotion project (LPP). PLoS One. 2016;11(10):e0165264. https://doi.org/10.1371/journal.pone.0165264.
63.• Mirzaei M, Moayedallaie S, Jabbari L, Mohammadi M. Prevalence of hypertension in Iran 1980–2012: a systematic review. J Tehran Univ Heart Cent. 2016;11(4):159.
64.• Rezazadehkermani M. Epidemiology and heterogeneity of hypertension in Iran: a systematic review. Arch Iran Med. 2008;11(4):444–52.
65. Mills KT, Bundy JD, Kelly TN, Reed JE, Kearney PM, Reynolds K, et al. Global disparities of hypertension prevalence and control clinical perspective: a systematic analysis of population-based studies from 90 countries. Circulation. 2016;134(6):441–50.
66. Picon RV, Fuchs FD, Moreira LB, Riegel G, Fuchs SC. Trends in prevalence of hypertension in Brazil: a systematic review with meta-analysis. PLoS One. 2012;7(10):e48255.
67. Anchala R, Kannuri NK, Pant H, Khan H, Franco OH, Di Angelantonio E, et al. Hypertension in India: a systematic review and meta-analysis of prevalence, awareness, and control of hypertension. J Hypertens. 2014;32(6):1170–7.
68. Fateh M, Emamian MH, Asgari F, Alami A, Fotouhi A. Socioeconomic inequality in hypertension in Iran. J Hypertens. 2014;32(9):1782–8.
69. Post Hospers G, Smulders Y, Maier AB, Deeg D, Muller M. Relation between blood pressure and mortality risk in an older population: role of chronological and biological age. J Intern Med. 2015;277(4):488–97.
70. Guo X, Zou L, Zhang X, Li J, Zheng L, Sun Z, et al. Prehypertension: a meta-analysis of the epidemiology, risk factors, and predictors of progression. Tex Heart Inst J. 2011;38(6):643.
71. Tripathy JP, Thakur JS, Jeet G, Chawla S, Jain S. Alarmingly high prevalence of hypertension and pre-hypertension in North India-results from a large cross-sectional STEPS survey. PLoS One. 2017;12(12):e0188619.
72. Hu L, Huang X, You C, Li J, Hong K, Li P, et al. Prevalence and risk factors of prehypertension and hypertension in Southern China. PLoS One. 2017;12(1):e0170238.
73. Choi KM, Park HS, Han JH, Lee JS, Lee J, Ryu OH, et al. Prevalence of prehypertension and hypertension in a Korean population: Korean National Health and Nutrition Survey 2001. J Hypertens. 2006;24(8):1515–21.
74. Erem C, Hacihasanoglu A, Kocak M, Deger O, Topbas M. Prevalence of prehypertension and hypertension and associated risk factors among Turkish adults: Trabzon hypertension study. J Public Health. 2008;31(1):47–58.
75. Harries AD, Kumar AM, Karpati A, Jahn A, Douglas GP, Gadabu OJ, et al. Monitoring treatment outcomes in patients with chronic disease: lessons from tuberculosis and HIV/AIDS care and treatment programmes. Tropical Med Int Health. 2015;20(7):961–4.
76. Dzudie A, Kengne AP, Muna WF, Ba H, Menanga A, Kouam CK, et al. Prevalence, awareness, treatment and control of hypertension in a self-selected sub-Saharan African urban population: a cross-sectional study. BMJ Open. 2012;2(4):e001217.
77. Gu D, Reynolds K, Wu X, Chen J, Duan X, Muntner P, et al. Prevalence, awareness, treatment, and control of hypertension in China. Hypertension. 2002;40(6):920–7.
78. Hien HA, Tam NM, Tam V, Derese A, Devroey D. Prevalence, awareness, treatment, and control of hypertension and its risk factors in (central) Vietnam. Int J Hypertens. 2018;2018:1–12.
79. Feng XL, Pang M, Beard J. Health system strengthening and hypertension awareness, treatment and control: data from the China health and retirement longitudinal study. Bull World Health Organ. 2013;92:29–41.
80. Grotto I, Huerta M, Sharabi Y. Hypertension and socioeconomic status. Curr Opin Cardiol. 2008;23(4):335–9.