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Original Article

Prevalence, Awareness, Treatment, Control, and Correlates of Hypertension in the Pars Cohort Study

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Abstract

Background: High blood pressure is an important risk factor for all-cause mortality and cardiovascular mortality and morbidity among Iranians. We aimed to estimate its prevalence, correlates, and its rate of awareness, treatment, and control in South of Iran.

Methods: The Pars Cohort Study (PCS) was launched in a district of Fars province. All residents between 40 and 75 years old in the district were recruited from 2012 to 2014. Hypertension was defined as either systolic/diastolic blood pressure ≥ 140/90 mm Hg or taking medications. Logistic regression was used to identify the correlates of hypertension and awareness and its treatment and control. A total of 9264 participants were recruited. Of the total participants, 46.2% were men. The mean age was 52.6 years (SD: 9.7).

Results: Prevalence of hypertension was 26.9%. Of the total 2489 hypertensives, 49.6% were aware and 55.7% were under treatment. Blood pressure was controlled in 69.2% of treated hypertensives. In the adjusted model, female sex and history of cardiovascular disease (CVD) were positively associated with having hypertension, higher awareness, and better treatment and control. Older age, being overweight or obese, and having a history of diabetes were also positively associated with having hypertension and higher awareness and treatment; however, being overweight or obese was associated with poorer hypertension control. Older age and having a history of diabetes did not show a statistically significant association with control.

Conclusion: Being underweight and higher physical activity were inversely associated with having hypertension but were not associated with awareness, treatment, or control. Prevalence of hypertension is high but the rates of awareness, treatment, and control are not adequate.

Keywords: Awareness, Blood pressure, Hypertension, Iran, Prevalence, Risk factor

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Introduction

More than 25% of the world's adult population had hypertension in 2000, and it was estimated that it will rise to 29% by 2025.[1,2] In 1990, over 7 million deaths were attributable to hypertension, which has increased to over 10 million in 2013 and to 11 million in 2016.[3–5] Globally, the number of adults with high blood pressure increased from almost 6 million in 1975 to 1.13 billion in 2015.[6] The age standardized prevalence of hypertension reached 24.1% (21.4–27.1) in men and 20.1% (17.8–22.5) in women in 2015.[6] Although the prevalence of hypertension has reached a stable trend in developed countries, it has been increasing in developing countries in recent years and is highest in low-income and middle-income countries.[6,7]

In Iran, high blood pressure has been the second most important cause of mortality and morbidity since 1990.[8–10] There is considerable controversy regarding prevalence of hypertension, reported by various studies in Iran, among adults between 25 and 70 years old. One of the earliest studies by Sarrafzadegan et al reported the prevalence of hypertension to be about 21% and 7% in urban and rural areas, respectively in central Iran in 1990s.[11–13] The prevalence was reported to be rising in the late 1990s.[14,15] In 2002, the prevalence of hypertension in Isfahan was reported to be around 19% in women and 16% in men.[16] Prevalence of hypertension has been reported to be 22.1% by a systematic review and meta-

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analysis of published studies in Iran between 1996 and 2004. In this study, the lowest reported prevalence of hypertension was 7.2% and the highest was 48.3%.[17,18] Perhaps the most precise reports on prevalence of hypertension are the results of the national surveillance of risk factors of non-communicable diseases, which were reported in 2005,[19,20] 2007,[21] and 2011 for Iranians between 25–75 years old.[22] Unlike the previous decade, Esteghamati et al have reported a declining trend for hypertension in Iran since 2005.[22]

Awareness of hypertension has an extremely important role in its prevention and control. Awareness has been reported between 34% to 50% in different Iranian studies.[12,15,19,22] In the most recent study in Golestan, Northeast of Iran, 42% of the participants of the Golestan Cohort Study had hypertension, of whom 46% were aware of their hypertension. Only 17.6% of the hypertensives were receiving medication, of whom 32% had controlled hypertension.[23] However, these reported estimates cannot be generalizable to all communities in Iran. The association between hypertension and its correlates, and the role of awareness in prevention and control of hypertension most likely vary across regions in Iran, and this is the main justification for localized studies.

The aim of the present Pars Cohort Study (PCS) was to examine the prevalence of hypertension and its correlates in Valashahr district, Fars Province, Iran.

Materials and Methods

Study Framework

The PCS is a research project established in 2012 by the Digestive Disease Research Institute, Tehran University of Medical Sciences and Shiraz University of Medical Sciences in Valashahr. Valashahr is a city located in southern Fars province. The main goal of the project was to assess the prevalence and risk factors of non-communicable diseases at baseline and the prospective follow-up. The target population of the PCS includes all people between 40 and 75 years of age in the area. From 2012 to 2014, a sample of 9264 participants were enrolled in PCS. Participation rate was over 99%.

Research teams from the Non-Communicable Disease Research Center in Shiraz University of Medical Sciences and the Digestive Diseases Research Institute in Tehran University of Medical Sciences jointly launched PCS. The ethical review committees of the Digestive Diseases Research Institute and the Shiraz University of Medical Sciences approved the study protocol and the informed consent form.

Measurements

Details of the PCS have been described in previous reports.[24] Trained staff used standardized questionnaires for interview and data collection. Structured questionnaires were used in order to collect information about age, sex, ethnicity (Fars, Turk, and other), place of residence, marital status, past medical history, medication history, physical activity, property ownership, literacy, smoking history, and any opium or alcohol use. Literacy was defined as being completely illiterate or having at least one year of education. Data on regular daily activity was recorded based on self-report. Metabolic equivalent task (MET) was calculated for each participant and categorized into tertiles. A wealth score was created using multiple correspondence analyses based on property ownership. Past medical history consisted of chronic diseases diagnosed by physician and reported by the participant himself or herself. These included diabetes, heart disease, stroke, hypertension, chronic obstructive pulmonary disease, renal failure, and liver disease. Medication history was reported based on medications that participants mentioned or the blister of pills they brought with them.

After the interview, a short physical examination was carried out for measurement of height, weight, and waist and hip circumference. Weight and height were measured to calculate body mass index (BMI) while participants had minimal clothing but no shoes. BMI was categorized according to the WHO classification: underweight (BMI <18.5 kg/m^2), normal (BMI 18.5–24.9 kg/m2), overweight (BMI 25–29.9 kg/m^2), and obese (BMI over 30 kg/m^2) according to the WHO report.[25,26]

Definition of Hypertension

Blood pressure measurement was carried out twice in each arm while participants were in sitting position and after 5 minutes of rest. The two measurements were done with an interval of few minutes. Average of the second blood pressure measurement in each arm was calculated and recorded. According to the JNC8 criteria,[27] hypertension was defined as a systolic blood pressure (SBP) equal to or above 140 mm Hg, or a diastolic blood pressure (DBP) equal to or above 90 mm Hg, or being under treatment for hypertension. Those hypertensive participants who knew about their disease were regarded aware, and those who used drugs for their hypertension were considered as treated. Controlled hypertension was defined as a blood pressure less than 140/90 mm Hg in participants younger than 60 years and less than 150/90 mm Hg among those older than 60 years among hypertensive participants. Anti-hypertensive treatments included diuretics, beta blockers, alpha blockers, alpha adrenergic agonists, calcium channel blockers, angiotensin converting enzyme inhibitors, angiotensin receptor blockers, and vasodilators.[27]

Statistical Analysis

We used multiple correspondence analysis for calculating wealth score, considering different individual's properties such as home ownership, home size, number of bathrooms within the house, having cars and motorcycles, owning televisions, vacuum cleaners, washing machines, refrigerators, microwaves, and computers. The resulting score was finally categorized into quintiles. Binary logistic regression analysis was used to identify potential correlates associated with hypertension, awareness, treatment, and control. Two tailed *P* value < 0.05 was considered significant. For this analysis, odds ratios (OR) with their corresponding 95% confidence intervals (CI) were reported. All statistical analyses were carried out using Stata software version 13 (StataCorp. College Station, TX, USA).

Results

A total of 9264 participants were recruited in this study. Of the total study population, 4276 (46.2%) participants were men. Mean age was 52.6 (SD = 9.7) years in the total sample, 52.7 (SD: 9.9) years in men, and 52.6 (SD: 9.5) years in women. A total of 8212 (88.6%) were married, 5217 (56.3%) were of Fars ethnicity and 3596 (38.8%) were of Turk ethnicity. A total of 4538 (49.0%) were illiterate. Mean SBP was 112.0 ± 19.0 mm Hg and mean DBP was 73.5 ± 11.9 mm Hg. The summary of the participants' characteristics is provided in Table 1. Mean SBP was significantly different across all demographic subgroups. DBP was significantly different in all subgroups except for sex, marital status, and education. Hypertension was significantly different in all subgroups except for individuals who used alcohol.

Of the total study population, 2489 (26.9 %) were hypertensive. A total of 1235 subjects (49.6% of hypertensives) were aware of their hypertension. A total of 1387 hypertensive participants (55.4%) were treated for hypertension. Among treated hypertensives, 958 participants (69.1%) had controlled blood pressure. Hypertension, awareness, treatment rate, and blood pressure control were all more frequent among women compared to men (Table 2). Hypertension, awareness, and treatment were more frequent in older age groups but they had no difference in blood pressure control. The same pattern was observed between participants suffering from diabetes compared with diabetes free participants. However, among participants with a history of cardiovascular disease (CVD), along with higher awareness and better treatment, blood pressure was better controlled as well.

Of the total 1387 hypertensive participants who were under treatment, 923 (66.6%) used only one medication for hypertension, 354 (25.5%) used 2 medications, 98 participants (7.1%) used 3 medications, and 12 participants (0.9%) used 4 or more medications. Distribution of the number of medications used by hypertensive participants was not significantly different between men and women. The rate of control was 69.4% among participants who used one medication, 66.7% among those who used 2 medications, 74.5% among those who used 3 medications, and 83.3% among those participants who used 4 or more medications. There was no significant difference in rate of control between participants who used one or more medications for hypertension.

Table 3 demonstrates the results of univariate and multivariate logistic regression to explore the correlates of 4 outcomes of interest in this study: hypertension, awareness, treatment, and blood pressure control. Female sex had higher odds compared with male sex for hypertension and was associated with higher awareness and better treatment and control. Old age was directly associated with hypertension, higher awareness, and better treatment, but control was poorer among old participants. Being single or unmarried was directly associated with hypertension. Ethnicities other than Fars and Turk had lower odds for hypertension and their awareness was also lower, but their treatment and control was not significantly different from the other two ethnicities. Being literate had no association with hypertension and awareness but was associated with better blood pressure treatment. Being physically active and being underweight had also an inverse association with hypertension but their association with other outcomes were insignificant. Being overweight or obese was directly associated with hypertension and with higher awareness but was associated with poorer control. Diabetes was positively associated with hypertension and higher awareness and treatment but poorer control, while history of CVD was positively associated with all outcomes. Neither wealth nor consumption of tobacco, opium, or alcohol had any significant association, neither in crude nor in adjusted model, with the four outcomes of interest (data not shown).

Discussion

In this study, the prevalence of hypertension was 27% between adults aged 40 to 75 years. Of the total number of hypertensives (2849 adults), 50% were aware and 55% were under treatment, out of whom, 459 participants (30%) did not know that they were under treatment. Finally 69% of the treated hypertensives had controlled blood pressure.

The prevalence of hypertension calculated in this study is similar to previously published reports in Isfahan and Tehran or estimated in systematic reviews at the national scale.[14–17] However, it should be noted that previous

Table 1. The Demographic, Life Style, and Disease History of Study Participants in PCS

	No. (%) of participants[§]	Mean (SD) of SBP	*P* Value	Mean (SD) of DBP	*P* Value	Hypertension, No. (%)*	*P* Value
All	9264 (100)	112.0 (19.0)		73.5 (11.9)		2489 (26.9)	
Sex							
Female	4988 (53.8)	112.4 (19.9)	0.033	73.7 (12.0)	0.066	1563 (31.3)	<0.001
Male	4276 (46.2)	111.5 (17.9)		73.3 (11.7)		926 (21.7)	
Age							
40–49 years	4218 (45.5)	107.6 (16.3)	< 0.001	72.3 (11.3)	< 0.001	728 (17.3)	<0.001
50–59 years	2810 (30.3)	113.2 (19.1)		74.1 (12.3)		819 (29.2)	
60+ years	2236 (24.2)	118.5 (21.4)		74.9 (12.0)		942 (42.1)	
Ethnicity							
Fars	5217 (56.3)	112.0 (18.7)	0.001	73.4 (11.6)	0.002	1424 (27.3)	<0.001
Turk	3596 (38.8)	112.4 (19.6)		73.9 (12.2)		980 (27.3)	
Other	451 (4.9)	108.8 (18.6)		71.8 (11.8)		85 (18.9)	
Marital status							
Married	8212 (88.6)	111.6 (18.6)	< 0.001	73.5 (11.8)	0.936	2090 (25.5)	<0.001
Non-married	1052 (11.4)	114.9 (22.1)		73.5 (12.5)		399 (37.9)	
Education level							
Illiterate	4538 (49.0)	114.0 (20.4)	< 0.001	73.7 (12.1)	0.274	1481 (32.6)	<0.001
<5 years	2731 (29.5)	110.2 (17.9)		73.1 (11.7)		610 (22.3)	
6–8 years	974 (10.5)	109.4 (16.7)		73.4 (11.4)		181 (18.6)	
High school	733 (7.9)	109.9 (16.5)		73.5 (11.6)		152 (20.7)	
University	281 (3.0)	110.5 (15.9)		74.3 (10.8)		62 (22.1)	
Ever smoking							
No	7346 (79.3)	112.7 (19.3)	<0.001	73.8 (11.9)	<0.001	2,117 (28.8)	<0.001
Yes	1918 (20.7)	109.3 (17.6)		72.2 (11.4)		372 (19.4)	
Ever opium use							
No	8490 (91.6)	112.3 (19.1)	<0.001	73.7 (11.8)	<0.001	2348 (27.7)	<0.001
Yes	774 (8.4)	108.2 (17.9)		71.0 (11.9)		141 (18.2)	
Ever alcohol use							
No	9068 (97.9)	112.0 (19.0)	0.010	73.5 (11.9)	0.028	2443 (26.9)	0.278
Yes	196 (2.1)	108.5 (17.4)		71.7 (12.0)		46 (23.5)	
BMI							
Underweight	725 (7.9)	103.1 (17.7)	<0.001	67.2 (11.7)	<0.001	101 (13.9)	<0.001
Normal	3376 (36.6)	109.7 (18.7)		71.8 (11.6)		736 (21.8)	
Overweight	3442 (37.3)	113.6 (18.6)		74.9 (11.3)		995 (28.9)	
Obese	1675 (18.2)	116.9 (19.1)		77.0 (12.0)		642 (38.3)	
History of diabetes							
No	8390 (90.6)	111.4 (18.7)	<0.001	73.3 (11.9)	<0.001	2108 (25.1)	<0.001
Yes	874 (9.4)	117.8 (20.7)		75.3 (11.5)		381 (43.6)	
History of CVD							
No	8188 (88.4)	111.3 (18.7)	<0.001	73.2 (11.8)	<0.001	1838 (22.5)	<0.001
Yes	1076 (11.6)	117.4 (20.4)		75.8 (12.1)		651 (60.5)	

Abbreviations: SBP, systolic blood pressure; DBP, diastolic blood pressure; BMI, body mass index; CVD, Cardiovascular disease; Hypertension, SBP/DBP ≥ 140/90 mm Hg OR being treated for hypertension;
[§]Percentages are reported for columns.
*Percentages are reported for rows; For comparing mean SBP and DBP across subgroups, t-test and one-way ANOVA were used and $\chi 2$ test for comparing the proportion of hypertension across sub-groups.

studies were conducted on adults in different age ranges. The results recently reported from the Golestan province by Malekzadeh et al on a sample with a similar age distribution demonstrated a still higher prevalence (41.8%). The difference between these two studies may be due to differences in demographic and life style characteristics. The population under study in the Pars province are all rural and variations in wealth are small compared to participants in Golestan which constitute both rural and urban dwellers with a higher variance in wealth. Esteghamati et al reported higher prevalence of hypertension in urban areas in their national studies.[22] The ethnicities are very different and the population in Pars province have a high literacy rate. Additionally, this difference may be due to the dates of studies. The recent study by Esteghamati et al reported an evidently decreasing trend in prevalence of hypertension from 2005 to 2011.[22] As the Golestan cohort study was conducted between 2004 and 2008, the prevalence may have actually decreased till 2012 when the Pars cohort was launched. Ultimately, in the present study, self-reported prior diagnosis of hypertension was not included in its definition based on the JNC8 report,[27] which partly justifies the lower prevalence rate in our study.

Table 2. The Prevalence of Hypertension, Awareness, Treatment, and Blood Pressure Control Among Participants in PCS

	Men				Women			
	Hypertension No. (%)	Awareness No. (%)	Treatment, No. (%)	Blood Pressure Control Among Treated, N (%)	Hypertension No. (%)	Awareness No. (%)	Treatment Ni. (%)	Blood Pressure Control Among Treated, N (%)
Total	926 (21.7)	355 (38.3)	420 (45.4)	272 (64.8)	1,563 (31.3)	880 (56.3)	967 (61.9)	686 (70.9)
Age								
40–49	265 (13.7)	60 (22.6)	86 (32.5)	61 (70.9)	463 (20.3)	179 (38.7)	235 (50.1)	170 (72.3)
50–59	324 (23.9)	121 (37.4)	152 (46.9)	96 (63.2)	495 (34.0)	277 (56.0)	304 (61.4)	211 (69.4)
60+	337 (34.1)	174 (51.6)	182 (54.0)	115 (63.2)	605 (48.5)	424 (70.1)	428 (70.7)	305 (71.3)
Ethnicity								
Fars	521 (22.0)	217 (41.7)	251 (48.2)	165 (65.7)	903 (31.7)	510 (56.5)	593 (65.7)	435 (73.5)
Turk	367 (21.6)	130 (35.4)	155 (42.2)	99 (63.9)	613 (32.3)	348 (56.8)	348 (56.8)	228 (65.7)
Other	38 (18.0)	8 (21.1)	14 (36.8)	8 (57.1)	47 (19.6)	22 (46.8)	26 (55.3))	23 (88.5)
Education								
Illiterate	353 (26.4)	135 (38.2)	157 (44.5)	96 (61.2)	1,128 (35.2)	687 (60.9)	720 (63.8)	515 (71.1)
Literate	571 (19.5)	219 (38.4)	262 (45.9)	175 (66.8)	434 (24.3)	192 (44.2)	246 (56.7)	170 (69.1)
Marital status								
Married	896 (21.5)	339 (37.8)	403 (45.0)	263 (65.3)	1,194 (29.6)	645 (54.0)	731 (61.2)	517 (70.8)
Non-married	30 (29.4)	16 (53.3)	17 (56.7)	9 (52.9)	369 (38.8)	235 (63.7)	236 (64.0)	169 (71.9)
Diabetes								
No	776 (20.1)	273 (35.2)	321 (41.4)	208 (64.8)	1,221 (29.1)	634 (51.9)	714 (58.5)	512 (71.9)
Yes	150 (36.1)	82 (54.7)	99 (66.0)	64 (64.7)	342 (43.4)	246 (71.9)	253 (74.0)	174 (68.8)
CVD at baseline								
No	675 (17.7)	225 (33.3)	227 (33.6)	135 (59.5)	1,163 (26.6)	604 (51.9)	629 (54.1)	429 (68.4)
Yes	251 (55.2)	130 (51.8)	193 (76.9)	137 (71.0)	400 (64.4)	276 (69.0)	338 (84.5)	257 (76.0)

Reports regarding the association of sex with risk of hypertension are quite controversial. Some studies report higher prevalence among women,[15,16,20,23] and others in men.[18] Esteghamati et al reported higher prevalence in men in 2008,[19] lower prevalence in 2009,[21] and again higher prevalence in 2011.[22] A possible justification is higher prevalence of being overweight and obese and lower physical activity among women. However, in the current study, the association of female sex with hypertension remained significant when models were adjusted for BMI and physical activity.

Our results demonstrated that older age is associated with higher risk of hypertension, higher awareness and treatment rate, but poorer control. These results are compatible with all previously published papers.[19–23] We found no association between literacy and socio-economic status and risk of hypertension. This is in contrast with results reported by Malekzadeh et al in Golestan province and a few other studies in which literacy, urban residence, and higher socio-economic status were all associated with lower risk of hypertension.[18,20,21,23] The insignificant results in the current study may be due to the homogeneity in distribution of these demographic and socio-economic characteristics in the locally recruited sample of participants.

Most studies on risk factors of hypertension in Iran report significant association of overweight, obese, and having central obesity with higher risk of hypertension.[16,18–21,23,28,29] Evidence on the association of central obesity with risk of hypertension is specifically consistent. Malekzadeh et al reported an adjusted OR of 1.87 (1.79–1.96) for overweight and 3.06 (2.90–3.22) for obesity. The corresponding figures in our study were 1.50 (1.31–1.71) for overweight and 2.21 (1.89–2.58) for obesity. The same pattern is observed for physical inactivity.[18,28] In the current study as well as the study conducted by Malekzadeh et al, the association is significant in both crude and adjusted models.[23] Physical activity may exert its effects through weight loss and better metabolic rate.

Ultimately, we explored the rate of awareness, treatment, and control of blood pressure among all hypertensives and treated hypertensives in PCS, which were 50%, 55%, 43%, and 69%, respectively. It seems the "rule of halves" is actually valid in Iran, which means 50% awareness of hypertension, 50% treatment coverage among aware adults, and 50% controlled hypertension among hypertensive adults under treatment.[30] All rates were lower than corresponding reports in the United States and high-income European and East Asian countries.[31] However, rates in our study are much higher than corresponding rates reported in previous studies in Iran. In a large study in 2000, in the city of Tehran, the capital of Iran, the rate of awareness, treatment, and control were 50%, 36%, and 40%, respectively.[15] A more recent study in three cities in central Iran in 2002 reported the rate of treatment to be 26.7% in men and 47.7% in women, while the corresponding

Table 3. The Correlates of Hypertension, Awareness, Treatment, and Blood Pressure Control

	Hypertension		Awareness		Treatment		Control	
	Crude OR (95% CI)	Adjusted OR (95% CI)	Crude OR (95% CI)	Adjusted OR (95% CI)	Crude OR (95% CI)	Adjusted OR (95% CI)	Crude OR (95% CI)	Adjusted OR (95% CI)
Sex								
Male	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Female	1.65 (1.50–1.81)	1.22 (1.08–1.38)	2.07 (1.76–2.45)	2.03 (1.65–2.50)	1.95 (1.66–2.30)	2.19 (1.78–2.72)	1.34 (1.05–1.71)	1.56 (1.16–2.10)
Age (y)								
40–49	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
50–59	1.97 (1.76–2.21)	1.81 (1.59–2.05)	1.93 (1.57–2.38)	1.97 (1.57–2.47)	1.59 (1.30–1.95)	1.54 (1.22–1.94	0.79 (0.58–1.09)	0.73 (0.52–1.02)
60+	3.49 (3.11–3.92)	2.82 (2.44–3.26)	3.56 (2.90–4.36)	3.56 (2.77–4.59)	2.33 (1.91–2.84)	1.98 (1.54–2.56)	0.86 (0.64–1.15)	0.72 (0.50–1.02)
Marital status								
Married	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Non-Married	1.79 (1.57–2.05)	1.25 (1.07–1.46)	1.91 (1.53–2.38)	1.16 (0.90–1.49)	1.46 (1.17–1.82)	0.94 (0.72–1.21)	1.09 (0.81–1.47)	1.01 (0.73–1.40)
Ethnicity								
Fars	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Turk	1.00 (0.91–1.10)	1.10 (0.99–1.22)	0.91 (0.78–1.07)	0.98 (0.82–1.16)	0.72 (0.62–0.85)	0.79 (0.66–0.94)	0.76 (0.60–0.96)	0.74 (0.58–0.95)
Others	0.62 (0.48–0.79)	0.61 (0.47–0.79)	0.52 (0.33–0.83)	0.50 (0.31–0.82)	0.61 (0.39–0.95)	0.64 (0.39–1.04)	1.40 (0.65–2.97)	1.34 (0.62–2.91)
Literacy								
Illiterate	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Literate	0.56 (0.51–0.61)	0.97 (0.86–1.10)	0.55 (0.47–0.65)	1.13 (0.91–1.39)	0.70 (0.60–0.83)	1.29 (1.04–1.60)	0.91 (0.72–1.16)	0.98 (0.73–1.32)
Physical activity								
Low	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Medium	0.71 (0.64–0.79)	0.85 (0.76–0.96)	0.84 (0.70–1.01)	1.05 (0.86–1.29)	0.71 (0.59–0.85)	0.82 (0.67–1.01)	1.09 (0.84–1.41)	1.14 (0.87–1.50)
High	0.47 (0.42–0.53)	0.75 (0.66–0.85)	0.57 (0.47–0.70)	0.95 (0.76–1.19)	0.45 (0.37–0.55)	0.67 (0.53–0.84)	0.92 (0.68–1.25)	0.95 (0.69–1.32)
BMI								
Underweight	0.58 (0.46–0.73)	0.58 (0.46–0.73)	0.96 (0.63–1.46)	0.94 (0.60–1.46)	1.22 (0.80–1.86)	1.36 (0.86–2.15)	0.98 (0.52–1.83)	1.09 (0.58–2.08)
Normal	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Overweight	1.46 (1.31–1.63)	1.47 (1.31–1.66)	1.29 (1.07–1.56)	1.35 (1.10–1.66)	1.14 (0.94–1.38)	1.07 (0.86–1.32)	0.74 (0.55–0.99)	0.70 (0.52–0.95)
Obese	2.23 (1.96–2.53)	2.20 (1.91–2.55)	1.47 (1.19–1.82)	1.42 (1.12–1.80)	1.32 (1.07–1.64)	1.05 (0.82–1.34)	0.61 (0.45–0.83)	0.51 (0.36–0.70)
Diabetes								
No	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Yes	2.10 (1.85–2.38)	1.35 (1.18–1.55)	2.40 (1.95–2.96)	1.93 (1.55–2.40)	2.34 (1.89–2.90)	1.95 (1.55–2.47)	0.91 (0.70–1.18)	0.96 (0.74–1.26)
CVD								
No	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Yes	5.29 (4.63–6.04)	4.00 (3.47–4.61)	2.02 (1.68–2.42)	1.68 (1.38–2.06)	5.08 (4.08–6.31)	4.78 (3.80–6.02)	1.48 (1.16–1.88)	1.62 (1.26–2.09)

Abbreviations: OR, odds ratio; BMI, body mass index; CVD, Cardiovascular disease.

figures for hypertension control were 6.4% and 13.8% in men and women, respectively, which are much lower than our estimations.[16] In national surveillance surveys, the reported rates of awareness were around 48%, which is similar to our results, but rates of treatment and control of hypertension in 2011, in corresponding age groups, were 39% and 43%, respectively, which are again considerably less than the results of our study.[19–22]

Ultimately, in the study by Malekzadeh et al in Golestan, the reported proportion of awareness, treatment, and control of hypertension were 46.2%, 17.6%, and 32.1%, which are evidently lower than our results.[23]

In summary, the results of our study demonstrate a higher percentage of overall awareness, treatment, and control of hypertension in comparison with all previously published studies in Iran. It is not easy to justify such a remarkable difference. It may be due to higher literacy, higher socio-economic status, or less rate of smoking or opium use compared to Golestan province and other provinces in Iran. On the other hand, it may be due to the recent achievement of the health care system in increasing awareness of the general population or enhanced detection of hypertension and adherence to treatment as a result of increased awareness. The higher rate of control in our study may be partly justified by the definition of control in our study. We used the definition in the eighth report of Joint National Committee in which, SBP of less than 150 mm Hg is considered controlled in participants over 60 years old.[27] Still, the rate of control in our study is too high to be justified by the choice of definition.

Our results showed that awareness, treatment, and control rates are higher among women, which is consistent with previous reports. In older age groups, awareness and treatment are better but control is poor, which is again consistent with literature. Literacy was not associated with higher awareness in our study, which is not consistent with previous reports. Being overweight, obesity, and history of diabetes were associated with higher awareness and treatment rate but not better control. This observation can be justified with more frequent referral of obese participants and patients to health care professionals but no effective treatment when the individual has high BMI or suffers from diabetes. However, in patients suffering from CVD, the rate of control is better, which may be the result of medications prescribed to CVD patients that may be anti-hypertensive.

The health care network that provides primary care in remote deprived rural areas in Iran has been successful in significant decrease of communicable, maternal and pediatric diseases. With the epidemic of non-communicable diseases in Iran, new service packages should be developed and implemented in the network for controlling non-communicable diseases and their risk factors which includes non-pharmacological life style interventions and pharmacological interventions. The evidence on the effectiveness of primary care including life style and dietary interventions is controversial.[32] However, in the case of hypertension, reduced salt intake is among the most cost-effective interventions reported in various communities.[33–35] As for pharmacological interventions, there is new evidence on effectiveness of fixed-dose combination therapies for treatment and control of CVDs risk factors called Polypill. A number of studies have been conducted in the world, as well as in Iran in setting of the Golestan Cohort Study, which show the effectiveness of Polypill.[36–38] More recently, a new trial on Polypill is ongoing in the Goelstan Cohort Study, the PolyIran study that is expected to reveal hidden facts about the effectiveness of this new treatment strategy.[39]

Our study has certain strengths including a large representative sample and precise data collection of demographic characteristics and life style. There are certain limitations as well. This is a cross-sectional study, which makes it impossible to explore reverse causality, and the single measurement of blood pressure in one setting imposes regression dilution bias on our estimations.

In conclusion, hypertension is highly prevalent in South of Iran while the rates of awareness, treatment, and control of hypertension are not adequate. Primary and secondary prevention are mandatory to decrease its burden on health of Iranians.

Authors' Contribution

AG, HP, FM conducted and managed the entire study. MMM helped in the design of the study. SGS drafted the manuscript. MM, MM, HI, MRF, MMS, and SMTA helped in data collection, analysis, and critical revision of the manuscript. RM supervised the entire processes of the study.

Conflict of Interest Disclosures

The authors have no conflicts of interest.

Ethical Statement

All procedures performed in this study were in accordance with the ethical standards of the institutional research committees of both universities and with the 1964 Helsinki Declaration and its later amendments and comparable ethical standards. Informed consent was obtained from all individual participants included in this study. The informed consent form was completed and signed in presence of a third party.

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