The prevalence and predictors of high blood pressure in Kherameh cohort study: a population based study on 10663 persons in south of Iran

Fatemeh Jafari (m.jafarii4319@gmail.com)
Shiraz University of Medical Sciences
Abbas Rezaianzadeh
Shiraz University of Medical Sciences
Seyed Ebrahim Sadeghi
Shiraz University of Medical Sciences
Salar Rahimikazerooni
Shiraz University of Medical Sciences

Research article

Keywords: Prevalence, Risk factor, Blood pressure, Pre-hypertension

Posted Date: December 9th, 2019

DOI: https://doi.org/10.21203/rs.2.18422/v1

The prevalence and predictors of high blood pressure in Kherameh cohort study: a population based study on 10663 persons in south of Iran

Abbas Rezaianzadeh[1], Fatemeh Jafari[2*], Seyed Ebrahim Sadeghi[3], Salar Rahimikazerooni[1]

*correspondence: m.jafarii4319@gmail.com

[1]Colorectal Research Center, SUMS, Shiraz, Iran

[2]MSc Candidate of Epidemiology in Shiraz University of Medical Science, Shiraz, Iran

[3]Anesthesiology Department, SUMS, Shiraz, Iran

Abstract

Background: Hypertension (HTN) is an important risk factor for Cardiovascular Disease (CVD) mortality and morbidity among Iranians. The present study aimed to estimate the prevalence of HTN and some of its related factors in south of Iran.

Methods: This cross-sectional survey was conducted on the data of the Persian cohort study in Kherameh. The participants consisted of 10663 people aged 40-70 years. HTN was defined as either Systolic/Diastolic Blood Pressure (SBP/DBP) greater than or equal to 140/90 mmHg or taking medications. Pre-HTN was defined as SBP = 120-139 mmHg and/or DBP = 80-89 mmHg. The logistic regression method was used to identify the factors associated with pre-HTN and HTN.

Results: The prevalence of pre-HTN and HTN was 18.8% and 27.7%, respectively. Male gender, old age, being unemployed, low education level, high Body Mass Index (BMI), no smoking, diabetes, Cerebro-cardiovascular disease, suffering from another chronic disease, family history of CVD, and negative family history of cancer and other chronic diseases were independently associated with pre-HTN ($p<0.05$). All variables, except for gender, smoking, and family history of cancer, were significantly associated with HTN. Drug abuse was also correlated to HTN ($p<0.05$).

Conclusion: This study revealed the increased prevalence of HTN in rural and urban areas. Therefore, the health system needs to develop strategies to raise the accessibility of screening and diagnostic services.

Keywords: Prevalence, Risk factor, Blood pressure, Pre-hypertension

Introduction

In the current century, the rapid growth of Non-communicable diseases (NCDs) is considered a serious health challenge that threatens the societies' socioeconomic development and people's health [1]. The most common types of NCDs include Cardiovascular diseases (CVDs), diabetes, chronic respiratory diseases, and cancers [2]. Hypertension (HTN) has been considered to be the first and the most common risk factor for CVDs, stroke, and kidney diseases [3]. HTN has been reported to cause 7.5 million deaths per year, which is equivalent to 57 million disability-adjusted life years [4]. Although the prevalence of HTN has reached a steady trend in developed countries, it has been increasing in developing countries in the recent years, with the highest rates being related to low- and middle-income countries [5]. The highest prevalence of HTN was found to be 46% among adults in Africa, 35% among American adults, and 23% among Canadian adults [6]. In Iran, the prevalence of HTN was estimated to range from 17% to 68% [7, 8]. Overall, about 50% of the middle-aged population worldwide have been estimated to have pre-HTN and 25% have been reported to have HTN, which has been predicted to increase to 29% by 2025 [9, 10]. The increasing trend of HTN is significantly associated with economic development, population growth, lifestyle changes, and traditional eating habits [11]. Indeed, the risk factors of HTN include age, low physical activity, smoking, unhealthy eating habits, and high salt consumption [12].

The prevention and control of HTN have not received sufficient attention in developing countries [13]. In the recent decades, population-based cohort studies have played an important role in scientific discoveries, especially regarding cardiovascular risk factors and understanding their biological and genetic bases. Although the identification of cardiovascular risk factors seems to be relatively complete, social and environmental behavioral patterns are changing and the ability to measure the needs, must be improved [14]. Therefore, the present study aims to analyze the prevalence and predictors of HTN and pre-HTN according to the baseline data of Kherameh cohort study. The results can help health policymakers

to estimate the disease status more accurately, provide up-to-date information, adopt the best and most effective preventive methods to reduce the burden of the disease.

Materials and Methods

Study framework

The present analytical cross-sectional study was performed on the data of Kherameh cohort study, which is a branch of the Prospective Epidemiological Research Studies in Iran (PERSIAN). The rationale, objectives, and design of the PERSIAN cohort study have been published earlier [15]. Kherameh is a city located in southern Fars province with a population of 61580 people. The main objective of Kherameh cohort study was to determine the prevalence and risk factors of NCDs at baseline and follow-up. The target population of the study included all people aged 40-70 years in the region. Since 2014, 10663 participants have been enrolled into this study.

Measurement

Demographic and lifestyle information:

The participants were first requested to fill out written informed consent forms. Then, they were interviewed by trained experts using standardized questionnaires including information about demographic characteristics, Socioeconomic status (SES), individual habits, history of chronic diseases, family history of diseases, physical activity, and reproductive history. Since this cohort project was a part of the main PERSIAN cohort project, the validity and reliability of the questionnaire were reviewed by the national team of the Persian cohort prior to implementation of the project. After the interviews, a short physical examination was carried out in order to measure the participants' blood pressure, height, weight, and waist and hip circumferences. Weight was measured with light clothing and without shoes by using a SECA scale (made in Germany). Waist circumference was considered as the midline of the lower ribs and the upper outer edge of the right iliac crest. Finally, the standard measurements of height and waist circumference were carried out using a measuring tape to the nearest 0.1 centimeter. Abdominal obesity was defined as waist circumference greater than 102 cm in males and greater than 88

cm in females [16]. Indeed, Body Mass Index (BMI) was calculated and categorized as less than 25, between 25 and 29, and equal to or greater than 30 kg/m^2 [17].

The Metabolic Equivalent of Task (MET) index was used to measure the participants' physical activity. The individuals were asked to recount their daily activities considered as the average of their physical activity during the past year. The benefits of this questionnaire include assigning a score to each individual for taking into account all occupational and sport activities as well as the time spent on eating and sleeping. Factor analysis was used to determine the participants' SES by considering their properties, such as homeownership, home size, number of bathrooms within the house, having cars, price of the cars, domestic and international travels, owning mobile phones, televisions, vacuum cleaners, washing machines, refrigerators, microwaves, and computers. Accordingly, a score was assigned to each individual at the significance level of 0.4.

Blood pressure and HTN

Blood pressure was measured on the participants' left arms after a five-minute rest in sitting position using a standard calibrated sphygmomanometer (Reister Model, Germany) at an appropriate cuff size. Two consecutive measurements were carried out with at least a 10-minute interval and the average was recorded. According to the Eighth Joint National Committee (JNC8) criteria, HTN was defined as Systolic blood pressure (SBP) equal to or above 140 mmHg, Diastolic blood pressure (DBP) equal to or above 90 mmHg, or being under treatment for HTN. Besides, pre-HTN was defined as SBP of 120-139 mmHg and/or DBP of 80-89 mmHg in the individuals who did not take any antihypertensive medications [18].

Statistical analysis

Continuous variables were presented as mean ± standard deviation, while qualitative variables were presented as number (percentage). The relationships between the categorical variables were tested by chi-square test. Multivariate logistic regression analysis was also conducted to evaluate the association between the prevalence of HTN and pre-HTN and their related factors. All statistical tests were two-tailed and p-values less than 0.05 were considered to be statistically significant.

Results

Out of the 10663 participants, 5944 (55.7%) were female. The mean age of the participants was 51.9±8.2 years. In addition, 9492 participants (89%) were married and 5587 ones (52.4%) were illiterate. Besides, 6247 participants (58.6%) lived in rural areas.

Among the study participants, 6656 (62.4%), 2000 (18.8%), and 2953 (27.7%) were normotensive, pre-hypertensive, and hypertensive, respectively (Table 1). The means of SBP and DBP were respectively 105.8±10 and 67.8±7.4 mmHg in the healthy participants, 130.3±8.5 and 79.9±6.7 mmHg in the pre-hypertensive ones, and 131.9±20 and 80.2±11.9 mmHg in the patients.

The results showed that the prevalence of pre-HTN and HTN was higher in females (55.5%, p=0.01 and 67.5%, p<0.001) as well as in the people who lived in rural areas (62%, p<0.001 and 58.5%, p=0.336). Moreover, the frequency of pre-HTN and HTN was higher in the illiterate participants compared to the other groups (63.3%, p<0.001 and 66.2%, p<0.001). The prevalence of both pre-HTN and HTN was also higher among married people (87.8%, p<0.001 and 83.6%, p<0.001). Finally, the frequency of both pre-HTN and HTN was higher among the unemployed participants (48.4%, p<0.001 and 63.5%, p<0.001).

Table 1. The demographic characteristics of Kherameh population

	Participants, No. (%)	**Pre-hypertensive, No. (prevalence)**	**P-value**	**Hypertensive, No. (prevalence)**	**P-value**
All	10663 (100)	2000 (18.8)		2953 (27.7)	
Sex					
Male	4719 (44.3)	890 (44.5)		961 (32.5)	
Female	5944 (55.7)	1110 (55.5)	0.01	1992 (67.5)	<0.001
Age					
40-49 years	4639 (43.5)	672 (33.7)		919 (31.2)	
50-59 years	3759 (35.3)	746 (37.4)		1119 (38)	
+60 years	2218 (20.8)	574 (28.8)	<0.001	905 (30.8)	<0.001
Living place					
Urban	4416 (41.4)	760 (38)		1226 (41.5)	
Rural	6247 (58.6)	1240 (62)	<0.001	1727 (58.5)	0.336
Literacy					
Illiterate	5587 (52.4)	1267 (63.3)		1956 (66.2)	
<5 years	2676 (25.1)	400 (20)		587 (19.9)	
6-8 years	1136 (10.7)	148 (7.4)		177 (6)	
High school	702 (6.6)	93 (4.6)		140 (4.7)	

Academic	562 (5.3)	92 (4.6)	<0.001	93 (3.1)	<0.001
Marital status					
Married	9492 (89)	1757 (87.8)		2468 (83.6)	
Non-married	1171 (11)	243 (12.2)	<0.001	485 (16.4)	<0.001
Employed					
Yes	5516 (51.7)	967 (48.4)		1077 (36.5)	
No	5147 (48.3)	1033 (51.6)	<0.001	1876 (63.5)	<0.001

According to Table 2, the percentage of pre-HTN participants was higher in all variables compared to normotensive individuals. This point was also correct about the hypertensive group in comparison to the pre-HTN group regarding all factors, except for alcohol use. Furthermore, all variables, except for cancer and high cholesterol, were related to HTN ($p<0.05$) and all variables, except for cancer, alcohol use, and drug use, were correlated to pre-HTN ($p<0.05$) (Table 2).

Table 2. Comparison of normotensive, pre-hypertensive, and hypertensive individuals regarding the factors related to HTN in Kherameh population

	Normotensive, No. (%)	**OR (95% CI)**	**Pre-hypertensive (prevalence)**	**OR (95% CI)**	**Hypertensive, No. (prevalence)**	**OR (95% CI)**
Diabetes						
Yes	652 (9.8)	0.57	382 (19.1)	1.24	822 (27.8)	1.66
No	6004 (90.2)	(0.54-0.6)*	1618 (80.9)	(1.19-1.31)*	2131 (72.2)	(1.57-1.77)*
Cerebro-cardiovascular disease						
Yes	414 (6.2)	0.51	289 (14.4)	1.33	738 (25)	2.05
No	6242 (93.8)	(0.48-0.53)*	1711 (85.6)	(1.25-1.41)*	2215 (75)	(1.89-2.22)*
Cancer						
Yes	29 (0.4)	0.84	8 (0.4)	0.98	21 (0.7)	1.19
No	6627 (99.6)	(0.62-1.15)	1992 (99.6)	(0.82-1.16)	2932 (99.3)	(0.94-1.51)
Another chronic disease						
Yes	2369 (35.6)	0.77	841 (42)	1.06	1519 (51.4)	1.18
No	4287 (64.4)	(0.73-0.81)*	1159 (58)	(1.04-1.09)*	1434 (48.6)	(1.15-1.22)*
Ever smoking						
Yes	1739 (55)	1.57	272 (31.3)	0.88	296 (26.5)	0.82
No	1420 (45)	(1.44-1.72)*	596 (67.8)	(0.86-0.91)*	819 (73.5)	(0.79-0.85)*
Ever opium use						
Yes	1274 (19.1)	1.33	301 (15)	0.99	341 (11.5)	0.85

No	5382 (80.9)	(1.23-1.43)*	1699 (85)	(0.97-1.01)	2612 (88.5)	(0.82-0.87)*
Ever alcohol use						
Yes	413 (6.2)	1.4	95 (4.8)	1.01	86 (2.9)	0.82
No	6243 (93.8)	(1.22-1.61)*	1905 (95.2)	(0.97-1.04)	2867 (97.1)	(0.79-0.86)*
Ever hookah use						
Yes	364 (5.5)	1.12	96 (4.8)	0.94	123 (4.2)	0.92
No	6292 (94.5)	(0.99-1.27)*	1904 (95.2)	(0.91-0.96)	2830 (95.8)	(0.87-0.97)*
Fasting blood sugar						
Yes	484 (7.3)	0.72	230 (11.5)	1.14	391 (13.2)	1.27
No	6172 (92.7)	(0.67-0.77)*	1770 (88.5)	(1.08-1.2)*	2562 (86.8)	(1.2-1.35)*
High cholesterol						
Yes	2220 (33.4)	0.93	740 (37)	1.03	1035 (35)	1.02
No	4436 (66.6)	(0.89-0.98)*	1260 (63)	(1.01-1.06)*	1918 (65)	(0.99-1.05)
High triglyceride						
Yes	1767 (26.5)	0.86	620 (31)	1.05	942 (31.9)	1.08
No	4889 (73.5)	(0.82-0.91)*	1380 (69)	(1.02-1.08)*	2011 (68.1)	(1.05-1.12)*

Among the variables included in logistic regression analysis, male gender (OR=0.52, p<0.001), old age (OR=1.03, p<0.001), being unemployed (OR=0.77, p=0.01), low education level (OR=0.62, p<0.001), high BMI (OR=1.11, p<0.001), no smoking (OR=0.71, p=0.001), diabetes (OR=1.5, p=0.020), Cerebro- cardiovascular disease (OR=1.55, p=0.001), another chronic disease (OR=1.22, p=0.01), family history of CVDs in the first degree relatives (OR=1.54, p<0.001), no family history of cancer (OR=0.78, p=0.05), and other chronic diseases in the second degree relatives (OR=0.69, p=0.01) were independently associated with pre-HTN. The factors that were positively correlated to HTN consisted of old age (OR=1.03, p<0.001), high BMI (OR=1.14, p<0.001), larger number of cigarettes smoked (OR=1.009, p=0.0008), diabetes (OR=2.65, p<0.001), Cerebro-cardiovascular disease (OR=3.35, p<0.001), other chronic diseases (OR=1.43, p=0.001), and family history of CVDs in the first degree relatives (OR=1.62, p<0.001). Other factors like education (OR=0.67, p=0.001), occupation (OR=0.64, p=0.002), drug use (OR=0.78, p=0.038), and family history of another chronic disease in the second degree relatives (OR=0.38, p<0.001) were inversely associated with HTN. It was notable that physical activity showed no correlation with pre-HTN and HTN (OR=1, p=0.006) (Table 3).

Table 3. The factors associated with the prevalence of pre-HTN and HTN by the multivariate logistic regression model

	Pre-HTN			HTN		
	Odds ratio	**95% CI**	**P-value**	**Odds ratio**	**95% CI**	**P-value**
Gender Male Female	 1 0.52	 (0.41-0.66)	 <0.001		-	
Age	1.04	(1.03-1.05)	<0.001	1.03	(1.02-1.05)	<0.001
Occupation Jobless Employed	 1 0.77	 (0.63-0.95)	 0.01	 1 0.64	 (0.49-0.85)	 0.002
Education Illiterate Literate	 1 0.62	 (0.52-0.74)	 <0.001	 1 0.67	 (0.53-0.84)	 0.001
Body mass index	1.11	(1.09-1.13)	<0.001	1.14	(1.11-1.17)	<0.001
Physical activity		-		1	(0.99-1)	0.006
Smoking No Yes	 1 0.71	 (0.59-0.87)	 0.001		-	
Number of cigarettes smoked		-		1.009	(1.002-1.016)	0.008
Ever drug use No Yes		-		 1 0.78	 (0.62-0.98)	 0.038
Diabetes No Yes	 1 1.5	 (1.16-1.95)	 0.002	 1 2.65	 (1.94-3.62)	 <0.001
Cerebro-cardiovascular disease No Yes	 1 1.55	 (1.2-2)	 0.001	 1 3.35	 (2.56-4.39)	 <0.001
Other chronic diseases No Yes	 1 1.22	 (1.03-1.44)	 0.01	 1 1.43	 (1.15-1.79)	 0.001
Family history of cardiovascular diseases in the first degree relatives No Yes	 1 1.54	 (1.29-1.84)	 <0.001	 1 1.62	 (1.28-2.07)	 <0.001
Family history of cancer in the second degree relatives No Yes	 1 0.78	 (0.61-1)	 0.05		-	

Family history of another chronic disease in the second degree relatives						
No	1			1		
Yes	0.69	(0.51-0.92)	0.014	0.38	(0.24-0.61)	<0.001

Discussion

There is compelling evidence from epidemiological studies that HTN is an independent and potent risk factor for CVDs, including coronary heart disease and stroke [19]. The prevalence of HTN varies significantly across countries and regions [20]. The present study aimed to highlight the major predictors of pre-HTN and HTN among people aged 40-70 years in Kherameh. The estimated crude prevalence rate of pre-HTN was 18.8%, which was consistent with the rate found in Rani's study (18.4%) [21], but lower than the rate reported in China (32.3%), Brazilian adults (36.1%) [22], and Iranian adults in Tehran province (35.4%) [23]. Moreover, the crude prevalence rate of HTN was 27.7%, which was comparable to the results of a study conducted in southern India (27%) [24]. However, some studies performed in Iran have shown a lower prevalence rate (23.8%) [25]. The prevalence of the disease was also estimated to be 28.9% in a meta-analysis conducted in Nigeria [26]. Nevertheless, Malekzadeh et al. estimated the prevalence rate of the disease to be 42.7% in the Golestan cohort study, which might be attributed to the higher age of the study population [27]. Increased prevalence of HTN has been thought to result from industrialization, population growth, aging, rapid economic development, lifestyle, and diet [13, 28]. In the present study, the prevalence of pre-HTN and HTN was higher among females compared to males. However, Yang et al. came to contradictory results [29]. Additionally, an upward trend was detected in the prevalence rate of pre-HTN and HTN up to the age of 59 years, which decreased after 60 years of age. This might be due to the lower number of elderly people in the population. Moreover, the prevalence of HTN was significantly higher in rural areas than in urban ones, which was in line with the results of a study carried out in China [3, 29]. In contrast to the current study, HTN was more prevalent among single people in Gandomkar's research [30].

The results of multivariate regression model indicated that males were more probable to be pre-hypertensive, which was in agreement with the report by Nuwaha

et al. [31]. This might be attributed to genetic, physiological, and hormonal differences between the two genders [11, 32]. Furthermore, similar to other investigations, the present study revealed that increase in age was accompanied with an increase in the prevalence rate of the disease [33, 34]. Indeed, a positive correlation was found between pre-HTN and HTN and higher BMI, which was consistent with the findings of other studies [35, 36] and suggested the need for effective interventions for overweight or obese patients. The metabolic syndrome induced by obesity leads to atherosclerosis and activation of the rennin-angiotensin-aldosterone system, which ultimately leads to the development of HTN [37].

Although SES did not remain in the multivariate regression model in the current study, a meta-analysis indicated an increase in the prevalence of HTN in the lowest SES concerning income, occupation, and education compared to the highest one [38]. It should be mentioned that the relationships between pre-HTN and HTN and occupation and education were investigated separately in the present study. The results indicated that occupation and education were inversely associated with pre-HTN and HTN. There are some intertwined paths that can explain the relationship between education and HTN. Firstly, higher levels of education might influence the individuals' knowledge of HTN and health behaviors, subsequently resulting in following a healthier lifestyle and medical care [39, 40]. Secondly, well-educated compared to lowly educated or jobless people have social and psychological resources, including a high sense of personal control and social support [41].

The current study findings revealed a strong association between chronic diseases and HTN and pre-HTN. In this context, cerebro-cardiovascular diseases, diabetes, and other chronic diseases were identified as the most important factors. Bcheraoui et al. found that HTN was associated positively with diabetes and inversely with prediabetes. Pre-HTN was also positively correlated to diabetes and chronic conditions [42]. Indeed, some studies have shown that smoking increased atherosclerosis [43], eventually raising blood pressure. In the present study, smoking was omitted from the final model of HTN, but was inversely correlated to pre-HTN. An inverse correlation was also detected between drug use and HTN. The inverse relationship might be due to the practitioners' recommendations for quitting smoking and using drugs. This pattern was also found in the research carried out by Malekzadeh [27].

In terms of family history, the current study results showed that the family history of CVDs in the first degree relatives was positively associated with pre-HTN and

HTN. Besides, the family history of cancer and another chronic disease in the second degree relatives showed an inverse relationship with HTN and pre-HTN. Pansare et al. and Simonetta et al. also reported a strong correlation between parents' and children's blood pressure [44, 45]. This might be due to the genetic impact as well as such common behaviors as diet and physical activity, which have been regarded as the risk factors of the disease [37].

This study had a few limitations. First, the cross-sectional design of the study made it difficult to rule out the inverse causation of variables, especially for smoking and drug use. Second, the relationship between nutrition status and pre-HTN and HTN was not taken into account. Despite these limitations, the strong points of the study included its large sample size and precise collection of data regarding the potentially relevant demographic and lifestyle factors.

In conclusion, pre-HTN and HTN were highly prevalent in Fars province. Hence, primary and secondary prevention is required to reduce its burden on Iranians' health. Further studies are recommended to investigate the relationship between the family history of some diseases and HTN. The researchers are also waiting for the follow-up results of Kherameh cohort study.

Abbreviations

NCD: Non-communicable disease; CVD: Cardiovascular disease; HTN: Hypertension; PERSIAN: Prospective epidemiological research studies in Iran; SES: Socioeconomic status; BMI: Body mass index; MET: Metabolic equivalent of task; JNC8: Eighth Joint National Committee; SBP: Systolic blood pressure; DBP: Diastolic blood pressure

Acknowledgements

The authors would like to thank Ms. A. Keivanshekouh at the Research Improvement Center of Shiraz University of Medical Sciences for improving the use of English in the manuscript.

Authors' contributions

AR contributed to the conception and design of the study, critical revision of the manuscript. FJ contributed to data analysis and interpretation, and writing up the manuscript. SS and SR contributed to design of the study and data collection. All authors read and approved the final version of the manuscript.

Availability of data and materials

The data sets used and analyzed during the current study are available from

the corresponding author on reasonable request.

Ethics approval and consent to participate

This study was approved by the Shiraz University of Medical Sciences

Ethics Committee (approval code: IR.SUMS.REC.1397.911). Written consent was obtained from all participants to publish the research findings as well.

Consent for publication

Not applicable.

Competing interests

The authors declare that they have no competing interests.

Author details

[1]Colorectal Research Center, SUMS, Shiraz, Iran. [2]MSc Candidate of Epidemiology in Shiraz University of medical science, Shiraz, Iran. [3]Anesthesiology Department, SUMS, Shiraz, Iran

References

1. Zinat Motlagh SF, Chaman R, Ghafari SR, Parisay Z, Golabi MR, Eslami AA, Babouei A: **Knowledge, Treatment, Control, and Risk Factors for Hypertension among Adults in Southern Iran**. *International journal of hypertension* 2015, **doi: 10.1155/2015/897070**.
2. Sepanlou SG, Kamangar F, Poustchi H, Malekzadeh R: **Reducing the burden of chronic diseases: a neglected agenda in Iranian health care system, requiring a plan for action**. *Archives of Iranian medicine* 2010, **13**(4):340-350.
3. Wang J, Sun W, Wells GA, Li Z, Li T, Wu J, Zhang Y, Liu Y, Li L, Yu Y *et al*: **Differences in prevalence of hypertension and associated risk factors in urban and rural residents of the northeastern region of the People's Republic of China: A cross-sectional study**. *PloS one* 2018, 13(4):e0195340.
4. Belachew A, Tewabe T, Miskir Y, Melese E, Wubet E, Alemu S, Teshome T, Minichel Y, Tesfa G: **Prevalence and associated factors of hypertension among adult patients in Felege-Hiwot Comprehensive Referral Hospitals, northwest, Ethiopia: a cross-sectional study**. *BMC research notes* 2018, **11**(1):876.
5. Danaei G, Finucane MM, Lin JK, Singh GM, Paciorek CJ, Cowan MJ, Farzadfar F, Stevens GA, Lim SS, Riley LM: **National, regional, and global trends in systolic blood pressure since 1980: systematic analysis of health examination surveys and epidemiological studies with 786 country-years and 5· 4 million participants**. *The Lancet* 2011, **377**(9765):568-577.
6. 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**. *Epidemiology and health* 2018, **40**:e2018020.
7. Ebrahimi M, Mansournia MA, Haghdoost AA, Abazari A, Alaeddini F, Mirzazadeh A, Yunesian M: **Social disparities in prevalence, treatment and control of hypertension in Iran: second National Surveillance of Risk Factors of Noncommunicable Diseases, 2006**. *Journal of hypertension* 2010, **28**(8):1620-1629.
8. Ghaffari S, Pourafkari L, Tajlil A, Sahebihagh MH, Mohammadpoorasl A, Tabrizi JS, Nader ND, Azizi Zeinalhajlou A: **The prevalence, awareness and control rate of hypertension among elderly in northwest of Iran**. *Journal of cardiovascular and thoracic research* 2016, **8**(4):176-182.
9. Kowlessur S, Hu Z, Heecharan J, Wang J, Dai J, Tuomilehto JO, Soderberg S, Zimmet P, Barengo NC: **Predictors of Hypertension in Mauritians with Normotension and Prehypertension at Baseline: A Cohort Study**. *International journal of environmental research and public health* 2018, 15(7).
10. Mittal BV, Singh AK: **Hypertension in the developing world: challenges and opportunities**. *American journal of kidney diseases : the official journal of the National Kidney Foundation* 2010, 55(3):590-598.
11. Aldiab A, Shubair MM, Al-Zahrani JM, Aldossari KK, Al-Ghamdi S, Househ M, Razzak HA, El-Metwally A, Jradi H: **Prevalence of hypertension and prehypertension and its associated cardioembolic risk factors; a population based cross-sectional study in Alkharj, Saudi Arabia**. *BMC public health* 2018, **18**(1):1327.
12. Krishnan A, Garg R, Kahandaliyanage A: **Hypertension in the South-East Asia region: an overview**. In: *Regional Health Forum: 2013*; 2013: 7-14.

13. Abebe SM, Berhane Y, Worku A, Getachew A: **Prevalence and associated factors of hypertension: a crossectional community based study in Northwest Ethiopia**. *PloS one* 2015, 10(4):e0125210.
14. Kheradmand M, Enayati A, Rafiei A, Moosazadeh M: **Population Based Cohort Studies in Iran: A Review Article**. *Journal of Mazandaran University of Medical Sciences* 2015, **25**(125):171-185.
15. Poustchi H, Eghtesad S, Kamangar F, Etemadi A, Keshtkar A-A, Hekmatdoost A, Mohammadi Z, Mahmoudi Z, Shayanrad A, Roozafzai F: **Prospective epidemiological research studies in Iran (the PERSIAN Cohort Study): rationale, objectives, and design**. *American journal of epidemiology* 2017, **187**(4):647-655.
16. Shahbazian H, Latifi SM, Jalali MT, Shahbazian H, Amani R, Nikhoo A, Aleali AM: **Metabolic syndrome and its correlated factors in an urban population in South West of Iran**. *Journal of diabetes and metabolic disorders* 2013, **12**(1):11.
17. Organization WH: **Global database on Body Mass Index: BMI Classification. 2006**. *World Health Organization: Geneva, Switzerland* 2015.
18. James PA, Oparil S, Carter BL, Cushman WC, Dennison-Himmelfarb C, Handler J, Lackland DT, LeFevre ML, MacKenzie TD, Ogedegbe O: **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):507-520.
19. Barengo N, Antikainen R, Kastarinen M, Laatikainen T, Tuomilehto J: **The effects of control of systolic and diastolic hypertension on cardiovascular and all-cause mortality in a community-based population cohort**. *Journal of human hypertension* 2013, **27**:693-697.
20. Hu L, Huang X, You C, Li J, Hong K, Li P, Wu Y, Wu Q, Bao H, Cheng X: **Prevalence and risk factors of prehypertension and hypertension in Southern China**. *PloS one* 2017, **12**(1):e0170238.
21. Rani B, Pal R, Jha S, Punia A, Singh S: **Prevalence and risk factors associated with prehypertension and hypertension among attendants of patients at a rural tertiary care institute of Haryana**. *International Journal Of Community Medicine And Public Health* 2019, 6(4):1657-1664.
22. Silva DAS, Petroski EL, Peres MA: **Prehypertension and hypertension among adults in a metropolitan area in Southern Brazil: population-based study**. *Revista de saude publica* 2012, 46(6):988-998.
23. Taherian R, Jalali-Farahani S, Karimi M, Amiri P, Maghsoudi E, Mirmiran P, Azizi F: **Factors associated with pre-hypertension among Tehranian adults: A novel application of structural equation models**. *International journal of endocrinology and metabolism* 2018, **16**(3).
24. Singh M, Kotwal A, Mittal C, Babu SR, Bharti S, Ram CVS: **Prevalence and correlates of hypertension in a semi-rural population of Southern India**. *Journal of human hypertension* 2018, 32(1):66-74.
25. Peymani P, Heydari ST, Ahmadi SM, Sarikhani Y, Joulaei H, Moghadami M, Faramarzi H, Lankarani KB: **The Prevalence of High Blood Pressure and Its Relationship with Anthropometric Indicators; a Population Based Study in Fars Province, IR Iran**. *International Cardiovascular Research Journal* 2012, **6**(2):40-45.
26. Adeloye D, Basquill C, Aderemi AV, Thompson JY, Obi FA: **An estimate of the prevalence of hypertension in Nigeria: a systematic review and meta-analysis**. *Journal of hypertension* 2015, 33(2):230-242.
27. Malekzadeh MM, Etemadi A, Kamangar F, Khademi H, Golozar A, Islami F, Pourshams A, Poustchi H, Navabakhsh B, Naemi M *et al*: **Prevalence, awareness and risk factors of hypertension in a large cohort of Iranian adult population**. *Journal of hypertension* 2013, 31(7):1364-1371.

28. Pakzad B, Akbari M, Baberi F: **Prevalence, awareness, treatment, and control of hypertension in an Isfahan state institution sample**. *The Journal of Tehran University Heart Center* 2018, 13(2):65-72.
29. Yang G, Ma Y, Wang S, Su Y, Rao W, Fu Y, Yu Y, Kou C: **Prevalence and correlates of prehypertension and hypertension among adults in northeastern China: a cross-sectional study**. *International journal of environmental research and public health* 2016, **13**(1):82.
30. Gandomkar A, Poustchi H, Malekzadeh F, Malekzadeh MM, Moini M, Moghadami M, Imanieh H, Fattahi MR, Sagheb MM, Taghi Ayatollahi SM: **Prevalence, Awareness, Treatment, Control, and Correlates of Hypertension in the Pars Cohort Study**. *Archives of Iranian medicine* 2018, 21(8):335-343.
31. Nuwaha F, Musinguzi G: **Pre-hypertension in Uganda: a cross-sectional study**. *BMC cardiovascular disorders* 2013, **13**(1):101.
32. Lam CS, Cheng S, Choong K, Larson MG, Murabito JM, Newton-Cheh C, Bhasin S, McCabe EL, Miller KK, Redfield MM: **Influence of sex and hormone status on circulating natriuretic peptides**. *Journal of the American College of Cardiology* 2011, **58**(6):618-626.
33. Tian S, Dong G-H, Wang D, Liu M-M, Lin Q, Meng X-J, Xu L-X, Hou H, Ren Y-F: **Factors associated with prevalence, awareness, treatment and control of hypertension in urban adults from 33 communities in China: the CHPSNE Study**. *Hypertension Research* 2011, **34**(10):1087-1092.
34. Vasan RS, Beiser A, Seshadri S, Larson MG, Kannel WB, D'Agostino RB, Levy D: **Residual lifetime risk for developing hypertension in middle-aged women and men: The Framingham Heart Study**. *Jama* 2002, **287**(8):1003-1010.
35. Costa JSDd, Barcellos FC, Sclowitz ML, Sclowitz IKT, Castanheira M, Olinto MTA, Menezes AMB, Gigante DP, Macedo S, Fuchs SC: **Hypertension prevalence and its associated risk factors in adults: a population-based study in Pelotas**. *Arquivos brasileiros de cardiologia* 2007, **88**(1):54-59.
36. Basu S, Millett C: **Social epidemiology of hypertension in middle-income countries: determinants of prevalence, diagnosis, treatment, and control in the WHO SAGE study**. *Hypertension* 2013, **62**(1):18-26.
37. Kumar J, Deshmukh PR, Garg BS: **Prevalence and correlates of sustained hypertension in adolescents of rural Wardha, central India**. *The Indian Journal of Pediatrics* 2012, **79**(9):1206-1212.
38. Leng B, Jin Y, Li G, Chen L, Jin N: **Socioeconomic status and hypertension: a meta-analysis**. *Journal of hypertension* 2015, **33**(2):221-229.
39. Cha SH, Park HS, Cho HJ: **Socioeconomic disparities in prevalence, treatment, and control of hypertension in middle-aged Koreans**. *Journal of epidemiology* 2012, **22**(5):425-432.
40. Huang J, Zhang W, Li X, Zhou J, Gao Y, Cai Y, Lin X, Lai X, Wu Y, Huang B *et al*: **Analysis of the prevalence and risk factors of hypertension in the She population in Fujian, China**. *Kidney & blood pressure research* 2011, **34**(2):69-74.
41. Cutler DM, Lleras-Muney A: **Understanding differences in health behaviors by education**. *Journal of health economics* 2010, **29**(1):1-28.
42. El Bcheraoui C, Memish ZA, Tuffaha M, Daoud F, Robinson M, Jaber S, Mikhitarian S, Al Saeedi M, AlMazroa MA, Mokdad AH: **Hypertension and its associated risk factors in the kingdom of saudi arabia, 2013: a national survey**. *International journal of hypertension* 2014, **doi:** 10.1155/2014/564679.
43. Jatoi NA, Jerrard-Dunne P, Feely J, Mahmud A: **Impact of smoking and smoking cessation on arterial stiffness and aortic wave reflection in hypertension**. *Hypertension* 2007, **49**(5):981-985.

44. Panesar S, Chaturvedi S, Saini N, Avasthi R, Singh A: **Prevalence and predictors of hypertension among residents aged 20-59 years of a slum-resettlement colony in Delhi, India**. *WHO South-East Asia journal of public health* 2013, **2**(2):83-87.
45. Simonetti GD, Schwertz R, Klett M, Hoffmann GF, Schaefer F, Wühl E: **Determinants of blood pressure in preschool children: the role of parental smoking**. *Circulation* 2011, **123**(3):292-298.

Supplementary Files

This is a list of supplementary files associated with this preprint. Click to download.

- Table1Copy.pdf